The Role of Innovative Elements in the Patentability of Machine Learning Algorithms

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Table of Contents

Abstract

Advances in data-driven digital innovations during Industrial Revolution 4.0 are the foundation for this patent discussion. In a shifting technological paradigm, I argue for an approach that considers the broader theoretical perspectives on innovation and the place of the term invention within that perspective. This research could inform the assessment of a patent for Machine Learning algorithms in Artificial Intelligence. For instance, inventions may have elements termed abstract (yet innovative) and not previously within the purview of patent law. Emergent algorithms do not necessarily align with existing patent guidance rather algorithms are nuanced, increasing support for a refined approach.

In this thesis, I discuss the term algorithm and how a novel combination of elements or a cooperating set of essential and non-essential elements, can result in a patentable result. For instance, a patentable end can include an algorithm as part of an application, whether it is integrated with a functional physical component such as a computer, whether it includes sophisticated calculations with a tangible end, or whether parameters adjust for speed or utility. I plan to reconsider the term algorithm in my arguments by exploring some challenges to the section 27(8) of the *Patent Act*, "What may not be patented," including, that "no patent shall be granted for any mere scientific principle or abstract theorem." The role of the algorithm in the proposed invention can be determinative of patent eligibility.

There are three lines of evidence used in this thesis. First, the thesis uses theoretical perspectives in innovation, some close to a century old. These are surprisingly relevant in the digital era. I illustrate the importance of considering these perspectives in innovation when identifying key contributing factors in a patent framework. For instance, I use innovation perspectives, including cluster theory, to inform the development of an approach to the patentable subject matter and the obviousness standard in AI software inventions. This approach highlights applications of emerging algorithmic technologies and considers the evolving nature of math beyond the basic algorithm and as a part of a physical machine or manufacture that is important in this emerging technological context.

As part of the second line of evidence, I review how the existing Canadian Federal & Supreme Court cases inform patent assessments for algorithms found in emerging technologies such as Artificial Intelligence. I explore the historical understanding of patent eligibility in software, professional skills, and business methods and apply cases that use relevant inventions from a different discipline. As such, I reflect upon the differing judicial perspectives that could influence achieving patent-eligible subject matter in the software space and, by extension how these decisions would hold in current times. Further to patent eligibility, I review the patentability requirements for novelty, utility, and non-obviousness.

As part of the third line of evidence, I reflect on why I collected the interview data and justify why it contributes to a better understanding of the thesis issues and overall narrative. Next, I provide detail and explain why certain questions formed a part of the interview and how the responses helped to synthesize the respective chapters of the thesis. The questions focus on patent drafting, impressions of the key cases, innovation, and the in-depth expertise of the

experts on these topics. Finally, I provide recommendations for how the patent office and the courts could explore areas for further inquiry and action.

List of Tables

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Reflections

“To everything there is a season and a time to every purpose under heaven”

Ecclesiastes 3

“ Keep your stick on the ice”

Canadiana

May the road rise up to meet you
May the wind always be at you back
May the sun shine warm upon your face; the rains fall soft upon your fields,
And until we meet again may God hold you in the palm of his hand.
Irish blessing (Unknown)

Abbreviations

AI	Artificial Intelligence
CIPO	Canadian Intellectual Property Office
COP	Commissioner of Patents
FCA	Federal Court of Appeal
FCC	Federal Court of Canada
IP	Intellectual Property
ML	Machine Learning
OECD	Organization for Economic Co-operation and Development
PAB	Patent Appeal Board
PESM	Patent-Eligible Subject Matter
POSITA	Person of Ordinary Skill in the Art
S & T	Science and Technology
SCC	Supreme Court of Canada
USPTO	United States Patent and Trademark Office
WEF	World Economic Forum
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

CHAPTER ONE

1.1 Introduction

Over the past several years, the Canadian federal government has prioritized policy directions associated with current and emerging digital technologies. These technologies include innovations in cloud computing, digital manufacturing, Artificial Intelligence (AI), quantum computing and driverless cars.[1] In this thesis, the technology of choice will be the algorithm, specifically ML algorithms in AI. Professor John McCarthy defined AI as the "science and engineering of making intelligent machines, especially intelligent computer programs."[2] While not a legal definition, legal experts have indicated that "AI is software by nature, but also very much about the data and necessarily involves implementation for real-world applications."[3]

In 2020, McKinsey conducted a survey indicating that "organizations are using AI as a tool for generating value. Increasingly that value is coming in the form of revenues."[4] In 2018, AI was expected to deliver around US $13T worldwide in additional economic output and by 2030 "boosting global GDP by about 1.2% per year."[5] However, the COVID-19

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[1] Government of Canada, Positioning Canada to Lead: An inclusive innovation agenda, (26 July 2016), online: *Government of Canada* <https://www.ic.gc.ca/eic/site/062.nsf/eng/h_00009.html>.

[2] John McCarthy, 'What is artificial intelligence?'(Revised 12 November 2007), online: *Stanford.edu* < http://www-formal.stanford.edu/jmc/whatisai.pdf>.
Ichiro Nakayama, "Patentability and PHOSITA in the AI era - A Japanese Perspective in Artificial Intelligence and Intellectual Property" in Jyh- An Lee, Reto M Hilty, and Kung- Chung Liu, eds, *Artificial Intelligence and Intellectual Property* (UK: Oxford University Press, 2021) 1 at 82.

[3] Isi Caulder & Mark D Penner, *Patenting Artificial Intelligence Advanced Prosecution Strategies* (IPIC PowerPoint presentation, Ottawa, November 13, 2019).

[4] McKinsey Global Survey on Artificial intelligence "The State of AI in 2020" (November 17, 2020), online: <https://www.mckinsey.com/business-functions/quantumblack/our-insights/global-survey-the-state-of-ai-in-2020>.

[5] Government of Canada, Canada's "Digital Charter in Action: A plan by Canadians for Canadians" (23 October 2019), online: *Government of Canada* <https://www.ic.gc.ca/eic/site/062.nsf/eng/h_00109.html; McKinsey Global Institute>.; McKinsey & Co, "Notes from the AI frontier: Modeling the Impact of AI on the

pandemic disrupted the world order over the past several years. Interestingly, the *Harvard Business Review* indicates that "the crisis accelerated the adoption of analytics and Artificial Intelligence, and this momentum will continue into the 2020s."[6]

In 2020, themes of global health and climate change were predominant in discussions about emerging technologies. In addition, the continued evolution of algorithms, beyond virtual and augmented reality to spatial computing, was labelled the "next step in the ongoing convergence of the physical and digital worlds."[7] The World Economic Forum (WEF) highlighted key emerging technologies that included augmented reality everywhere, advanced diagnostics for personalized Medicine, AI for molecular design, AI that can argue and instruct, and algorithms for quantum computers over the past couple of years.[8] The WEF further highlights social robots, collaborative telepresence (a mix of augmented reality, virtual reality, 5G networks and advanced sensors) and blockchain in advanced food tracking and packaging.[9] As is indicated by these changes, we are progressing through the 4th Industrial Revolution.

Industrial Revolutions 1, 2, and 3 were driven by steam, electricity and digital. However, Industrial Revolution 4.0 includes many emerging technologies where "the focus

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world economy" (September 4 2018) 1 at 99, online: *McKinsey & Co* <https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-modeling-the-impact-of-ai-on-the-world-economy>.

[6] Joe McKendrick, "AI adoption skyrocketed over the last 18 months (September 27 2021), online: *Harvard Business Review* < https://hbr.org/2021/09/ai-adoption-skyrocketed-over-the-last-18-months>.

[7] World Economic Forum, "Top 10 Emerging Technologies of 2020 (2020), online: *World Economic Forum* <http://www3.weforum.org/docs/WEF_Top_10_Emerging_Technologies_2020.pdf>.

[8] World Economic Forum, "Top 10 Emerging Technologies of 2018" (2018), online: *World Economic Forum* <http://www3.weforum.org/docs/Top10_Emerging_Technologies_report_2018.pdf>;
Ashley Montanaro, "Quantum algorithms: An overview"(2016) 2 npj1 , Quantum; Quantum algorithms "run on a quantum computer and achieve a speedup, or other efficiency improvement, over any possible classical algorithm."

[9] World Economic Forum, "These are the top 10 emerging technologies of 2019" (2019), online: *World Economic Forum* <https://www.weforum.org/agenda/2019/07/these-are-the-top-10-emerging-technologies-of-2019/>.

of value creation and innovation is moving from traditional engineering towards the automated regulation of any type of system through the collection and analysis of data."[10] The "combination of technologies further increases the importance of software—and thus of computer-implemented inventions—in almost all areas of technology."[11] For example, AI and Big Data have seen many advances in computing capacity in the digital realm.

This thesis examines Canadian patent law to provide insight that can shape judicial interpretations of patentable inventions in emerging algorithmic technologies in a manner reflecting the dramatic changes of Industrial Revolution 4.0. I propose an innovative approach to shape patent office and judicial interpretation for ML algorithms. In a shifting technological paradigm, I focus on the need to rework analytic constructs used in patentability assessments by proposing recommendations with a view to improved guidance in fields such as AI.

The entire thesis is premised on a knowledge of several key components, statutory definitions of invention and exclusions to patentability; the contents of the patent application including the specification and the claims; the construction of claims as well as patent validity and infringement.

To start, a patent primer is necessary to give background to the narrative. The term of a patent is 20 years from the filing date if filed on or after October 1, 1989.[12] For patents filed before this time, the term is 17 years. As for patent-eligible subject matter: section 2 of the *Patent Act* indicates that *"invention* means any new and useful art, process, machine,

[10] Xavier Seuba, Christophe Geiger, and Julien Penin, eds, "Intellectual Property and Digital Trade in the Age of Artificial Intelligence and Big Data" (2018) in *Global Perspectives for the Intellectual Property System* (France: CEIPI-ICTSD, 2018) 1 at 33.
[11] Xavier Seuba, Christophe Geiger, and Julien Penin, eds, *ibid* at 33.
[12] *Patent Act*, RSC 1985 c P-4, ss 44, 45(1).

manufacture or composition of matter, or any new and useful improvement in any art, process, machine, manufacture or composition of matter."[13] The criteria for patentability are novelty, utility, and non-obviousness.

Several terms associated with the actual patent application have relevance to this thesis. First, section 27(3) 'Specification' refers to the terms of a patent disclosure in that "the patent specification must correctly and fully describe the invention and its operation or use as contemplated by the inventor."[14] The various steps of section 27(3) spell out the need to disclose the steps in a process or method to allow a person skilled in the art or science to construct the invention.

The specification definition is then directly related to the claims found in a patent application. The specification contains the description, disclosure, and the claims. Section 27(4) of the *Patent Act* indicates that "the specification must end with a claim or claims defining distinctly and in explicit terms the subject-matter of the invention for which an exclusive privilege or property is claimed." [15] The specification and claims are important as I consider incorporating innovative elements into the patent assessment.

Claim construction is discussed later in the thesis. Claims are construed in Canadian courts using a purposive construction. From the perspective of the patent bar, "[a] patent claim is construed from the perspective of a person skilled in the art based on a knowledgeable reading of the patent specification as a whole, including the claims, description, and drawings."[16] The claims are important to assess patentability and scope of

[13] *Patent Act*, RSC 1985 c P-4, s 2.
[14] *Patent Act*, RSC 1985 c P-4, s 27(3).
[15] *Patent Act*, RSC 1985 c P-4, s 27(4).
[16] Steven Garland, Jeremy Want & Matthew Burt, "Patent Litigation in Canada: An Overview" (Thomson Reuters), online: *Thomson Reuters* <https://uk.practicallaw.thomsonreuters.com/5-621-1843?transitionType=Default&contextData=(sc.Default)&firstPage=true>.

the invention qualifying for exclusive rights. The Crown grants exclusive rights in exchange for a disclosure at the 18-month mark when the application is laid open to the public.

Finally, patent validity and infringement are important to give context to the narrative. Patent validity can be challenged based on failure to meet the patentability criteria, insufficiency of disclosure or a problem with claim drafting. Regarding infringement, one must have "sufficient evidence that 1 party has either directly infringed the patent or induced another to infringe the patent."[17] Claim construction also applies in determining invalidity and the scope of the invention in infringement actions.

In Canada, if the proposed invention does not fit within the definition of "invention" in section 2, it does not qualify as patentable subject matter. [18] I use the broad overarching term "software invention" for an invention involving software in some way. I will also use "software and business method invention" for a business method implemented by software.

Indeed, 'algorithm' and software are sometimes used interchangeably. Algorithms can be excluded from patentability by section 27(8) of the *Patent Act* when falling in the scientific principle or abstract theorem category.[19] According to the Canadian Intellectual Property Office (CIPO) Manual of Patent Office Practice (MOPOP):

> This subsection has been interpreted by the courts as excluding from patentability (*inter alia*) mathematical formulae, natural phenomena and laws of nature…The exclusions of this subsection apply when an attempt is made to claim the excluded subject-matter in a general sense, but not when a scientific principle, law of nature or mathematical formula is relied upon in operating a practical form of an invention…[20]

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[17] Government of Canada, " What is patent infringement?"(19 March 2021), online: *CIPO* < https://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/h_wr04897.html>.
[18] *Patent Act*, RSC 1985 c P-4, s 27(8).
[19] *Patent Act*, RSC 1985 c P-4, s 27(8).
[20] Government of Canada, "Manual of Patent Office Practice (MOPOP) - Canadian Intellectual Property Office", online: *CIPO* <https://s3.ca-central-1.amazonaws.com/manuels-manuals-opic-cipo/MOPOPPreviousJune2022-en.html#_Toc105676795>.

In the February 2022 IPIC Submission to CIPO, IPIC reflects Siebrasse's sentiments in its submission in pointing out, "the Supreme Court thus drew a distinction between the rule against patenting disembodied ideas, as codified in subsection 27(8), and "field-specific" exclusions such as professional skills.[21] IPIC criticized the current MOPOP framing, noting:

> this guidance is not compliant with our law on patentable subject matter as set out in section 2 and subsection 27(8) of the Act, as interpreted by the Supreme Court and Federal Court of Appeal in cases such as *Shell Oil, Tennessee Eastman*, and *Amazon* FCA, principally for the same reason that prior examination guidance was found to be legally incorrect.[22]

These cases and associated exclusions are explored in Chapter 3. At this stage I note that, *Amazon.com Inc. v. Canada* (*Attorney General*),[23] teaches that one can achieve patentability in an algorithm, in this case, an automated business method or a computer-implemented invention, if it forms part of a novel combination of elements that are found to be inventive. [24] One may also ask whether *Amazon* FCA is too narrow on the definition of an invention and contrary to the expansive SCC view of "invention," particularly art as a useful invention in *Shell Oil Co. v Commissioner of Patents.*[25] However, given that the *Amazon* FCA decision is newer and discussed purposive construction in light of *Free World Trust* v. *Electrosante*[26] and *Whirlpool Corp.* v. *Camco Inc,*[27] *Amazon* FCA holds more weight

[21] Intellectual Property Institute of Canada (IPIC), "IPIC Response to CIPO's Consultation on Changes to MOPOP resulting from 'Patentable Subject Matter under the Patent Act'" (25 February 2022) at 9, [on file with author]; See Norman Siebrasse, "The Rule Against Abstract Claims: History and Principles" (2011) 26:2 C.I.P.R. 205; See Norman Siebrasse, "The Structure of the Law of Patentable Subject Matter" (2011) 23 Intellectual Property Journal 169 at 176.
[22] *Ibid*, Intellectual Property Institute of Canada (IPIC) "Response to CIPO's Consultation on changes to MOPOP resulting from "Patentable Subject-Matter under the Patent Act" (25 February 2022) at 2.
[23] 2011 FCA 328 Sharlow J [*Amazon* FCA].
[24] *Ibid.*
[25] [1982] 2 S.C.R 536 Wilson J [*Shell Oil*].
[26] (2000 SCC 66, [2000] 2 S.C.R. 1024) Binnie J [*Free World Trust*].
[27] (2000 SCC 67, [2000] 2 S.C.R 1067) Binnie J [*Whirlpool*].

in the range of elements to be considered on determinations of patentable subject matter in computer-implemented inventions.

In this thesis, I discuss the term algorithm and how a novel combination or cooperation of elements, both essential and non-essential, can result in a patentable result. A patentable invention can include an algorithm as part of an application, whether it is integrated with a functional physical component such as the computer, sophisticated calculations with a tangible end, or whether one adjusts parameters for speed or utility. I plan to reflect upon section 27(8) of the *Patent Act*, "What may not be patented," including that "no patent shall be granted for any mere scientific principle or abstract theorem."[28] The role of the algorithm in the proposed invention can be determinative of patent eligibility.

Advances in data-driven digital innovations have left AI inventions without adequate guidelines. I argue for an approach that considers the broader concept of innovation and the place of an invention within that perspective. This approach could inform the assessment of a patent for emerging algorithmic technologies incorporating AI. For instance, inventions may have elements termed abstract (yet innovative) and not previously within the purview of patent law. Given that algorithmic technologies do not necessarily align with existing patent guidance frameworks, a variety of nuances associated with the algorithm (increased speed and complexity) present, increasing support for the call for a refined approach.

This narrative builds on a decades-old case trajectory that reflects some of the longstanding challenges associated with (a) section 2 invention (b) section 27(8) of the *Patent Act* exclusion of "any mere scientific principle or abstract theorem."[29] and (c) obviousness codified in Canadian patent legislation. Obviousness forms part of the discussion as the

[28] *Patent Act,* RSC 1985 c P-4, s 27(8).
[29] *Patent Act,* RSC 1985 c P-4, ss 2, 27(8).

standard is receiving scrutiny in Canadian case law touting the search for the inventive concept as a solution. This tends to happen when implementing a problem-solution approach to claim construction. The fact that US case law has evolved to entertain discussions on the inventive step warrants mention.

As such, this thesis focuses on patent eligibility and patentability in Canada, including claim construction and the obviousness standard. These key considerations in the analysis of claims involving a software invention, is reflected in the twenty-year old cases of *Whirlpool*[30] and *Free World Trust,*[31]and reflect the position of the Canadian judiciary on the purposive approach to claim construction. There has been a history of conflicting interpretations of claim construction in Canada, most recently, in the 2020 case of *Choueifaty* v. *Canada (Attorney General)*[32]and the 2022 case of *Benjamin Moore*[33]

In November 2020, the Canadian Intellectual Property Office (CIPO) issued new guidance in response to the 2020 decision of *Choueifaty,* replacing former practice notices and inviting yet another interpretation of how claim construction should be characterized during patent prosecution and in the courts.[34] There has been an ongoing tension between the jurisprudence on claim construction (consistent with *Whirlpool* and *Free World Trust* cases) and the approach taken by the patent office, which avoids a fulsome application of purposive construction in the construction of claims. The 2020 CIPO guidance replaces statements from the patent office that promulgated problem-solution approaches to claim construction currently espousing in Europe. Some Canadian IP experts have written/spoken about how

[30] *Whirlpool, supra* note 27.
[31] *Free World Trust, supra* note 26.
[32] 2020 FC 837, Zinn J [*Choueifaty*].
[33] 2022 FC 923, Zinn J [*Benjamin Moore*].
[34]CIPO,"Patentable Subject-Matter under the *Patent Act"* (2020), online: *Industry Canada* <https://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/wr04860.html> [PN 2020].

the patent office is avoiding the direction of the Federal Court and Federal Court of Appeal to apply purposive construction, most recently seen in *Choueifaty*[35] and *Benjamin Moore*[36] There are conflicting opinions on whether the CIPO guidelines indicate a proper approach to claim construction or are still reflecting the problem-solution approach.[37]

That brings us to the obviousness standard and the part that this piece plays in the narrative. A paucity of cases in Canada deal with obviousness in software inventions and the inventive concept. Some of these cases are discussed in Chapter 3. In the United States the topic of inventive step was brought to the forefront, in the case of *Alice Corp. Pty.* v. *CLS Bank Int'l* [38] as part two of a two-step test to patentability in an invention involving software.

The issue of AI and patenting has arisen in other jurisdictions displaying disparate roles or approaches. The differing approaches demonstrate the relevance of exploring the issues in Canada to establish its position globally. The following quote reflects the international effort to patent strategically and appropriately in foundational AI:

> AI encompasses a global market, with key players typically comprising large multinational technology firms. It can be assumed that such firms will file patents in the three primary markets for intellectual property, the US, Europe, and Japan, [citation omitted] if and when the technology patented is foundational for the progress and development of AI. Termed triadic patents, these sets of patents are filed for the same invention at the European Patent Office, the Japan Patent Office and the USPTO.[39]

I consider the international context because the treatment of emerging technologies in a connected and collaborative world is increasingly relevant to how Canada approaches

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[35] *Choueifaty*, *supra* note 32.
[36] *Benjamin Moore*, *supra* note 33.
[37] Mitchell Folk, "More Problem than Solution? Patent Subject-Matter Eligibility Following Choueifaty and CIPO's 2020 Practice Notice" (2021) 36 CIPR 50-57.
[38] 134 S. Ct. 2347, Thomas J [Alice].
[39] Raphael Zingg, "Foundational Patents in Artificial Intelligence" in Jyh- An Lee, Reto M Hilty, and Kung-Chung Liu, eds, *Artificial Intelligence and Intellectual Property* (UK: Oxford University Press, 2021) 82 at 82.

patenting in AI ML algorithms. Even though approaches are vastly different among major superpowers, it is important to consider Canada's position on emerging technologies, guidance, and next steps in a global context.

In this thesis, I am recommending a refreshed approach to the patentability of innovative components of inventions, including algorithms. To further economic development, this approach could aid in identifying, capturing, and capitalizing intellectual property potential. Guidance rooted in innovation theory, including cluster theory, gives clarity to patent assessments. I write predominantly about the Canadian patent system and explore the nascent stage of rules and guidelines in Canada and associated scholarship on AI innovations.

In this instance, I include patents in the business method and software inventions space in the emergence of algorithmic invention. The thesis opens new lines of inquiry, particularly as it relates to section 2 invention and section 27(8) exclusion of a mere scientific principle or abstract theorem from patentability. Section 27(8) includes the word "mere" and has relevance to the discussion of the abstract. The perspective of the Patent Office is as follows:

> The Patent Office considers that mere scientific principles and abstract theorems do not constitute an invention within the meaning of section 2 of the *Patent Act*. Accordingly, claims that are found to be directed to scientific principles or abstract theorems will be identified as defective under both subsection 27(8) and section 2 of the *Patent Act*.[40]

[40] Government of Canada, "Manual of Patent Office Practice (MOPOP) - Canadian Intellectual Property Office", online: *CIPO* < https://s3.ca-central-1.amazonaws.com/manuels-manuals-opic-cipo/MOPOPPreviousJune2022-en.html#_Toc105676795>.

One could argue that the term “mere” is allowing section 27(8) to make a distinction between the patentable and the unpatentable and the case law supports the instance of an application of the algorithm as making that distinction. For example, section 27(8) exclusion has been applied in the case of *Schlumberger*. In that case the use of a computer did not change the nature of the discovery and the novel algorithm was excluded from patentability. On the other hand, the exclusion did not apply in the case of *Amazon* FCA when a purposive construction was applied. Using the innovation lens, the novel combination of elements can avoid the application of section 27(8) exclusion. Historically, the case law excluded certain subject matter in this area, such as with the exclusion of professional skills in the case of *Lawson* and of the algorithm in the case of *Schlumberger*. There is a tension in the case law between the abstract and patentable subject matter in software and business methods, this does not happen in other technological areas. The section 27(8) exclusion is part of how one understands the distinction.

There does not appear to be a clear definition of what is ‘abstract’. My understanding of the relationship between the definition of what is “abstract” on the one hand and the categories of patent-eligible subject matter on the other is that the categories are stand-alone constructs of what may be patentable. None of the section 2 categories include principles or schemes of an abstract nature and presumably reflect patent-eligible subject matter.

There are questions about how one would expand the abstract theorem to qualify as patentable subject matter given the siloed contents of section 2. While my prescribed approach may appear to encourage broader application to section 2, “invention,” I argue that this prescription is about math in the form of an algorithm and how the ML algorithms are something more than basic math. One could point out that all software contains mathematical

elements. I argue in response that there is a something more associated with some emergent technologies.

The argument and subsequent prescription include a subject matter assessment using a purposive approach to claim construction. I am recommending regard for the specification while considering theoretical perspectives on innovation, primarily as related to essential and non-essential elements. This gives originality to the patenting assessment. This thesis lays the groundwork for the characterization of some of these emerging algorithmic technologies as something more than abstract. This includes the integration of a high-powered computer or the implementation of the idea on such a machine. This scenario indicates something more than mere scientific principles or abstract theorems. I justify the innovative approach in several ways.

Firstly, there is a continuing divide between the patent office and the judiciary regarding claim construction, notwithstanding a legislative intervention in the months and days to come. This divide has generated some ambiguity as to the patenting and subsequent validity of inventions in this area, creating uncertainty for industry and the patent agents in the drafting process. Secondly, this approach will allow for greater clarity in patent assessments and similarly greater predictability of patentability outcomes in emerging algorithmic inventions. I am suggesting something other than a broader expansion of patentability for algorithms as a preferred approach.

1.2 Methodology

As this is a rapidly developing area, which is under-researched and in which there are fundamental gaps in knowledge this research study is important. In a review of emerging technologies, it appears that the role of the algorithm is often core to a software invention.

The thesis includes several streams of evidence using a mixed methods approach to research in building this case. As is noted by Yin, 'multiple sources of evidence' may be needed in a study.[41]

First, using an interdisciplinary approach, theoretical perspectives on innovation are used to assess patent eligibility and patentability. I also review the literature on innovation to inform later analysis of subject matter and patentability criteria. Second, I review the case law and scholarship past and current arguments for the patentability and patent eligibility of software inventions, such as business method (an automated method or scheme) and computer-implemented inventions (depending on the degree of implementation with the computer). I consider the role of the algorithm in relevant court rulings in Canada and the United States. Third, expert interviews are used to supplement these findings and are explored later in this thesis. The interviews focus on "small–scale interactions and understanding."[42] I found that by building on the foundation of the law in Canada and the US, innovative perspectives may lead to novel approaches in assessing software inventions.

1.3 Literature review

This thesis is an interdisciplinary legal work. Combining computer science, innovation, qualitative methods, and legal scholarship is rare in one narrative. I argue that theoretical perspectives on innovation support patent eligibility in algorithms found in emerging technologies. Patent-eligibility in the software and business method invention space has been an issue for the past two decades in Canada, with the discussion of claim construction in patents and continuing challenges to the Supreme Court of Canada's rulings

[41] Robert K. Yin, *Case Study Research Design and Methods* (USA: SAGE Publications, 2014) at 16-17.
[42] Sharlene Nagy Hesse – Biber & Patricia Leavy, *The Practice of Qualitative Research*, 2nd ed (Los Angeles, USA: SAGE Publications, 2011) 3 at 15.

of *Whirlpool* and *Free World Trust*. Bita Amani makes an interesting case for the role of interdisciplinarity and the law. She studies intellectual property and biotechnology and seeks guidance from actor network theory to inform her thesis.[43] This approach is consistent with my thesis that technologies involving algorithms are becoming increasingly complex, and theoretical perspectives on innovation can play a role in patent interpretation.

In structuring this literature review, I identify key themes in the legal literature. I aim to illustrate where my work fits in broad terms. In Chapter 2, I discuss more extensively how innovation theory provides a new lens on patent questions. Modern-day innovation reflects some of the early thinking found in Schumpeter's writing. I see that through gradual changes in patent guidance or a move to revisit basic principles of patent law, one can close the gap between patent office guidance and current cases in the area. I am doing this by looking at innovation perspectives and their relationship to patent law to inform future support for decision-making. Innovation perspectives, including those on clusters, allow one to reconsider patent eligibility and patentability requirements.

Canadian patent law deserves more attention. The foundations are found in treatises that are more practice-oriented with less emphasis on the more cutting-edge issues that face today's legal community. Treatises do an excellent job of explaining the fundamentals of black letter law in patents, including case law developments. In Canada, several well-known treatises cover the area of patent law, including those authored by Justice Roger Hughes,[44] Professor David Vaver[45] and Stephen J. Perry and T Andrew Currier.[46] More recently,

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[43] Bita Amani, "Biopatenting and Industrial Policy Discourse" in B. Courtney Doagoo, et. al, eds, *Intellectual Property for the 21st Century: Interdisciplinary Approaches* (Toronto, Canada: Irwin Law, 2014) 1 at 41.
[44] Roger Hughes et al., *Hughes and Woodley on Patents*, 2nd ed, looseleaf (Markham.: LexisNexis Canada, 2005).
[45] David Vaver, Intellectual Property Law: Copyrights, Patents, Trade Marks, 2nd ed (Toronto: Irwin Law, 2011).
[46] Stephen J. Perry and T Andrew Currier, *Canadian Patent Law*, 4th ed (Markham: LexisNexis, 2021).

Currier and Perry have written a piece on *Choueifaty*, that is included in part in a new edition of *Patent Law*.[47] These treatises are pre-dated by by Fox's *Canadian Patent Law and Practice*.[48] Also, one of the oft-referenced U.S treatises on patents is *Chisum on Patents: A treatise on the Law of Patentability, Validity and Infringement.*[49] Firms, students, academia, and the courts cite these authoritative treatises. Later in this chapter, I discuss journal articles in patent law and software, algorithms, and AI. Through this review, I illustrate how the patentability of the algorithm has evolved and has, as of late, become more of a question in advanced algorithms, including those used in AI.

Academic writing on patenting and emerging technologies in Canada has not advanced to the same extent as in the United States and internationally. Over several decades in the U.S there has been a much more fulsome treatment including analysis of algorithms in the context of patent law. This may result from a larger market, much more activity in the courts and a greater demand for teaching and scholarship in the area. The nature of AI research is cutting edge, changing day by day, warranting consideration of these advances in light of preconceived patterns in patent doctrine.

1.3.1 What does the literature say about algorithms and IP?

Before embarking on a discussion of algorithms and patenting, I clarify several terms. I use the umbrella term "software invention" for an invention involving software in some way. I use this for an overall term because it allows one to manoeuvre the space with a

[47] Andrew Currier & Stephen J. Perry, "After Choueifaty: A New Test for examining software inventions in Canada" (November 2, 2020), online: *PCK Intellectual Property* <https://www.pckip.com/article/choueifaty-new-test-software-inventions>.
[48] Harold G. Fox, *Canadian Patent Law & Practice* (Toronto: Carswell, 1941).
[49] Donald S. Chisum, *Chisum on Patents: A treatise on the Law of Patentability, Validity and Infringement* (New York: LEXIS Pub., 1978-).

ubiquitous characterization. Officially, the Manual of Patent Practice [50] at CIPO refers to such inventions, including software, as 'computer-implemented inventions.' This term tends to cover all classifications that include computer-implemented software. I would venture that the software invention is itself an improvement to the actual functioning or efficiency of the subject of the invention whether that is via complexity or capacity. The computer-implemented invention speaks to the actual integration of the algorithm with the computing power, creating a unique and powerful combination, the power driven by the computer and the unique capabilities of the algorithm as written. The CIPO does not use the term software, software invention or algorithm when referencing patent-eligible subject matter.

According to Heer and adapted from Karjala, "software patents essentially fall into two categories: pure software inventions, which often claim programming improvements or inventions otherwise contained entirely within a computer program, and computer-related inventions, where the claim is for a machine or process that uses software during its operation."[51] This thinking indicates that pure software does not fit within the patent framework, but elements uniquely integrated with computer hardware may be patentable. In this thesis, I push the boundaries of what would qualify as a patentable element when framed within the purview of theoretical perspectives on innovation.

There are continuing challenges with how to characterize software, programs and algorithms. For example, Gillepsie is cited in Rob Kitchin where he indicates, "software is fundamentally composed of algorithms -- sets of defined steps structured to process

[50] Government of Canada, "Manual of Patent Office Practice (MOPOP) - Canadian Intellectual Property Office", online: *CIPO* <https://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/h_wr00720.html>.
[51] Christopher Heer, "Follow the Leader: Software Patents with Inadequate Disclosure at the Canadian Patent Office" (2004) 62 U. Toronto Fac. L. Rev. 85 at 85 Footnote 3 adapted from Dennis S. Karjala, "The Relative Roles of Patent and Copyright in the Protection of Computer Programs" (1998) 17 J. Marshall J. Computer & Info. L. 41 at 60-63.

instructions/data to produce an output -- with all digital technologies thus constituting 'algorithm machines.'"[52] While one can conflate "algorithm" with mathematical principle, formula, and idea, Gregory Stobbs indicates that these terms are not "synonymous."[53] Stobbs cites the Webster dictionary definition that an algorithm is a "predetermined set of instructions for solving a problem in a limited number of steps."[54] There are mathematical and non-mathematical algorithms. I look back to some older writings on the form and purpose of algorithms to lay the groundwork for understanding the today's algorithms.

Donald Chisum describes the mathematical forms taken by algorithms.[55] In 1986, Chisum argued that the algorithm should be patentable if standards of novelty and non-obviousness are met.[56] He notes that the higher court decisions at that time gave inconsistent instructions on the patentability of algorithms and concluded that patent protection is needed to "provide incentives for innovation in software development."[57] Interestingly, that there were questions in 1986 about how an algorithm is to be defined and when it is considered patentable. Chisum described an algorithm as the backbone to a program; [58] if this is the case, how can we today ignore the determined sophistication of some algorithms for which patent protection is sought?

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[52] T. Gillespie, "The relevance of algorithms" in T. Gillespie, P. J. Boczkowski, & K. A. Foot, eds, *Media technologies: Essays on communication, materiality, and society* (Cambridge: MIT Press, 2014) 167–193.
in Rob Kitchin, "Thinking critically about and researching algorithms" (2016) 2:1 Information Community and Society 2 at 1.

[53] Gregory Stobbs, *Software Patents,* 2nd ed (New York, New York, USA: Aspen Law & Business, 2000) 1 at 42.

[54] *Ibid* at 42.

[55] As per Donald Chisum, "The first algorithms were invented to solve numerical problems such as multiplying numbers, finding the greatest common divisor, calculating trigonometric functions and so on. Today non-numerical algorithms are of equal importance; they have been devised for tasks such as finding the smallest element in a sequence, searching for a given word in a text, scheduling events and sorting data into some specified order." "Niklaus Wirth, "Algorithms and Data Structures" (1984) 65 251 Scd. AM. in Donald S. Chisum, "The Patentability of Algorithms" (1986) 47 U. Pitt. L. Rev. 959.

[56] Donald S. Chisum, *supra* note 55 at 959.

[57] Donald S. Chisum, *supra* note 55 at 959.

[58] Donald S. Chisum, *supra* note 55 at 959.

If one wishes to revisit the early judicial approaches in an attempt to contrast the algorithm of yesterday with the algorithm of today, one can look to Gan's paper, *Before Mayo & After Alice: The Changing Concept of Abstract Ideas*, [59] which covers four distinct patent eligibility standards that existed prior to the Mayo decision: practical application (*Le Roy v. Tatham*;) [60] scope-limited practical application (*Gottschalk v. Benson;*) [61] process application (*Diamond v. Diehr*;)[62] and inventive application (*Parker v. Flook.*)[63] This context demonstrates that difficulties with clarifying the question of algorithm patentability were longstanding and translating into some of the distinctions made in the cases.

Sears' analysis reflects the struggle to reconcile these older decisions with today's technologies. He emphasizes the changes that have occurred over the past century and the challenge associated with implementing a "practical applications" approach to patentable subject matter in the early thinking of *LeRoy v Tatham*:[64]

> Le Roy's antebellum distinction between unpatentable principle and patentable application may have seemed clear enough when it was first made, in an age of steam engines. But 125 years further on, the Court found "[t]he line between a patentable 'process' and an unpatentable 'principle' is not always clear." ... As Flook illustrates, the Court has struggled with how to draw Le Roy's line in the context of digital technologies (and biotechnology).[65]

On the other hand, Stobbs indicates difficulty with the simple interpretation that an algorithm is a mathematical equation, as math "encompasses vast intellectual territory" and

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[59] Magnus Gan, "*Before* Mayo *& After* Alice*: The Changing Concept of Abstract Ideas"* 22 MICH. TELECOMM. & TECH L REV (2016) 287 at 288.
[60] 55 U.S. 156 (1852), McLean J [LeRoy].
[61] 409 U.S. 63 (1972), Douglas J [Gottschalk].
[62] 450 U.S. 175 (1981), Rehnquist J [Diamond].
[63] 437 U.S. 584, 590 (1978*)*, Stevens J [Parker].
[64] *Le Roy, supra* note 60.
[65] *Parker v. Flook, 437 U.S. 584, 590 (1978)* in L. Rex Sears, "Two Stepping with Alice in Justice Stevens' Shadow" (2017) 99 J. Pat. & Trademark Off. Soc'y 129 at 133-4.

it is problematic to exclude "vast territory" from the patent system.[66] I aim to clarify the divides in terms of what ***is*** captured under the patent system and what could be captured.

David Friedland indicates that the term algorithm has reach beyond excepted areas under the "laws of nature" exception.[67] In 1988, Friedland highlighted the challenges in using patent protection for software invention, identifying legal tensions over the definition of computer algorithms (termed in the article to be "fundamental elements comprising computer software.")[68] In the trilogy of cases including *Gottschalk, Parker*, and *Diamond*, the courts could not settle on the appropriate characterization of the term algorithm. But again, this supports my focus on the algorithm, and that the guidance to frame it should also be flexible given the changing dynamics of technology.

While Friedland's paper is three decades old, the sentiment is still relevant unless we are to deem today's algorithms to be just too complex. More recently, authors still adopt varying approaches to defining software and algorithms. For instance, Garza writes about the difficulties of assigning consistent definitions to software and algorithms due to the complexity of the subject matter.[69]Another nuance is the definition of the computer program. According to the Cambridge dictionary, a "computer program" is "a set of instructions that

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[66] Gregory Stobbs, *Software Patents, supra* note 53 1 at 42.

[67] See David K. Friedland, "Computer Software Patentability: The Dilemma of Defining an Algorithm" (1988) 2 Software L.J. 537 at 538, "Unlike natural phenomena and their descriptions, which are not protected by the United States *Patent Act* [Citation omitted], these commentators believe that the 'descriptions of algorithms that computer scientists have accepted and the manner in which these scientists have incorporated algorithms … reveal that algorithms conceptually are not equivalent to these laws of nature.' 'Therefore, a proper description of algorithms by the Supreme Court is the initial step in a determination as to whether software is patentable.'"

[68] *Ibid*, David K. Friedland, "Computer Software Patentability: The Dilemma of Defining an Algorithm," at 537.

[69] See Robert Daniel Garza, "Software Patents and Pretrial Dismissal Based on Ineligibility" (2018) 24:1 Rich. J.L. & Tech. at 24-26 or para 32, "Due to the inherent complexity of software, attempting to establish a definition is difficult. [citation omitted] Some scholars believe that attempting to define software and fit it into strict categories may be 'pointless.' [citation omitted] This has resulted in many different problems; however, perhaps the most problematic is that patent attorneys have become creative and draft claims to 'obscure the true nature of the patented invention.' [citation omitted] Instead of solving the issue, practitioners made it worse."

makes a computer do a particular thing."[70] More specifically, Daldaban gives a comprehensive explanation of the divide between an AI (ML) algorithm and a program:

> An algorithm must have five fundamental features: input, output, definiteness, finiteness, and effectiveness. [citation omitted] First, an algorithm, in order to solve a problem, must be fed with inputs. [citation omitted] Second, upon the receipt of an input, the algorithm must process it through specifically designated computational steps and generate an output. [citation omitted] Third, the instructions in an algorithm must be precise and definite; these instructions should not have any vagueness. [citation omitted] Fourth, the computational steps determined in an algorithm must be finite; accordingly, whenever the algorithm is run, it must terminate after implementing a specific number of instructions. [citation omitted] **This feature is considered to be a significant difference between a computer program and an algorithm, as a computer program is not subject to such a principle, hence, it may or may not cease at a certain point**. [citation omitted] Another significant difference between an algorithm and a computer program is that while an algorithm is a mechanism or a sequence of instructions used for solving a problem by using inputs, a computer program is the utilization of an algorithm by using a programming language. [citation omitted] As there is a variety of programming languages, [citation omitted] the same algorithms may be implemented by a variety of programs. [citation omitted] The last feature, effectiveness, refers to the principle that the instructions of an algorithm must be practicable; they cannot be impossible tasks. [citation omitted][71]

Some of the algorithms in early case law out of the United States were not as complex as those we see today. For instance, some use increased computing capacity. According to the current AI literature, "four developments have given rise to new opportunities and new challenges. These include a significant increase in the processing power of computers, the availability of data on an unprecedented scale, the fall in the costs of the data storage, and the increasingly sophisticated software services which have become available."[72] It can be drawn from this that in Industrial Revolution 4.0, "math" as part of the emerging

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[70] Dictionary.Cambridge.org "Computer Program" (2021), online: *Cambridge Dictionary* <https://dictionary.cambridge.org/dictionary/english/computer-program>.

[71] Ihsan Ibrahim Daldaban, "RegTech and SupTech for Robo-Advisers: Alternative Regulatory Methods for Enhancing Compliance" (2019) 19 Asper Rev Int'l Bus & Trade L 59 at 71.

[72] "Forward: Algorithms and the Law" in Woodrow Barfield, ed, *The Cambridge Handbook of the Law of Algorithms* (Cambridge Law Handbooks) (Cambridge: Cambridge University Press, 2020) xix at xix.

technologies, especially in the AI space, is different than we have seen before.

The outcome of patentability is influenced by how an invention is claimed. Software or algorithms are often categorized as unpatentable unless some structure or hardware is attached. One cannot use the physicality of the invention associated with the algorithm as a clear-cut route to patentability. There needs to be an integration of the two, not just a machine completing routine data processing. A unique capability from the integration is optimal. This claiming strategy aids in the identification of patentable subject matter. Hsiao describes the nuances of the algorithm not a law of nature.[73]

In 1991, Swinson explained that an algorithm can be understood as having the following features: (1) having a set of instructions that a processor follows to carry out a process, which need not have anything to do with mathematics; (2) not dependent on having a digital computer as the processor; (3) every computer program is the expression of at least one algorithm; and (4) can be used to solve many problems, not just mathematical problems.[74] As we have seen in the past characterizations, this one is standard but not fully complete in terms of Machine-Learning.

1.3.2 Algorithms in Machine Learning and Big Data

It is important to establish the parameters for this thesis. I separate the AI discussion

[73]See Jerry I-H Hsiao, "Patent Eligibility of Predictive Algorithm in Second Generation Personalized Medicine" (2019) 22:1 SMU Science & Technology L Rev 23 at 31, “it is important to note that an algorithm can be expressed in different ways, using divergent expressions at different levels of sophistication and abstraction. An algorithm is not necessarily dependent on computers or devised to solve problems of a mathematical nature... An algorithm, therefore, is not a natural phenomenon or abstract concept, because one cannot conceive an algorithm in nature. An algorithm does not describe a natural phenomenon. In fact, it does not describe anything other than a series of operations to be performed by a machine or human being. Hence, algorithms are highly specific rather than abstract. The Federal Circuit also shared this view: ". . . a mathematical algorithm does not appear in nature at all, but only in human numerical processes. . . It is difficult to determine how or why mathematical algorithms are 'like' laws of nature."

[74] John Swinson, “Copyright or Patent or Both: An Algorithmic Approach to Computer Software Protection” (1991) 5 HARVARD J.L. & TECH. 145 at 150 in Jerry I-H Hsiao Patent Eligibility of Predictive Algorithm in Second Generation Personalized Medicine" (2019) 22:1 SMU Science & Technology L Rev 23 at 31.

along two trajectories: the AI invented by humans and the AI invented by machine. While the predominance of the literature on AI now focusses on the inventions by machine discussion, it is not the focus of this thesis (patentability of AI and ML algorithms). Therefore, it is relevant to characterize the shift from human intervention to a machine-generated invention.[75] Further to the distinctions highlighted above, the challenges associated with applying existing definitions of invention in the context of AI are considerable.[76]

Algorithms form a select part of a broader discussion of the patentability of software inventions. While there are various algorithms, this thesis considers ML algorithms in AI with a discussion of Big Data to illustrate the distinction. There are a couple of key areas to highlight. Big Data is rough and uncleaned data which one must be refine and integrate to make it useful. In this sense, it is the raw input to an ML algorithm, with the output being the actual intelligence or processed data. Important to note that while there are blurred boundaries between Big Data and AI, in both cases, "algorithmic power is essential to unleash the (assumed) enormous potential hidden in large amounts of raw data."[77]

Even though AI in its most foundational form has been around for many years, it is now featuring predominantly in emerging technology. I don't use the term "foundational" with any specific genre of algorithms. The term foundational refers to a general algorithm, architecture, or routine. featuring high volumes of training data and high-capacity computing power. The differing parameters are part of what is unique about each application of the

[75] Feldman and Thieme spell out the oft used categories of AI invention involved when humans and computers are involved; the "invention must be either 1) created by humans alone, 2) invented in tandem by humans and computers, 3) invented by computers alone, or 4) 'invented' by neither." See Robin Feldman and Nick Thieme, Competition at the Dawn of Artificial Intelligence (June 22, 2018) Journal of Antitrust Enforcement, Forthcoming, UC Hastings Research Paper No. 298, online: *SSRN* <https://ssrn.com/abstract=3218559> at 3.
[76] Liza Vertinsky, "Thinking machines and patent law" in Woodrow Barfield & Ugo Pagollo, eds, *Research Handbook on the Law of Artificial Intelligence* (UK: Edward Elgar Publishing 2018) 489-510.
[77] Stefan Strauß, "From Big Data to Deep Learning: A Leap Towards Strong AI or 'Intelligentia Obscura'?" (2018) Big Data Cogn Comput 1 at 4.

algorithms. One can apply IP to pre-processing of inputs and training datasets. To link with the later discussion on ML algorithms, pre-processing can gather massive datasets, to clean and derive insights.

A course on AI for radiologists mentions seven seminal (foundational) AI algorithms.[78] Caulder and Penner of the patent bar define foundational AI in an advanced patent prosecution workshop as "AI algorithms; analytic systems that report correlations from large data sets; often broadly useful in many technology sectors."[79] Zingg notes that "the foundations of AI arise from the private sector. It follows that the fundamentals of AI innovation may come to exist behind a blockade of privatization."[80] However, industry leaders such as Google, Facebook, Amazon, and Microsoft all maintain open-source AI repositories.[81] Evidently, there is a mix of open and proprietary approaches to manage foundational AI.

Following this, foundational AI includes an algorithm that may form part of a clearly patent-eligible invention. I can frame the landscape for patenting AI algorithms in several ways. Over time, the shift in what could be termed an innovative element in AI inventions leads one to consider what future responses by both the patent office and the judiciary could look like moving forward. The subject matter encountered in current-day patent practice involves very sophisticated, complex algorithms. The algorithms are non-linear and often a result of higher-order modelling. It is more challenging to apply patent criteria (novelty, utility, and non-obviousness) in the traditional way. One can achieve utility with a low

[78] See the different algorithms such as Naïve Bayes, K-Nearest neighbour, K-Means, Random Forest, the Perceptron, Support Network Machines and Neural Network in Alexander L. Lindquister et.al, "AI-RADS: An Artificial Intelligence Curriculum for Residents" (2020) Academic Radiology 1810 at 1811.
[79] Isi Caulder & Mark D Penner, *Patenting Artificial Intelligence Advanced Prosecution Strategies, supra* note 3.
[80] Raphael Zingg, "Foundational Patents in Artificial Intelligence", *supra* note 39 at 76.
[81] Raphael Zingg, *ibid* at 75.

threshold in most inventions, including AI.

Before delving into the distinctions in algorithms, I revisit the definition of Big Data and its use in the literature. Big Data can be considered a generic term for the whole domain. Big Data is used to drive insight and processes "large volumes of data with high velocity and variety."[82] The term Big Data dates to the 1990's and refers to the "handling and analysis of massive datasets."[83] While there is no official academic definition, a frequently used characterization references three aspects of Big Data "volume, velocity and variety."[84] This indicates high volumes of high-speed data of different types and quality. Kitchin indicates that there is emerging literature beyond the 3 v's on Big Data that highlighting its "exhaustive nature," its "fine-grained resolution," and that it is "relational," "flexible," and "scalable" in nature.[85]

Given that the Big Data discussion involves both the terms "algorithm" and "analytic," I highlight the distinction below. Big Data "constitutes diverse datasets, which can be anything from expanded datasets to social media data. The granularity of data can give insights into a variety of predicted behaviours and incidents."[86] There are four types of Big Data analytics: descriptive analytics, diagnostic analytics, predictive analytics, and prescriptive analytics.[87] The connection between an algorithm and a data analytic is as follows: "many of the techniques and processes of data analytics have been automated into mechanical processes and algorithms."[88] Further, because of the increased significance of

[82] Fábio Diniz Rossi et.al., "Dynamic Network Bandwidth Resizing for Big Data Application" (16 November 2017), online: *IEEE* <https://ieeexplore.ieee.org/document/8109161/?reload=true>.
[83] Rob Kitchin, *The Data Revolution* (Los Angeles, U.S.A.: SAGE publishing, 2014) at 67.
[84] *Ibid,* Rob Kitchin, *The Data Revolution* at 67-68.
[85] *Ibid,* Rob Kitchin, *The Data Revolution* at 68.
[86] OECD, "The Impact of Big Data and Artificial Intelligence (AI) in the Insurance Sector" (2020) at 6, online: OECD < https://www.oecd.org/finance/impact-big-data-ai-in-the-insurance-sector.htm>.
[87] *Ibid,* OECD, "The Impact of Big Data and Artificial Intelligence (AI) in the Insurance Sector" at 11.
[88] *Ibid,* OECD, "The Impact of Big Data and Artificial Intelligence (AI) in the Insurance Sector" at 11.

Big Data analytics, computer science experts emphasize that "many applications require large-scale data processing as well as advanced statistical methods."[89] Using software-based solutions by Big Data companies can "allow for new ways to represent, transmit, and/or access insight gains."[90] Gothing and Muñoz-Kaphing emphasized that "Big Data lets organizations extract a whole new level of data-driven insights, value, and actionable strategies that … relies heavily on software and proprietary algorithms."[91] Al-Jabery et. al. notes the following:

> Data Analytics has become a transformational technology, fueled by advances in computer and sensor hardware, storage, cloud computing, pervasive data collection, and advances in algorithms, particularly machine learning. No single one of these would have fueled the advance nearly so much as their convergence has. This fundamentally changed the way many industries do business. Data analytics is even revolutionizing industries that were not formerly dominated by data, such as transportation.[92]

> Fortunately, automated analysis has improved dramatically. Some approaches were previously difficult because of the computational complexity of solving for parameters of large systems. The increased amount of data, although a challenge, can be helpful. Some of the most sophisticated techniques demand huge datasets… Most of these techniques were invented due to the high computational cost of solving for the parameters.[93]

The types of algorithms under consideration in the early stages of data collection include the work of the pre-processing algorithm, i.e. "unsupervised learning is often used as a part of the pre-processing step to make the follow up supervised learning more

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[89] Kun Li, "UDA-GIST: Unified Data-Parallel and State-Parallel Analytics in DB" (12 November 2014), online: <http://dsr.cise.ufl.edu/uda-gist-an-in-database-framework-to-unify-data-parallel-and-state-parallel-analytics/>.
[90] Andrea L. Gothing & Angela M. Muñoz-Kaphing, "Protecting Big Data Systems in a Post - Alice World" (September 2014), online: *Robins Kaplan* <http://www.robinskaplan.com/resources/articles/protecting-big-data-systems-in-a-post-alice-world>.
[91] *Ibid*, Andre L. Gothing & Angela M. Muñoz-Kaphing, "Protecting Big Data Systems in a Post - Alice World."
[92] Khalid Al-Jabery,et.al, *Computational Learning Approaches to Data Analytics in Biomedical Applications* (London: Academic Press, 2020)1 at 1.
[93] *Ibid*, Al-Jabery et. al at 1.

efficient."[94]A pre-processing algorithm is necessary as "computational intelligence needs clean, numeric, homogeneous, well organized, and normalized data.[95] This phase includes "converting text, symbols, and characters to numeric values, data imputation, and data cleansing."[96] In Big Data processing "data quality is a major concern."[97] The pre-processing stage enables "high level analyses" such as clustering "to be applied to the data."[98] The ML model is built upon clean data.

Algorithms can replace human's work in various ways in a process known as automation. For instance, "critics of artificial intelligence systems suggest that artificial intelligence systems take out the human factor in problem-solving and provide technical solutions to problems that do not have a technical nature."[99] According to Tsang et. al., "Artificial intelligence (AI) software means computer programs with the capacity to perform operations analogous to learning and decision making in humans."[100] At this time, "most current AI technology fits into the Machine Learning category, in which advanced algorithms and statistical models are used to identify patterns in large data sets. These models and patterns are used to create predictive systems that evaluate and respond to real world events." [101] Recent legal scholarship indicates that "the term 'artificial intelligence' describes 'a broad set of methods, algorithms, and technologies that make software 'smart' in a way that may

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[94] Jerry I-H Hsiao, "Patent Eligibility of Predictive Algorithm in Second Generation Personalized Medicine", *supra* note 73 at 29.
[95] Al-Jabery et. al, *supra* note 92 at 7.
[96] *Ibid*, Al-Jabery et. al at 7.
[97] *Ibid*, Al-Jabery et. al at 7.
[98] *Ibid*, Al-Jabery et. al. at 29.
[99] Bridget Watson, "A Mind of Its Own - Direct Infringement by Users of Artificial Intelligence Systems" (2017) 58 IDEA 65 at 77.
[100] Lincoln Tsang, et. al. "The Impact of Artificial Intelligence on Medical Innovation in the European Union and United States" (2017) 29:8 *Intellectual Property & Technology Law Journal* 3 at 3.
[101] Bhupinder Randhawa & Cameron Gale, "Protecting Technology and IP in the Age of AI and Collaborative Technology Development" (July 4, 2019), online: *Bereskin & Parr* <https://www.bereskinparr.com/doc/protecting-technology-and-ip-in-the-age-of-ai-and-collaborative-technology-development>.

seem human-like to an outside observer.'"[102] The aim is for the AI to use a large amount of data to make a quick decision; the AI is making a recommendation to the human.

There are extra layers of refinement applied to the ML data, whereas most Big Data appear in much greater volumes and at a much higher velocity. I will adopt the definition of ML by Anthony Man-Cho So found in a collection on AI and Intellectual Property from the Oxford University Press. He defines ML as follows:

> ML is a sub-field of AI that is concerned with the automated detection of meaningful patterns in data and using the detected patterns for certain tasks. Roughly speaking, the learning process involves an algorithm, (citation omitted) which takes *training data* (representing past knowledge or experience) as input and outputs information that can be utilized by other algorithms to perform tasks such as prediction or decision-making. With the huge amount of data generated on various online platforms, (citation omitted) the increasing power (in terms of both speed and memory) of computers, and advances in ML research, researchers and practitioners alike have been able to unleash the power of ML and contribute to the many impressive technologies we are using or experiencing today.[103]

ML involves inputting "data for the algorithm to learn responses. Big Data is a valuable data source for Machine Learning, but the extent of their potential contribution is uncertain, given that Big Data often involves unstructured free text."[104] Big-data AI "uses algorithms to find subtle relationships in a large set of 'training' data. The training process locates those relationships and encodes them into a 'model,' such as a neural network. The model can then find relationships between inputs similar to those in the training data."[105]A

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[102] Bridget Watson, "A Mind of Its Own - Direct Infringement by Users of Artificial Intelligence Systems." *supra* note 99 at 67.
[103] Anthony Man-Cho So, "Technical Elements of Machine-Learning for Intellectual Property" in Jyh- An Lee, Reto Hilty, and Kung- Chung Liu, eds, *Artificial Intelligence and Intellectual Property* (UK: Oxford University Press, 2021) 1 at 11.
[104] OECD, "The Impact of Big Data and Artificial Intelligence (AI) in the Insurance Sector", *supra* note 86 at 8.
[105] Christopher J. White & Hamid R. Piroozi, "Big Data AI extracts Patterns from Large Data Sets" (January/February 2019) Landslide, online: *American Bar Association*

patent can be granted for "techniques that constitute the very basis of artificial intelligence, such as fundamental techniques" for creating and training neural nets.[106] The purpose of the following section is to review AI and Neural Networks.

1.3.3 Algorithms and Neural Networks

Deep Learning is very versatile and can work in quite different ways. It is "a new name for an approach to artificial intelligence called neural networks, which have been going in and out of fashion for more than 70 years."[107] Artificial Neural Networks are one type of ML algorithm. Neural Networks are described as "brute force" AI and as a set of algorithms that are modelled after the human brain. An Artificial Neural Network "consists of artificial neurons or processing elements and is organized in three interconnected layers: input, hidden that may include more than one layer, and output."[108] One can also describe neural networks as having "an interconnected group of processing nodes that provides the architecture for a machine to learn how to perform certain tasks by analyzing training examples. Neural Networks also "introduce … incremental changes and test them through trial and error to observe whether the efficiency of a program improves."[109] For example, a Deep Learning "object recognition application may be fed thousands of identified images so that it can learn

<https://www.americanbar.org/groups/intellectual_property_law/publications/landslide/2018-19/january-february/drafting-patent-applications-covering-artificial-intelligence-systems/>.

[106] Misha Benjamin, Element AI, "IP Challenges for AI Companies," (Presentation delivered at Second Annual IP Research Workshop, Ottawa, ON, 25 March 2019) (On file with author).

[107] Larry Hardesty "Explained: Neural Networks" (14 April 2017), online: *MIT News* <https://news.mit.edu/2017/explained-neural-networks-deep-learning-0414>.

[108] Olga Davydova, "7 types of Artificial Neural Networks for Natural Language Processing" (26 September 2017), online: *medium.com* <https://medium.com/@datamonsters/artificial-neural-networks-for-natural-language-processing-part-1-64ca9ebfa3b2>.

[109] Samuel Scholz, "A Siri-ous Societal Issue: Should Autonomous Artificial Intelligence Receive Patent or Copyright Protection?" (2020) 11:1 Cybaris: An Intellectual Property L Rev 81 at 83-84.

patterns associated with certain objects and learn how to identify them."[110] In some cases, algorithms are good in narrow areas but have a rather hard time making abstract decisions.[111]

In terms of algorithms and detail to be found in AI-related patent applications, it is increasingly difficult to overcome objections based on subject matter eligibility "in part due to black box implementation of AI-related tools such as neural networks, which can make drafting a detailed description challenging."[112] Esmaili describes patent eligibility and the Neural Network:

> in the context of a neural network, the description may include various types and configurations of the layers of a neural network; the effect of different types of training data on network performance and training times; and the advantageous performance of neural network-based implementation as opposed to conventional, non-AI implementations. Including information such as this in an application and emphasizing these points during prosecution can help establish eligibility."[113]

A Neural Networks patent containing a patent claim with a great deal of hardware was presented to a start-up audience in April 2020.[114] In terms of AI and patenting, "most of the ideas usually boil down to mathematical operations. So, it would be tricky to patent an idea unless the researchers show that their algorithm or software completely changes the way hardware functions."[115] Stephen Thaler, the creator of DABUS (device for the autonomous

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[110] Frank A. DeCosta, Aliza G. Carrano & Ruohan Li, "Early Strategies for Protecting Neural Network inventions (6 September 2018), online: *Finnegan.com* <https://www.finnegan.com/en/insights/articles/early-strategies-for-protecting-neural-network-inventions.html>.

[111] Bruce Ironhardt, "Artificial Intelligence and Neural Networks For everyone, even kids" (17 November 2020), online: *Datascience.com* <https://towardsdatascience.com/artificial-intelligence-and-neural-networks-for-everyone-even-kids-94336eb7440e>.

[112] Shahrzad Esmaili, "Patenting Artificial intelligence Inventions in Canada" (24 October 2019), online: *Gowlings* <https://gowlingwlg.com/en/insights-resources/articles/2019/patenting-artificial-intelligence-inventions/>.

[113] *Ibid*, Esmaili.

[114] Noel Courage, Isi Caulder and Grant Burns, "Pivoting, Persevering or Pressing On: Key points for Start-up companies on IP, Funding and Collaborations," (Presentation from Ontario Bioscience Innovation Organization 27 April 2020), (On file with author).

[115] Ram Sagar, "Google's Geoff Hinton and his team file a patent for Capsule Neural Networks" (25 September 2020), online: <https://analyticsindiamag.com/geoff-hinton-patent-capsule-neural-networks/>.

bootstrapping of unified sentience)[116] describes DABUS as "connectionist artificial intelligence," with the following words:

> [it] relies upon a system of many neural networks generating new ideas by altering their interconnections. A second system of neural networks detects critical consequences of these potential ideas and reinforces them based upon predicted novelty and salience.[117]

Clearly the Neural Networks discussion needs to be pursued further—for the purposes of this thesis one can reflect upon the ongoing changes occurring in math that can affect future patenting in the area.

1.3.4 AI and Intellectual Property

Scholarship more directly relevant is found in several collections on AI. The peer-reviewed collection from Teresa Scassa and Florian Martin-Bariteau[118] is the first in Canada to cover the legal and policy challenges in AI, a quickly evolving technology. There is a key piece from Gregory Hagen[119]on AI patents and trade secrets, disclosures and accountabilities in inventions and automated decision-making. Also, Carys J. Craig explores the intersections of copyright law and policy with this rapidly evolving technology.[120] While my treatment of copyright is limited in this thesis, analyzing this evolving technology in terms of Canadian doctrine highlights areas of potential focus in revisions to legislation and policy positions.

Aviv Gaon, *Intellectual Property at a Crossroad: Awarding IP Protection for*

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[116] Martin Coulter, "Patent agencies challenged to accept AI inventor" (31 July 2019), online: *Financial Times* <https://www.ft.com/content/9c114014-b373-11e9-bec9-fdcab53d6959>.
[117] Emma Woollacott, "European Patent Office Rejects World's First AI Inventor" (3 January 2020), online: *Forbes* <https://www.forbes.com/sites/emmawoollacott/2020/01/03/european-patent-office-rejects-worlds-first-ai-inventor/#483e691f5cd0>.
[118] Florian Martin-Bariteau & Teresa Scassa eds, *Artificial Intelligence and the Law* (Toronto: LexiNexis Canada, 2021).
[119] Gregory R. Hagen, "AI and Patents and Trade Secrets", in Florian Martin-Bariteau & Teresa Scassa, eds, *Artificial Intelligence and the Law in Canada* (Toronto: LexisNexis Canada, 2021) c.2.
[120] Craig, Carys J., "AI and Copyright" in Florian Martin-Bariteau & Teresa Scassa eds, *Artificial Intelligence and the Law* (Toronto: LexisNexis Canada, 2021) c.1

Algorithms, in Woodrow Barfield, ed., *The Cambridge Handbook on the Law of Algorithms,*[121] discusses patenting and software and the evolution of the 'inventive concept' test post-*Alice*. Several pieces of relevant research can be found in the *Research Handbook on the law of Artificial Intelligence* from Cambridge University Press.[122] William Samore explores AI, the patent system and obviousness specific to genetic programming, that can create inventions.[123]

A key piece by Ryan Abbott, *Everything is Obvious*, explains the enduring nature of the obviousness standard and leads one to consider how it may apply in emerging technologies.[124] While the obviousness standard is discussed in Canada and codified in legislation, it has not received the attention of some areas of patent law, particularly in the software space.

International patent offices have faced the issue of AI being named as an inventor, in contravention of the definition of inventor found in most patent legislation. However, Ryan Abbott a member of the 'Artificial Inventor Project', has supported the patent process for numerous patents invented by an AI. An article written by Abbott "addresses whether a computer could and should be an inventor for the purposes of patent law as well as whether computational inventions could and should be patentable."[125] This literature is relevant to my thesis in the broader context of AI and Patent Law. While my work focuses on the algorithmic

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[121] Aviv Gaon, "Intellectual Property at a Crossroad: Awarding IP Protection for Algorithms" in Woodrow Barfield, ed, *The Cambridge Handbook on the Law of Algorithms* (Cambridge: Cambridge University Press, 2020) 1 at 391.
[122] William Samore, "Artificial Intelligence and the patent system: can a new tool render a once patentable idea obvious?" in Woodrow Barfield & Ugo Pagollo, eds, *Research Handbook on the Law of Artificial Intelligence* (UK: Edward Elgar Publishing 2018) c. 17 471-488.
[123] *Ibid,* William Samore.
[124] Ryan Abbott "Everything is obvious" (2018) 66 UCLA L. Review 2, online: *SSRN* < https://ssrn.com/abstract=3056915>.
[125] Ryan Abbott, "I Think, Therefore I Invent: Creative Computers and the Future of Patent Law" (2016) 57 B.C.L. Rev. 1079, online: *BCLR* <http://lawdigitalcommons.bc.edu/bclr/vol57/iss4/2>.

elements of an AI invention from a patent eligibility and patentability stance, it is important to have an awareness of what these technologies mean in terms of other sections of the *Patent Act*,[126] including the definition of patent applicant which can include the inventor in Canada.[127] As noted by Gallagher, these intersections can provide "unprecedented questions and obstacles to the world of intellectual property law."[128] That is, the legislation may be outdated, and there is a need to consider longstanding positions within the purview of emergent technologies.

1.3.5 AI as Patent-Eligible Subject Matter

In Canada, the analysis of case law on the abstract theorem, professional skills and business methods evolves with early discussions stemming from *Schlumberger v. Commissioner of Patents*,[129] *Shell Oil*[130], *Amazon* FCA[131] and more recently *Choueifaty*[132] and *Benjamin Moore*.[133] A purposive construction of the claims to identify patentable subject matter dominates Canada's discussion on software and business method inventions. However, I see benefit in taking the ever-evolving dynamic between the patent office and the judiciary a step further to AI innovations where often the invention is founded on the idea of "something more" than an abstract theorem. This can further a discussion of the inventive step or inventive concept.

The use of algorithms on the boundary of a patentable invention in the Big Data context is a case that warrants review. Given the current state of the law and the US Supreme

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[126] *Patent Act*, RSC 1985 c P-4.
[127] *Patent Act*, RSC 1985 c P-4, s 2.
[128] Bailey Gallagher, "The Singularity Is Near: Implications for Patent and Copyright Law in the Age of Whole Brain Emulation", 26 Fed. Cir. B.J. 1 (2016) at 1 – 2; See Bailey Gallagher Footnote 4.
[129] [1982] 1 F.C. 845 (C.A.), Pratte J [*Schlumberger*].
[130] *Shell Oil*, *supra* note 25.
[131] *Amazon* FCA, *supra* note 23.
[132] *Choueifaty*, *supra* note 32.
[133] *Benjamin Moore*, *supra* note 33.

Court case of *Alice*[134] the current commentary indicates that "the key question left open …is whether claims to specific information-processing techniques represent ineligible abstract ideas or eligible applications."[135] Commentators have noted that the "complex solutions that analyze, manipulate, or store Big Data may be less vulnerable to the attack that cost Alice its patent."[136]

In a corporate 'Big Data' environment that demands novel software solutions, investigating the types of solutions that may qualify for a patent is a useful exercise that could influence the broader patent community. For example, at the most basic level, the claims in a patent for a software invention sometimes cover data processing or a "manipulation of data."[137] In my research, I encountered the terms "foundational patent" and "foundational AI." I propose that the term "foundational" can include a patent on a fundamental building block or the fundamental building block itself. The enduring theme of inputs to an algorithm and the resulting outcomes, including foundational approaches to algorithms (pre-processing and selection of training data and data processing) take their place in structuring the narrative.

Also, part of the patenting discussion are components that can increase the likelihood of patentability in software, including hardware, data structure (Neural Networks) and improved computer function. Data is drawn from different sources.[138] As Mattioli notes, "'the single data set has very little value,' … 'The unique intellectual property is from the

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[134] *Alice*, *supra* note 38.
[135] Jason Rantanen, Are Specific Information-Processing Claims Abstract Ideas? (5 May 2015), online: *PATENTLYO Blog* <http://patentlyo.com/patent/2015/05/information-processing-abstract.html>.
[136] Andrea L. Gothing & Angela M. Muñoz-Kaphing, *supra* note 90.
[137] John R. Allison, McCombs School of Business, "University of Texas at Austin Empirical Studies of IP Protections for Software what do we know and not know?" (Presentation delivered at Software IP: The 20th Annual BCLT/BTLJ Symposium – Intellectual Property Protections for Computer Programs: What's Going Right and What's Going Wrong? Berkeley, California 14 April 2016).
[138] Michael Mattioli "The Data-Pooling Problem" (2017) 32:2 Berkeley Technology Law Journal, online: *SSRN* <https://ssrn.com/abstract=2671939 or http://dx.doi.org/10.2139/ssrn.2671939> 1 at 17.

integration of data sets and the algorithms that you can generate on top of them.'"[139] In the case of Big Data, or more specifically, in emerging technologies including AIs (ex: ML algorithms and Neural Networks), it appears that inventions, including algorithms, have had both successes and failures in the patenting process. Gaon and Stedman comment on Canadian IP law in the AI context in a more general way: "Artificial intelligence also presents a challenge to Canada's intellectual property laws in relation to both the data inputs necessary for AI and the outputs generated by AI (for example, the creations or inventions). In fact, the current laws in Canada might hinder the progress of AI."[140] On the other hand, Esmaili points out:

> In recent years, the confluence of advancements in computational power and the abundance of rich data sets has led to a surge in the number of practical applications of AI. The time and money required to properly train, test, and deploy AI in these applications makes protecting them using patents a crucial consideration in any business plan.[141]

Approaches to integrating hardware and the use of purposive construction have made patents in this area possible. The processing, manipulation, or integration of multiple different datasets to obtain unique, novel, useful solutions can take various forms. The theoretical component behind choosing specific subsets of data to compare or predict plays a role in the assessment and factors into AI and patent eligibility.

Teresa Scassa gives a comprehensive summary of the software and business method invention trajectory mainly in Canada but also references aspects of U.S law.[142] She does this as part of a more extensive discussion on e-commerce patents. While this is an older text, the

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[139] *Ibid*, Michael Mattioli, "Data Pooling Problem" 1 at 15.
[140]Aviv Gaon & Ian Stedman "A Call to Action: Moving Forward with the Governance of Artificial Intelligence in Canada (2019) 56:4 Alberta Law Review 1137 at 1148.
[141] Esmaili, *supra* note 113.
[142] See Teresa Scassa, "Software and E – Business Patents" in Teresa Scassa & Michael Deturbide, *Electronic Commerce and Internet Law in Canada,* 2nd *ed* (Toronto:LexisNexis, 2012*)* 375.

roots of the software and business method invention debate are related to AI innovations which are based on software. The evolution of the software patent referencing Canadian Patent Appeal Board decisions illustrates the many steps involved in making decisions on such technology. The first software invention decision to be heard at the Federal Court is the oft-referenced decision of *Schlumberger*. Scassa notes that from a public policy point of view, "the Court resisted making patentable in a machine that which would not be patentable when performed by a human being."[143] This informs my thinking on the patent continuum regarding software and computer-implemented inventions.

In George Takach's *Computer Law,* focused on older issues, he makes interesting observations on the decades-old *Schlumberger*. For example, he notes that because "the program merely performed a series of mathematical equations" to "extract useful information," the case did not "preclude a computer program or a data processing system from being proper patentable subject matter."[144] This thinking indicates to me that the claims in *Schlumberger* are highly abstract and in hindsight, would benefit from a more fulsome consideration. An interpretation that could influence findings on computer-implemented inventions towards the patentable end of the decision-making spectrum, particularly when one sees an integration of software and hardware in an innovative way.

In my review of the literature, several gaps exist on software inventions including the exclusions that present for software as a potentially abstract theorem, and professional skills.

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[143]*Ibid*, See Teresa Scassa, "Software and E – Business Patents" in Teresa Scassa & Michael Deturbide, *Electronic Commerce and Internet Law in Canada,* 375 at 379; 381.
Other cases at the Patent Appeal Board that followed Schlumberger, including Re Application for Patent of Westinghouse Electric Corporation (No.1) saw the patent granted seemingly with the reasoning "that the programming was an integral part of something that would otherwise be patentable subject matter." This was followed by a PAB case of Re Motorala Inc. Patent Application No. 2.085,228 where we see an algorithm integrated with hardware deemed patentable.

[144] George S. Takach, *Computer Law* (Toronto: Irwin law, 1998)1 at 96.

While I first focussed on the role of math versus the role of the machine, to this point, I can reference the *Patent Act* section 2 definition of invention.[145] I agree that math in the traditional sense is not an invention. However, a machine is contained within the definition of the invention. A computer qualifies as a machine, and the integration of the computer with algorithms can relate to the sophistication, and speed and patentability of an AI application. Further, current questions surrounding patentability (novelty, utility, and non-obviousness) are explored.

The conversation in Canada involves the 2011 Federal Court of Appeal case in *Amazon.*[146] There is a significant contribution found in Gregory Stobbs, *Software Patents Worldwide*[147] from Canadian litigators Steven Garland and Colin Ingram. They provide a comprehensive review of patent law in Canada in general. This paper includes the state of software inventions, including key decisions of *Amazon* FCA[148] and *Schlumberger.*[149] *Schlumberger* was notable because the algorithm in question was the novel component and was deemed unpatentable. The paper notes that *Amazon* FCA[150] will be a point of contention for years to come because of its inconclusive findings on business methods and the use of purposive approach to claim construction. Other questions include whether software and business method inventions qualify as patentable. The chapter ends with the note that "guidelines suggest that the Office may approach purposive construction in a manner that is

[145] *Patent Act,* RSC 1985 c P-4, s 2.
[146] *Amazon* FCA, *supra* note 23.
[147] Steven Garland & Colin Ingram "Canada" in Gregory Stobbs, ed *Software Patents Worldwide* (Netherlands: Wolters Kluwer, 2008), online: *Smart & Biggar* < https://www.smartbiggar.ca/_Archives/files/SPW_CANADA_DEC2013.pdf>.
[148] *Amazon* FCA, *supra* note 23.
[149] *Schlumberger*, *supra* note 129.
[150] *Amazon* FCA, *supra* note 23.

not entirely consistent with the jurisprudence."[151] This key point recurs later in the thesis and has come full circle with recent guidance statements by the CIPO (post- *Choueifaty*).

I sought information in several areas during this portion of the literature review dealing with purposive construction. First, I researched the Canadian landscape for journal articles on patenting involving software, most notably dealing with the *Amazon* FCA case on business methods. Then, on a deeper dive into patent law, I examined articles in Canada on the topic of purposive construction and the cases of *Whirlpool* and *Free World Trust.* The precedential value of these two cases on claim construction continues today.

Purposive construction is a key part of this narrative. The disconnect between patent office guidance and judicial determinations affecting software inventions creates much of the discussion from early 2000's to present. Key pieces were authored by Gregory Stobbs,[152] Steven Garland, Colin Ingram and Norman Siebrasse which includes a 2011 article on claim construction, specifically the essential elements doctrine.[153]

In the case of *Choueifaty*,[154] there have been a couple of recent articles in the *Canadian Intellectual Property Review*.[155] At the time of the *Choueifaty* guidelines there were responses from the patent bar. Bereskin and Parr LLP partner Paul Horbal gives his take on the role of *Choueifaty*,[156] and notes that "although the Federal Court rebuffed CIPO's previous examination approach to patentable subject matter, CIPO has issued new guidelines

[151] Garland & Ingram, *supra* note 147 at 86.
[152] Garland & Ingram, *supra* note 147.
[153] Norman Siebrasse, "The Essential Elements Doctrine in patent infringement: Free World and Whirlpool in light of Kiri-Magen" (2011) 22 I.P.J. 223.
[154] *Choueifaty, supra* note 32.
[155] Mitchell Folk, "More Problem than Solution? Patent Subject-Matter Eligibility Following Choueifaty and CIPO's 2020 Practice Notice", supra note 37; Ronald E. Dimock et. al "Protection Against Infringement of Patents in Canada" (2021) 36 CIPR 58.
[156] *Choueifaty*, *supra* note 32.

that specifically relied on *Schlumberger*."[157] That is that a computer used in an incidental unrelated way to the algorithm "does not impart patentability."[158] Distinct from the *Schlumberger* algorithm, the *Choueifaty* computer works in a more robust and speedier fashion (due to the advanced algorithms).

1.3.6 Summary

In terms of broad directions, I am exploring the dual roles of the invention as reflected in theoretical perspectives on innovation and patent law. Patent law can foster overall innovation but does not always result in a commercially viable invention. While a patent-eligible invention is necessary to obtain a patent, the progress of the invention to create a commercially relevant solution is, according to Schumpeter, characterized as innovation.[159] However, it is understood that one can seek patent protection and even a combination of protections to provide some sort of return on investment. There are pockets of the literature that argue strongly against using solely the patent to generate innovative ends and that support the claim the appropriate direction for innovation includes open science.[160] While this thesis includes consideration of long-held theoretical perspectives used to advance innovation, I also considering theoretical innovative approaches when assessing patentability of ML algorithms. While algorithms are not listed as patentable subject matter in Canadian

[157] Paul Horbal, Partner Bereskin & Parr, Good news for patent applicants with computer-implemented inventions: Canada's Patent Appeal Board has decided to allow Yves Choueifaty's patent application, after it was remanded back for further consideration by the Federal Court (Choueifaty v Canada (AG) 2020 FC 837. (January 25, 2021), online: *Twitter* @horbal
[158] *Ibid*, Paul Horbal.
[159] Joseph A. Schumpeter, *The Theory of Economic Development* (Cambridge, Mass.: Harvard University, 1934) translated from German by Redvers Opie Schumpeter (London: Routledge, 2017) See Footnote 32 at liv.
[160] Matthew Herder, Janice E. Graham & Richard Gold, "From Discovery to delivery: public sector development of the *r*VSV-ZEBOV Ebola vaccine" (2020) 7:1 Journal of Law and the Biosciences 1 at 2.

patent legislation, I illustrate those opportunities for a more fulsome assessment of patent potential in inventions involving cutting-edge algorithms.

The patent protection of software inventions has been a controversial issue in Canada, the U.S. and internationally. This is of increasing importance with an increase of AI patent applications. My review of the patent literature involving software shows that the U.S. had a trilogy of cases following the once-liberal approach to business methods enunciated in *State Street & Trust v. Signature Financial Group*[161] in 1998. This trilogy started with *Bilski v. Kappos*[162] and *Mayo Collaborative Services v. Prometheus Labs.*[163] The parameters for what was patentable in this space tightened considerably culminating in the Supreme Court case of *Alice.*[164] This case implemented a two-step test, including an inventive step to determine patentability. This sort of trajectory is not present in Canadian case law, which has focused mainly on the characterization of patentable subject matter as per the section 2 *Patent Act* definition of invention.[165]

1.4 IP protections for software

The patent is not the only IP protection for software inventions. There are a variety of valid protections for differing aspects of the software. For instance, given that computer programs can be composed of various elements including, program code, structural features, operating elements (e.g., menu command systems), program outputs (e.g., screen displays), and user interfaces, a variety of protections may apply.[166]

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[161] 149 F.3d 1368 (1998), Rich J [*State Street*].
[162] 561 U.S. 593 (2010), Kennedy J [*Bilski*].
[163] 132 S. Ct. 1289 (2012), Breyer J [*Mayo*].
[164] *Alice*, *supra* note 38.
[165] *Patent Act,* RSC 1985 c P-4, s 2.
[166] Peter S. Menell, "An Epitaph for Traditional copyright protection of network features of Computer Software" (1998) 43 The Antitrust Bulletin 651 at 683.

There are several options to protect elements of a ML algorithm in AI, including patents, trade secrets, and copyright. Patents cannot be the only protection for software since all components are not patent-eligible. Copyright is independent protection from patents. On the other hand, in the context of algorithms, trade secrets are an alternative or a complement to patent protection.

1.4.1 Copyright

In reviewing copyright law related to software inventions, it becomes evident that copyright is one of the primary protections applied to software, independent of, or as a complement to, the patent protection proposed throughout the thesis. Copyright does not offer the same protection as a patent. The reason is that software has many layers of abstraction incorporating both functional (can qualify for patent protection) and source code, literary or textual elements (can qualify for copyright protection). This division is far from clear.[167] Armstrong notes that "computer software is uniquely challenging subject matter for intellectual property law because software perfectly fits none of the law's governing paradigms."[168] In terms of literary elements and copyright, this protection is applied to the source code, or software's literary and textual elements. A software program can have literal elements which qualify as literary works and non-literal elements which do not qualify as literary works.

[167] Pam Samuelson, "Functionality and Expression in Computer Programs: Refining the Tests for Software Copyright infringement" (2017) 1 at 2, online: *Berkeley Law* <https://www.law.berkeley.edu/wp-content/uploads/2017/07/FUNCTIONALITY-AND-EXPRESSION-IN-COMPUTER-PROGRAMS.pdf>.
[168] Timothy K. Armstrong, "Symbols, Systems, and Software as Intellectual Property: Time for Contu, Part II" (2018) 24 Mich. Telecomm. & Tech. L. Rev. 131 at 132.

1.4.2 Confidential information/Trade secrets

One could also consider an innovative algorithm protected as a trade secret, using a confidentiality or non-disclosure agreement. The difference between the trade secret and the patent includes that once the components are compromised in trade secrets, they are lost, unlike the protection provided by the patent promise. In addition, a patent application in Canada discloses details of the invention to the public after 18 months whereas copyright (source code) or trade secrets do not.

The algorithm is unlikely to be characterized as patent-eligible given CIPO guidance and applicable sections of the *Patent Act,*[169] making it a good candidate for trade secret/confidential information protection. Patenting and trade secret protection can be complementary approaches to protecting the algorithm and its associated elements. Trade secret rights are common law in Canada and exist at the time of creation so long as one takes steps to keep the material confidential.

Further, there are numerous issues affecting IP in the software space, one being the speed of the technology development and the best choice to protect it; while some algorithmic solutions certainly seem to qualify for patents, some patent experts and researchers alike indicate that protection of "proprietary software advancements" are best done with trade secret law.[170]

> If satisfactory patent protection is not available, trade secrets in relation to processes of use or manufacture may be a reasonable approach. Additionally, products that will be developed and improved upon as time progresses may end up benefiting from patent rights in the original invention, and trade secret protection in the improvements made after the patent is filed (such as scale-

[169] *Patent Act,* RSC 1985 c P-4, ss 2, 27(8).
[170] Seth A. Northrop, "Software and Trade Secrets: Rethinking IP Strategies after CLS v. Alice", online: *Robins Kaplan LLP* <https://www.jdsupra.com/legalnews/software-and-trade-secrets-rethinking-i-15738/>.

> up manufacturing techniques). Patents are not typically filed again on every small, incremental improvement, so there remains a role for trade secrets, even when patents are used.[171]

There is potential to advance the development of valuable solutions in a secure environment by protecting the early elements of an invention. There are situations where incremental advances are protected via trade secrets, and the original is patented. Other elements include using "trade secrets to protect visible program features" in software.[172] Moving forward, the distinctions between the variety of protections give context to IP strategies in the area.

1.5 Scope: Research Questions and Arguments

1.5.1 Research Questions

In support of the thesis, four research questions are considered, (1) What are the historical and current day case law trends regarding purposive construction, patent eligibility (invention), patentability and software? (2) What are the contributions of innovation perspectives, including clusters, to the patenting of algorithms seen in AI? (3) How could incorporating innovation perspectives inform the identification of invention involving algorithms used in AI and (4) How do patent agent and litigator experiences in patent practice, as well as their impressions of innovation, inform the characterization of inventiveness in AI? The following three arguments are used to shape the answers to these questions.

[171] Noel Courage and Janice Calzavara, "Protecting Trade Secrets in Canada" (2015) 5:9 Cold Spring Harb Perspect Med, online: *NCBI* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4561395/>.
[172] Michael Risch, "Hidden in Plain Sight" (2016) 31 Berkeley Tech. L.J. 1635 at 1635.

1.5.2 Argument # 1

Some emerging technologies containing a novel algorithm are not patentable subject matter. While there must be parameters set as to what can be patented, this thesis considers innovation writ large (Schumpeter) and its relationship with invention in general. Part of this argument is about the nature of innovation and how it relates to algorithms – how to understand algorithms as more than abstract theorems and potentially as an innovative element to be considered within a patentable invention. This thesis considers claim construction in computer-implemented inventions in Canada as a key piece in identifying the invention. As per *Amazon* FCA, this can be done by identifying the combination of elements that form said invention. A computer-implemented invention may be claimed as a method (art, process, or method of manufacture), machine (generally, a device that relies on a computer for its operation), or product (an article of manufacture).

One can push the boundaries of what counts as an invention (and is therefore patent-eligible) by using an innovation lens. This can influence a revised approach to patent interpretation. Twentieth century economist Joseph Schumpeter's early writings include the intersection of innovation and invention and new combinations or combinatory activity in support of business cycles or new forms of innovation. The combination of essential and non-essential elements used in Sharlow J.'s inconclusive decision on business method patentability in *Amazon* FCA could reflect Schumpeter's thinking.

1.5.3 Argument # 2

Current jurisprudence and patent office practice related to determinations of patent eligibility for an invention (as per *Patent Act* definition)[173] and patentability (novelty, utility

[173] *Patent Act*, RSC 1985 c P-4, s 2.

and non-obviousness found both in the *Patent Act* and case law)[174] have not kept up with the technology shifts. Purposive claim construction in computer-implemented inventions reflect perspectives on innovation. Patent agents, scholars, and judges struggle with the appropriate parameters to draw around an essential and non-essential element in a patent claim. Part of this includes strategic construction of claims to identify patent-eligible subject matter or patentable subject matter.

In Canada, in the wake of *Choueifaty*, an attempt by the patent office at a more consistent approach on the current legal principles to be used in construing the claims (purposive construction) provides opportunity to argue for the granting of patents using innovation perspectives. This clarifies the role of an essential element in determining patentable subject matter (*Amazon* FCA). The patent claim as drafted in whole or in part may contain essential elements key to the purposive construction of a computer-implemented invention. One key distinction is the basic algorithm (not meeting traditional patentability and patent eligibility standards) and a patent for an algorithm with some degree of physical integration with hardware, in turn, achieving a patentable end.

1.5.4 Argument # 3

ML algorithms are considered starting with decades-old cluster theory (Porter) and his views on geographic proximity and a collaborative innovation hub. This is particularly relevant in claims construction with the combination of a diverse set of elements, acting in a cooperative manner. Innovative collaborations have changed over time to incorporate sophisticated algorithms that meet patent criteria. Cluster synergies reflect the combination or cooperation of elements with AI algorithms. Potential attributes (disruptive, incremental,

[174] *Patent Act*, RSC 1985 c P-4, ss 2, 28.3.

linear, non-linear) of a process (Wolfe) are reflective of the blurred boundaries that can exist when determining where the algorithm ends as an abstract theorem non-eligible for a patent or whether it forms a combination of elements (essential and non-essential) that in turn form an invention. Further, fulfillment of patent criteria (new, useful, or non-obvious) is important for these algorithms, including the determination of inventiveness in support of non-obviousness.

1.6 Organization of thesis

I illustrate the importance of considering theoretical perspectives in innovation (hereinafter 'innovation perspectives.') when identifying key contributing factors to any patent framework. I use innovation perspectives, including cluster theory to inform development of an approach to the patentable subject matter and the obviousness standard in AI software innovations. This approach highlights not only applications of emerging algorithmic technologies but also considers the evolving nature of math beyond the basic algorithm and as a part of a physical machine or manufacture that is important in this emerging technological context.

In Chapter 2, and as part of the first line of evidence, I situate linear and non-linear models of innovation (including disruptive and incremental characteristics) in the context of several perspectives of the 'cluster' in approaches to innovation. The chapter lays out the distinctions between inventions and innovations and how incorporation of an innovation element can inform the definition of invention and the ultimate patent eligibility of the technology in question.

In Chapter 3, and as part of the second line of evidence, I review how the existing Canadian Federal and Supreme Court cases inform patent assessments for algorithms found

in emerging technologies such as AI. I explore the historical understanding of patent eligibility in software, professional skills and business methods as well as applying cases that use relevant inventions from a different discipline. As such, I reflect upon the differing judicial perspectives that could influence achieving patent-eligible subject matter in the software space and by extension how these decisions would hold in current times. Further to patent eligibility, I review the doctrines of novelty, anticipation, and obviousness.

Recent case law and guidance has opened the door for patentability of an invention containing an abstract theorem (in this case an algorithm). The Federal Court cases of *Amazon* FCA, *Choueifaty* and *Benjamin Moore* affirmed the purposive construction principles in determining patentability of computer-implemented inventions. The guidance post-*Choueifaty* attempts to address the inconsistencies on claim construction in the past. However, as will be discussed in Chapter 3 the continuing tensions between the patent office and the judiciary continue to be reflected in the recent case of *Benjamin Moore*. The Federal court decision (now under appeal) directs CIPO on the method of claim construction to be used.

In Chapter 4, and as part of the third line of evidence, I reflect on why I collected the interview data and justify why it contributes to a better understanding of the thesis issues and overall narrative. I provide detail and explain why certain questions formed a part of the interview and how the responses helped to synthesize the respective chapters of the thesis. The questions focussed on patent drafting, impressions of the key cases, innovation, and the in-depth expertise of the experts on these topics.

In Chapter 5, I consider how a patent office, or the courts could consider existing challenges in patent interpretation. This includes how a patent application could be approached in the case of an AI innovation like an ML algorithm. These lines of evidence

inform the approach by incorporating scholarly concepts of a cluster and innovation all while setting a new consideration for patent assessments.

Ultimately, I suggest an approach that is grounded in innovation perspectives to explore future strategies for claim construction. As will be demonstrated over the course of this thesis there are challenges that influence the quality, scope, and available protection for emerging algorithmic technologies. The concluding chapters build on the findings from the jurisprudential review, the review of innovation perspectives and interviewee perspectives. During the conclusion, I will speak to next steps in term of recommendations to support the thesis and inform future work.

CHAPTER TWO: Theoretical Approach

2.1 Introduction to 'Innovation'

I view patentability in ML algorithms through the lens of Joseph Schumpeter's writing on innovation and Michael Porter's cluster theory. The interpretation of section 2 "invention" and the section 27(8) *Patent Act*[175] exclusion of abstract theorem, are considered in a broader application of innovation theory to patentability in the thesis narrative.

The literature defines innovation in many ways. As Godin notes, "innovation, broadly defined, has given rise to many theories and has been recognized as a key characteristic of the artist (S.T. Coleridge), the inventor (A. P. Usher), the scientist (J.-B. David; M.J. Mulkay), … the entrepreneur and the firm (J.A. Schumpeter)."[176]It is challenging to define the scope and parameters of 'innovation', as the term has widespread usage. As is stated in the *Oxford Handbook of Innovation*, "innovation is a multifaceted phenomenon, consequently, the rapidly increasing literature on innovation is characterized by a multitude of perspectives based on--or cutting across--existing disciplines and specializations."[177] Further, the term innovation is primarily found in the social sciences and is promoted by "economists, geographers, historians, psychologists and sociologists."[178] As noted by Fagerberg, "no single discipline deals with all aspects of innovation," and to "get a comprehensive overview, it is necessary to combine insights from several disciplines."[179]

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[175] *Patent Act*, RSC 1985 c P-4, s 27(8).
[176] Benoît Godin, "Innovation: The History of a category" (2008) Project on the Intellectual History of Innovation: Working Paper No.1 at 43, online: *CSIIC* <http://www.csiic.ca/PDF/IntellectualNo1.pdf>.
[177]Jan Fagerberg, David C. Mowery, & Richard R. Nelson, eds, *The Oxford Handbook of Innovation*, (New York, New York: Oxford University Press, 2005) Preface at V.
[178] *Ibid*, Preface at V.
[179] Jan Fagerberg, "Innovation: A guide to the Literature" in Jan Fagerberg, David C. Mowery & Richard R. Nelson, Richard R., eds, *The Oxford Handbook of Innovation*, (New York, New York: Oxford University Press, 2005) 1 at 3.

Hence this theoretical view on questions of patent interpretation generates some interesting insights.

One can see that innovation is evolving.[180] For instance, Rallet and Torre argue that "[t]he economic geography of innovation is now flourishing. However, it also has even in this digital age, important limitations in accounting for new forms of innovation. …[even] while innovation is now heading towards new shores."[181] This quote is reflective of the changes we are seeing in emerging technologies and how the style of innovation may shift in this digital age. During this chapter, I highlight that Schumpeter's discussions of innovation, and Porter's theory of clusters are present in ML algorithms (AI). These theories provide a new lens on how to reframe patent claim content to incorporate certain non-essential elements, whether the abstract theorem in the form of a complex mathematical concept or the capturing of unique data objects or their sub-elements. This thesis also considers shifts in innovation theories in this data-driven economy, including disruptive versus incremental characteristics and the linear versus non-linear models of innovation.

The OECD Definition

The definition of innovation is much more fluid than the legislative definition of invention in the *Patent Act*.[182] This is important as I make a case for inclusion of abstract or non-essential elements into claim construction approaches. I use an international standard found in the *Organisation for Economic Co-operation and Development's* manual, the OSLO

[180] Alain Rallet & Andre Torre, "Geography of innovation, proximity and beyond" (2017) in Harald Bathelt et. al, *The Elgar companion to innovation and knowledge creation* (United Kingdom: Edward Elgar Publishing Limited, 2017) 421 at 429.
[181] *Ibid*, Alain Rallet & Andre Torre, "Geography of innovation, proximity and beyond" (2017) in Harald Bathelt et. al, *The Elgar companion to innovation and knowledge creation* (United Kingdom: Edward Elgar Publishing Limited, 2017) 421 at 429.
[182] *Patent Act,* RSC 1985 c P-4, s 2.

Manual: *Guidelines for Collecting and Interpreting Innovation data*, 4th edition.[183] The manual states:

> An **innovation** is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process). [184]
>
> A **business innovation** is a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm. [185]

Following these characterizations, I argue that product and process innovations are the most relevant in the case of patent law and algorithms. In the context of emerging technologies that increasingly garner patent protection or border on what is considered patentable, the OSLO manual defines product or business process innovation.

> A **product innovation** is a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market. [186]
>
> A **business process innovation** is a new or improved business process for one or more business functions that differs significantly from the firm's previous business processes and that has been brought into use by the firm. [187]

Given that software invention can fit within these categories, I propose that the OECD definition of innovation works for this thesis. Arguments must be made for an algorithm as a process or the resulting application or solution being reflective of product innovation. The process or product solution can be new or significantly improved in this context.

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[183] OECD/Eurostat (2018), *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th* ed, The Measurement of Scientific, Technological and Innovation Activities (Paris/Eurostat, Luxembourg: OECD Publishing, 2018) at 19, online <https://doi.org/10.1787/9789264304604-en>.
[184] Oslo Manual, *ibid* at 20.
[185] Oslo Manual, *ibid* at 20.
[186] Oslo Manual, *ibid* at 21.
[187] Oslo Manual, *ibid* at 21.

A business process algorithm can be close to the market and industrially relevant. In Canada, from the standpoint of *Amazon* FCA it may require a novel combination of elements to reach a patentable end or product. The definitions of product and process were revised in the latest version of the OSLO manual and are reflective of shifting paradigms. That is, what may be captured in a successful patent claim can demonstrate a shift in how innovation is perceived to contribute to the inventive.

2.2 Innovation Models with proposed links to future patent eligibility: Linear versus Non-Linear

There are two models of innovation, linear and non-linear, that coincide with the shifting paradigms of innovation, particularly with the increasing sophistication of algorithms. Generally, in the context of fundamental science or basic research and development there are two main models of innovation, the linear model of innovation and the non-linear model of innovation. For example, according to Balthelt et al., the characteristics associated with the linear model of innovation were "based on the measurement of research and development (R&D) data in manufacturing industries."[188] These models are reflective of a straightforward innovation process found in traditional manufacturing versus the complex ecosystem or network seen in a non-linear innovation. According to Rametsteiner and Weiss, "there are different approaches to study innovation. One is to study innovation as a linear process. Another is to study innovation as a complex phenomenon from a systems perspective."[189] Lewis explains the approach:

> An important theoretical framework for understanding innovation, which is influential both in academia and also amongst policy-makers, is

[188] Harald Bathelt et al., "Innovation and knowledge creation: challenges to the field" in *The Elgar Companion to Innovation and Knowledge* Creation (UK: Edward Elgar Publishing Limited, 2017) 1 at 3.
[189] Ewald Rametsteiner & Gerhard Weiss, "Innovation and innovation policy in forestry: Linking innovation process with systems models" (2006) 8:7 Forestry Policy and Economics 691 at 691.

> the *innovation systems* (IS) approach. The key insights of this approach, which was developed in the late 1980s and early 1990s, are twofold. First, innovation is a non-linear process. Second, the working of that process, and therefore the extent and kind of innovation that takes place, is crucially shaped by the institutions governing how the firms and other organisations involved in innovation interact with one another (Freeman 1987; Dosi et al. 1988; Lundvall 1992; and Nelson and Rosenberg 1993)[190]

According to Kline, the terminology research & development "implies the linear model."[191] The linear model of innovation progresses from basic research to applied research and development to production and diffusion. Vassiliou et. al indicate,

> A simple linear model of innovation holds that fundamental scientific research leads to new ideas that can ultimately form the basis for new products. In this model, scientific research creates new knowledge; applied research and development focuses and applies the knowledge; development and engineering functions create products based on the knowledge; and manufacturing and production departments then take over and make the products. There is an implied unidirectional chain of causality between science and technology, and between technology and production.[192]

The "precise source of the linear model remains nebulous," with some, including Godin, arguing that V. Bush's 1945 *Science; The Endless Frontier*[193] is the origin.[194] Kline indicates that the "linear model views innovation as 'an orderly process, starting with the discovery of new knowledge, moving through various stages of development, and eventually

[190] P. Lewis, "The innovation systems approach: an Austrian and Ostromian perspective." (2021) 34 *Rev Austrian Econ* 97 at 98, online: < https://doi.org/10.1007/s11138-020-00507-8>.
[191] Stephen J. .Kline, "Innovation is not a linear process" (1985) 28:4 Research Management 36 at 45, online: <http://www.tandfonline.com/doi/abs/10.1080/00345334.1985.11756910?journalCode=urtm19>.
[192] Marius Vassiliou, Stan Davis, and Jonathan Agre (2011) "Innovation Patterns in Some Successful C2 Technologies" Paper delivered at the Proc. 16th International Command and Control Research and Technology Symposium (ICCRTS), Quebec City, Quebec, Canada June 21-23 2011).
[193] Vannevar Bush, Science-The Endless Frontier-A report to the President on a Program for Postwar Scientific Research (Washington: National Science Foundation, 1945).
[194] Benoît Godin, "The Linear Model of Innovation: The Historical Construction of an Analytical Framework" 2006) 31:2 Science, Technology, & Human Values 639.

emerging in a final viable form.'"[195] Kline and Rosenberg shifted the discussion from linear models to something much more interactive and radical: "Models that depict innovation as a smooth, well–behaved linear process badly misspecify the nature and direction of the causal factors at work. Innovation is complex, uncertain, somewhat disorderly, and subject to changes of many sorts."[196] In this case with shifts in emerging algorithmic technologies, one can see the non-linear characteristics presenting.

With these characterizations, I now shift to describe non-linear innovations. First, I shift from a linear, non-interactive portrayal of what innovation looks like to consider the presentation by Kline and Rosenberg:

> an improved model of innovation…[that]indicates not one, but rather five major pathways that are all important in innovation processes. These paths include not only the central-chain-of-innovation, but also the following:
>
> - Numerous feedbacks that link & coordinate R & D with production and marketing.
> - Side-links to research all along the central-chain-of-innovation.
> - Long-range generic research for backup of innovations.
> - Potentiation of wholly new devices or processes from research; and
> - Much essential support of science itself from the products of innovative activities, i.e., through the tools and instruments made available by technology.[197]

Some innovation literature challenges aspects of Kline and Rosenberg's arguments against the linear model in that firstly, it applies to a "minority of innovations," and secondly,

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[195] Stephen J.Kline, "Innovation is not a linear process" (1985) 28:4 Research Management 36 at 45, online: *Taylor Francis* <http://www.tandfonline.com/doi/abs/10.1080/00345334.1985.11756910?journalCode=urtm19>.
[196] Stephen J. Kline & Nathan Rosenberg, "An overview of Innovation" in Ralph Landau & Nathan Rosenberg, eds., *The Positive Sum Strategy* (National Academies Press: Washington, D.C., 1986) 275 at 275.
[197] *Ibid* at 303, Stephen J. Kline & Nathan Rosenberg, "An overview of Innovation."

it ignores the non-linear aspect including, the "many feedbacks and loops that occur between stages."[198] While I am mindful of the linear model when considering emerging algorithmic technology, characteristics of a non-linear or 'chain link' approach to innovation include multiple inputs and contributions not dependent on "invention processes."[199] One can see the shifting innovation paradigms in the following quote:

> The 'interactive model of innovation' conceptualizes technological change as a process that is internal to the economy (cit.omm). What drives the emergence and development of innovative ideas according to this model is a high intensity of interactions between multitudes of networked actors in the economy. This perspective has challenged many aspects of the linear model.[200]

These shifts did not start recently. In 1976, Carlsson, Keane and Martin also spoke to the limitations of a linear model of innovation, "linear models can describe what happened but not how it happened and tend to reinforce the belief in a kind of orderliness which does not exist" except as a theoretical device.[201] In 2006, Andersson and Karlsson argued that the linear model comes second to "the modern interactive model of innovation, upon which the systemic approach to innovation is based," and which "regards innovations as the outcome of an interactive process in which actors from a wide array of levels are involved."[202]

Different schools of thought on non-linear innovation are present in the literature; however, for this thesis, I present a high-level interpretation of the shift to non-linear. For

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[198] Jan Fagerberg, "Innovation A guide to the Literature" in Jan Fagerberg, David C. Mowery, & Richard R. Nelson, eds, *The Oxford Handbook of Innovation* (United Kingdom: Oxford University Press, 2006) 1 at 9.
[199] Keith Smith, "Measuring Innovation" in Jan Fagerberg, David C. Mowery, & Richard R. Nelson, eds, *The Oxford Handbook of Innovation* (UK: Oxford University Press, 2006) 148 at 150.
[200] Harald Bathelt et. al. "Innovation and knowledge creation: challenges to the field" in Harald Balthelt et. al, eds, *The Elgar Companion to Innovation and Knowledge Creation* (United Kingdom: Edward Elgar Publishing Limited, 2017) 1 at 2.
[201] Barbara Carlsson, Peter Keane, and J. Bruce Martin 1976, "Learning and Problem Solving: R&D Organizations as Learning Systems" (1976) 17 J Bruce Sloan Management Review 1 at 3.
[202] Martin Andersson and Charlie Karlsson, "Regional Innovation Systems in Small and Medium-Sized Regions" in B. Johansson, C. Karlsson & R. Stough, eds, *The Emerging Digital Economy: Entrepreneurship, Clusters and Policy* (Berlin: Springer Verlag, 2006) 55 at 57.

instance, the regional innovation system concept that we see in clusters "builds on the interactive-innovation model (Kline and Rosenberg, 1986), as well as other schools of interactive innovation such as the milieu concept (Camagni, 1991) and the studies on knowledge interdependencies in high tech regions (Saxenian, 1994, Keeble and Wilkinson, 2000)."[203] The basic mathematical equation in early case law on software invention was largely linear. The highly interactive systems approach seen in cluster theory reflects a higher order modelling. For instance, such as that seen in increasing synergies between non-essential and the essential in a cluster or new combination and likewise in complex sophisticated (ML) algorithms. These models shift the paradigm beyond early conceptualizations of the algorithm to the more complex systems in AI.

2.3 Categories of Innovation

Following the discussion of innovation models with proposed links to future patent eligibility in emerging technology, I encountered literature that categorize innovation as disruptive; radical; and incremental. There are blurred boundaries between these categories, with disruptive sometimes termed radical and radical sometimes termed incremental. For example, Rothwell in 1992 makes distinctions between the requirements used to facilitate the integration of one or the other of radical or incremental innovations.[204] He writes: "clearly, while an incremental innovation might be introduced using existing structures and procedures, a radical technological innovation might, and frequently will, require concomitant and significant organisational and procedural adaptations if it is to be

[203] Franz Todtling and Michael Trippl, "Regional Innovation Systems, C33" in Philip Cooke et al., *Handbook of Regional Innovation and Growth* (UK: Edward Elgar Publishing, 2011) 1 at 455.
[204] Roy Rothwell, "Successful industrial innovation: critical factors for the 1990s" (1992) 22:3 R & D Management 221 at 223.

successful."[205] This paper illustrates an awareness of the disruption to existing processes that can present with radically innovative emerging technology. Cromer et. al. argues that, in terms of firm performance, "corporate boards …may resist committing large investments to fund potentially lucrative projects (i.e., radical innovations) due to the perceived risk of the investment compared to the relatively less risky investment and expected payoffs of incremental innovations."[206]

Also warranting consideration is radical innovation. Radical innovations "stem from the creation of new knowledge and the commercialization of completely novel ideas or products."[207] Incremental innovation, in contrast, is often simply "sound practice that over time results in significant improvements in a product or a service."[208]

2.3.1 Disruptive

The term disruptive innovation originates in Christensen's and Bower's Harvard Business review article "Disrupting Technologies: Catching the Wave."[209] They conclude that:

> the key to prospering at points of disruptive change is not simply to take more risks, invest for the long term, or fight bureaucracy. The key is to manage strategically important disruptive technologies in an organizational context where small orders create energy, where fast low-cost forays into ill-defined markets are possible, and where overhead is low enough to permit profit even in emerging markets.[210]

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[205] *Ibid* at 223, Roy Rothwell, "Successful industrial innovation: critical factors for the 1990s."

[206] Cory Taylor Cromer, Clay Dibrell & Justin B. Craig, "A Study of Schumpterian (Radical) vs. Kirznerian (Incremental) Innovations in Knowledge Intensive Industries" (2011) 7:1 Journal of Strategic Innovation and Sustainability 28 at 40.

[207] Christian Hopp et al., "What 40 Years of Research Reveals About the Difference between Disruptive and Radical Innovation" (2018), online: *Harvard Business Review* < https://hbr.org/2018/04/what-40-years-of-research-reveals-about-the-difference-between-disruptive-and-radical-innovation>.

[208] Eric Nee, "Incremental Innovation" (19 November 2014), online: *Stanford Social Innovation Review* < https://ssir.org/articles/entry/incremental_innovation>.

[209] Joseph L Bower & Clayton M. Christensen, "Disruptive Technologies: Catching the wave" (January February 1995) online: *Harvard Business Review* <https://hbr.org/1995/01/disruptive-technologies-catching-the-wave>.

[210] *Ibid.*

Christensen also co-wrote a three-part series of books including, *The Innovator's Solution,* which talks about the role of business models in disruptive innovation, the *Innovator's Dilemma*, which talks about disruptive technologies; and *Seeing What's Next*, which builds on the previous books to develop a model for decision-making in the face of industry change.[211] This series expanded on the original conceptualization of disruptive innovation in the *Harvard Business Review*.

In 1995, Bower and Christensen indicated that "mainstream customers are unwilling to use a disruptive product in applications they know and understand. At first, then, disruptive technologies tend to be used and valued only in new markets or new applications; in fact, they generally make possible the emergence of new markets."[212]

In 2008, Schmidt and Druehl argued that "a disruptive innovation (i.e., one that dramatically disrupts the current market) is not necessarily a disruptive innovation (as we interpret Christensen to define this term.)"[213] Schmidt and Druehl explain their model as follows:

> when an innovation diffuses from the low end upward toward the high end, a pattern called low-end encroachment, the incumbent may be tempted to overlook its potential impact…conversely, when the pattern is one of high-end encroachment, the impact on the current market is immediate and striking.[214]

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[211] Glen M. Schmidt & Cheryl T. Druehl, "When Is a Disruptive Innovation Disruptive?" (2008) 25:4 J Prod Innov Manag 347 at 347. *Disruptive Innovation*, online: *The Christensen Institute* <https://www.christenseninstitute.org/disruptive-innovations/>; <https://store.hbr.org/product/seeing-what-s-next-using-the-theories-of-innovation-to-predict-industry-change/1857>.
[212] Joseph L. Bower & Clayton M. Christensen, "Disruptive Technologies: Catching the wave," *supra* note 209.
[213] Glen M. Schmidt & Cheryl T. Druehl, "When Is a Disruptive Innovation Disruptive?" (2008) 25:4 J Prod Innov Manag at 347.
[214] *Ibid* at 347, Glen M. Schmidt & Cheryl T. Druehl.

Later characterizations by Christensen et. al. describe disruption as "a process whereby a smaller company with fewer resources is able to successfully challenge established incumbent businesses."[215] They suggest "as an ever-growing community of researchers and practitioners continues to build on disruption theory and integrate it with other perspectives, we will come to an even better understanding of what helps firms innovate successfully."[216] I agree with their indication that innovation to be used in new applications and new markets is more disruptive than changes to existing markets which demonstrate more of an incremental approach to innovation.

More recently, in 2018, Hopp et al. described disruptive innovation as "a process in which new entrants challenge incumbent firms, often despite inferior resources… Disruption is not about technology alone, but rather the combination of technologies and business model innovation."[217] Disruptive innovation can utilize low-end market encroachment and, with advances in technology can displace long time market favorites, (Netflix and Blockbuster).[218] Christensen argues for the integration of disruption concepts with other perspectives. For example, in my thesis AI, "the most disruptive force in technology," is integrated into the theoretical perspectives on innovation.[219]

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[215] Clayton M. Christensen, Michael E. Raynor & Rory McDonald, "What is Disruptive Innovation?" (December 2015), online: *Harvard Business Review* <https://hbr.org/2015/12/what-is-disruptive-innovation>.
[216] *Ibid,* Clayton M. Christensen, Michael E. Raynor & Rory McDonald, "What is Disruptive Innovation?"
[217] Christian Hopp et al., "What 40 Years of Research Reveals About the Difference between Disruptive and Radical Innovation," *supra* note 207.
[218] *Ibid,* Christian Hopp et al., "What 40 Years of Research Reveals About the Difference between Disruptive and Radical Innovation."
[219] Anurag Rana et al., "A New Era: Artificial Intelligence is now the biggest tech disrupter" (6 October 2017), online: *Bloomberg.com* <https://www.bloomberg.com/professional/blog/new-era-artificial-intelligence-now-biggest-tech-disrupter/>.

2.3.2 Incremental

I describe the role of incremental innovation in the following section. If one were to categorize incremental innovation as a patented invention, the incremental innovation would qualify for an improvement patent on existing technology. Since incremental innovation is an improvement, it would not technically be considered radical or disruptive, but the incremental innovation itself could be disruptive. According to the Fraser Institute, "incremental innovation is typically a critical stage of technological change in which the commercial value of scientifically novel inventions is greatly enhanced, thereby expanding the number of potential adopters of the new technology."[220] While there may be aspects of incremental innovation to current-day AI technology, disruptive definitions also apply in the AI. Which type of innovation, radical, incremental, or disruptive fits with the emerging technology of AI ML; a technology that reflects higher order modelling and a non-linear approach to innovation? A rapidly changing digital environment results in emerging algorithmic technologies that mirror non-linear innovation. One could consider a purposive approach to claim construction informed by innovation perspectives.

The thesis must also be informed by the recent Federal Court case of *Choueifaty,* the response by the patent office, and the support to purposive construction in *Benjamin Moore*. In addition to patent eligibility, it is the form that the inventive concept takes that remains a debatable reality in Canada. In summary, representations of the radical/disruptive and incremental attributes can form part of the innovation construct in emerging technology because of the need to assess traditional approaches to patent doctrine in the face of a rapidly

[220] Steven Globerman & Kristina M. L. Acri, *The Benefits of Incremental Innovation* (Fraser Institute, 2014), online: *Fraser Institute* <https://www.fraserinstitute.org/research/benefits-incremental-innovation>.

changing emerging technology landscape where the nature of technology and invention are changing.

2.4 Schumpeter's role in innovation

There are several key perspectives from Schumpeter[221] that reflect early views, including innovation as ('new combinations') and the role of "entrepreneurship in economic growth."[222] Schumpeter was an economist, and his work received relatively little attention compared to his contemporary John Maynard Keynes. While Keynes wrote about "entrepreneurs and investment into the development of new technologies as the essence of healthy dynamic disequilibrium,"[223] Schumpeter focussed on innovation, entrepreneurship, and capitalism. Usher notes that the "business cycle, in Schumpeter's system, is a direct consequence of the appearance of clusters of innovation."[224] Schumpeter explains:

> those revolutions are not strictly incessant; they occur in discrete rushes which are separated from each other by spans of comparative quiet. The process as a whole works incessantly however, in the sense that there always is either revolution or absorption of the results of revolution, both together forming what are known as business cycles.[225]

I highlight this thinking to demonstrate how the early underpinnings of innovation, including clusters, can be reflected in emerging algorithmic technology. That, of course, includes clusters of innovation and an entrepreneurial mindset. At the time of Schumpeter's

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[221] Schumpeter studied law & economics at the University of Vienna. After several decades in Central Europe, he moved to Harvard University in the United States in the 1930s.

[222] Karol Śledzik, "Schumpeter's View on Innovation and Entrepreneurship" (2013) SSRN Electronic Journal, online: *Research Gate* <https://www.researchgate.net/publication/256060978> 89 at 89;
Vernon W. Ruttan, Usher and Schumpeter on Invention, Innovation, and Technological Change (1959) 73:4 The Quarterly Journal of Economics 596 at 599.

[223] New World Encyclopedia, "Joseph Schumpeter", online: *Joseph Schumpeter* <http://www.newworldencyclopedia.org/entry/Joseph_Schumpeter>.

[224] Vernon W. Ruttan, Usher and Schumpeter on Invention, Innovation, and Technological Change, *supra* note 222 at 599.

[225] Joseph A. Schumpeter *Capitalism, Socialism and Democracy* (USA: Routledge, 2003) 81 at 83 (Footnote 2).

writings, in the 1940's, Sweezy also highlighted that Schumpeter was a business–cycle theorist, although he had a much broader set of interests.[226] For instance:

> Schumpeter's view on innovation policy is something that may have vital relevance to today's increasingly policy-dominated world. We therefore conclude that besides his key ideas on innovation-led development also his policy view should be regarded as a significant legacy in innovation studies.[227]

According to Croitoru, "in Schumpeter's vision, innovation lies at the very heart of the economic evolution... It can be visible in different dimensions of the production process, and Schumpeter described it using the famous term of 'new combinations." [228] Next, one can see that new combinations of diverse elements are reflective of ML algorithms in AI.

2.4.1 New Combinations

In his 1934 piece, *The Theory of* Economic Development, Schumpeter named several styles of combinations or innovations that could today be useful in constructing a potential patent interpretation for an ML algorithm in AI. Next, I turn to Schumpeter on combinatory forces where he indicates "to produce means to combine materials and forces within our reach …To produce other things, or the same things by a different method, means to combine these materials and forces differently."[229] In essence, one can see the subtle distinction between combining or selecting elements locally or virtually while remaining innovative.

Schumpeter captures the role of the entrepreneur and the action of development by combining resources to produce innovation: "we saw that when new combinations are

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[226] Paul M. Sweezy, "Professor Schumpeter's Theory of Innovation" (1943) 25:1 The Review of Economics and Statistics 93 at 93.
[227] Gert-Jan Hospers, "Joseph Schumpeter and his legacy in innovation studies" (2005) 18:3 Knowledge, Technology & Policy 20.
[228] Alin Croitoru, "Schumpeter, Joseph Alois, 1939, Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process" (2017) 8:1 Journal of Comparative Research in Anthropology and Sociology 1 at 71.
[229] Joseph A. Schumpeter, *The Theory of Economic Development* (Cambridge, Mass: Harvard University,1934) translated from German by Redvers Opie Schumpeter (London: Routledge, 2017)1 at 65, *supra* note 159.

carried through this can be attributed to the actions of a particular type of economic agent whom we called an 'entrepreneur'" or what Schumpeter says can sometimes be characterized as an inventor.[230] This combinatory activity or entrepreneurial function is also characterized as a "novel combinations of knowledge, resources, etc. subject to attempts at commercialization — it is essentially the process through which new ideas are generated and put into commercial practice."[231]

While Schumpeter's thinking indicates a divide between invention and innovation, this is also somewhat reflective of the combinatory effect of selecting and organizing elements resulting in commercially viable and determined economic activity and patentable quality. Schumpeter highlights the distinction between what some consider to be equal, that is, invention as an innovation or invention, as an element of a market-ready innovation.

2.4.2 Invention and Innovation

Schumpeter highlights the distinction between invention and innovation, an invention that would optimally be of business value, which is a step beyond the terminology associated with invention. A footnote to a Schumpeter piece reinforces that "innovation thus is to be distinguished from 'invention' (even where inventor and innovator are the same person) … Innovation involves the (1) commercial application of (2) any new idea."[232] Schumpeter's 1934 writings address this innovation/invention divide:

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[230] Joseph A. Schumpeter, *The Theory of Economic Development* (Cambridge, Mass. 1934), translated by Ursula Backhaus, "Seventh Chapter of the Theory of Economic Development" (2002) 9:1-2 Industry and Innovation 93 at 96.

[231] Harini Mittal, Rajiv Shah, and Zhijie Gao, *Innovation, Entrepreneurship, and the Economy in the US, China, and India: Historical Perspectives and Future Trends* (Amsterdam: Elsevier, 2015) 1 at 3.

[232] Joseph A. Schumpeter, *The Theory of Economic Development* (Cambridge, Mass.: Harvard University, 1934) translated from German by Redvers Opie Schumpeter (London: Routledge, 2017) *supra* note 159 at Footnote 32.

> Economic leadership in particular must hence be distinguished from 'invention.' As long as they are not carried into practice, inventions are economically irrelevant. And to carry any improvement into effect is a task entirely different from the inventing of it...Besides, the innovations which it is the function of entrepreneurs to carry out need not necessarily be any inventions at all. It is, therefore, not advisable, and it may be downright misleading, to stress the element of invention as much as many writers do.[233]

Schumpeter disconnects the need for creating an invention from creating an innovation with a successful economic end. While it is helpful to visualize the separation between the two terms in a stepwise process to amalgamate them, the distinction must be made between the statutory definition of an 'invention' and whether there is room for a policy discussion to include 'innovation' in patent interpretation for emerging algorithmic technologies.

2.5 Cluster innovation

2.5.1 Theoretical perspectives on innovation

As a sub-question to a more general overview of Schumpeterian perspectives, this research study explores cluster theories in innovation as viewed from several different scholarly perspectives. In doing this, I examine Michael Porter's theory on clusters and innovation. Due to the digital nature of these innovations, I also consider virtual clustering increasing global presence and connectivity. Charlie Karlsson compiles a multitude of perspectives on virtual clustering.[234]

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[233] Joseph A. Schumpeter, *The Theory of Economic Development* (Cambridge, Mass.: Harvard University, 1934) translated from German by Redvers Opie Schumpeter (London: Routledge, 2017), *supra* note 159 at 88-89.

[234] Charlie Karlsson, professor emeritus at Jönköping University, Sweden, works in several relevant areas including "infrastructure economics, urban economics, the economics of technological change, regional economics, spatial industrial dynamics, entrepreneurship and small business economics, and the economics of R&D and higher education., online: *Jönköping University* <https://ju.se/personinfo.html?sign=kach&lang=en>.

The shift in the geographic component between the regional economic development of the cluster and the virtual development of the cluster illustrates how the cluster in innovation is evolving in the context of emerging technologies, particularly in selecting and incorporating highly interactive elements, as seen in higher order algorithms.

The use of the term cluster differs in multiple disciplines including geography, medicine, chemistry, and history. Modern-day interpretations of the cluster, particularly from a regional innovation systems perspective, identifying it as a group of linked companies and institutions (private, university and government) creating a critical mass or hub of innovation in one technology sector.

Theoretical perspectives on innovation, including cluster theory, provide a new window on some of the problems that arise in defining the invention in the context of emerging technology patents. As part of the argument in support of using theoretical perspectives on innovation in patent interpretation, I argue that invention as it is currently construed is a much smaller subset of the broader term 'innovation'. As such, when deciding what a patentable invention looks like in the context of emerging digital technologies, one can consider some of the innovation perspectives highlighted here.

Innovation characteristics could be practically applied to frame future patent interpretations of inventions involving algorithms associated with AI (ML). For example, decision-makers may use terms such as 'cluster' and 'new combinations,' and "market ready" as they relate to identification of inventions. This would include patent-eligible subject matter and patentability questions.

Each interpretation of the cluster can lend itself to a differing approach to innovation. For example, Rallet and Torre indicate that, "in the field of new digital services … different ways of constructing and organizing the ecosystem give rise to different innovation

dynamics."[235] The authors go further to identify that the "organization of the ecosystem's innovation matrix varies according to whether it is defined by the stars of the digital world (e.g. Google, Apple), the historical players (e.g. car manufacturers, transport operators) or by new entrants (e.g. telecom operators and start-ups such as Blablacar and Uber), even if the building blocks are the same."[236]

In this analysis, I started with early interpretations of innovation and clusters as reflective of invention, and novel combinations, including the selection or organization of elements to form a patent-eligible end. I then follow with the synergies seen in Porter's manifestation of Diamond theory in a cluster, where he stresses how these "elements combine to produce a "dynamic, stimulating, and intensely competitive business environment."[237] This theory would again be reflective of various elements to work in cooperation with an algorithm optimally to achieve a patent-eligible application, an otherwise marketable and competitive product. Finally, I go a step beyond the geographical proximity necessitated by Porter's cluster theory to the newer conceptualizations of the cluster or network as providing virtual contributions or prior art to the innovative products created by various remote elements.

2.5.2 Approaches by Porter to innovation clusters

While Michael E. Porter was first known for his work on industry competition and company strategy, his 1990 work *The Competitive Advantage of Nations* examined the concept of clusters, economic performance, and economic geography.[238] In 1998, Porter

[235] Alain Rallet and Andre Torre, "Geography of innovation, proximity and beyond"), *supra* note 180 at 435.
[236] *Ibid* at 435, Alain Rallet and Andre Torre.
[237] Michael E. Porter, "Cluster and the New Economics of Competition" (November-December 1998) *Harvard Business Review*, online: *HBR* <https://hbr.org/1998/11/clusters-and-the-new-economics-of-competition>.
[238] Michael E. Porter, *The Competitive Advantage of Nations*, (New York: The Free Press, 1990); Maria Forsman & Nikodemus Solitander, "Network Knowledge versus Cluster Knowledge – The Gordian Knot of

noted that "clusters are not unique, however; they are highly typical-and therein lies a paradox: the enduring competitive advantages in a global economy lie increasingly in local things-knowledge, relationships, motivation-that distant rivals cannot match." [239] We see this realized in the current global context, where countries attempt to develop their own domestic versus global supply chains. Porter describes the innovation dynamic in a cluster below, highlighting proximity as key. He first made the argument in *The Competitive Advantage of Nations;*[240] he revisits the argument in the *Harvard Business Review:*

> I modeled the effect of the local business environment on competition in terms of four interrelated influences, graphically depicted in a diamond: factor conditions (the cost and quality of inputs); demand conditions (the sophistication of local customers); the context for firm strategy and rivalry (the nature and intensity of local competition); and related and supporting industries (the local extent and sophistication of suppliers and related industries). Diamond theory stresses how these elements combine to produce a dynamic, stimulating, and intensely competitive business environment. A cluster is the manifestation of the diamond at work. Proximity—the colocation of companies, customers, and suppliers—amplifies all of the pressures to innovate and upgrade.[241]

One can see the shifts between the industrial model, more closely linked to traditional industry, and a more high-tech approach, more closely linked to a virtual network. There are distinctions between the industrial cluster model from its beginnings with "classic models of pure agglomeration"[242] and a subset, including technology clustering. Coletti notes that an industrial district deals "with sectors with low or intermediate technology content such as

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Knowledge Transfer Concepts" (2003) Swedish School of Economics and Business Administration Working Paper No 494, 1 at 4, online: *University of Helsinki* < http://urn.fi/URN:ISBN:951-555-797-6>.

[239] Michael E. Porter, "Cluster and the New Economics of Competition" (1998), *supra* note 237.

[240] Michael E. Porter, The Competitive Advantage of Nations, *supra* note 238.

[241] Michael E. Porter, "Cluster and the New Economics of Competition" (1998), *supra* note 237

[242] Charlie Karlsson, "Introduction" in Charlie Karlsson,ed, *Handbook of Research on Cluster Theory*, (Cheltenham, United Kingdom: Edward Elgar Publishing Ltd, 2008)1 at 2; See C, Karlsson," the classical model of pure agglomeration, referring to job matching opportunities and service economies of scale and scope, where externalities arise via the local market and local spillovers. The industrial complex model, referring to explicit links of sales and purchases between firms leading to reduced transaction costs. The club model, also referred to as the social–network model, which focuses on social ties and trust facilitating cooperation and innovation."

food, furniture and clothing, whereas hi-tech clusters deal with S & T– led industries."[243] As is expressed by Coletti, "innovation happens in industrial districts too, but it is less directly linked to S & T advances than in hi-tech clusters."[244]

2.5.3 Network versus cluster

To bring clarity to the discussion, I highlight the differences and similarities between a cluster and a network. According to, D'Alise, Giustiniano, and Peruffo, "the concept of a network is more general than that of a cluster and does not necessarily entail local embedding, a shared objective, or a specific market."[245] One can use the terms network and cluster independently as well as interchangeably. For example, Forsman and Solitander have detailed the difference between a network and a cluster, including that a network has restricted membership, is competitive through cooperation, has common business goals, formal partnerships, and limited scale with knowledge transfer through relationships.[246] By contrast, the cluster has an open membership, is competitive with cooperation, has a collective vision, informal interactions, and a large scale with the location being the basis of knowledge transfer.[247] This reference is one interpretation of the cluster versus network but provides an example of the differing governance approaches in the respective models.

Further, to illustrate the interchangeability of the terms, Ferrary and Granovetter remind us that we should: "consider the innovativeness of Silicon Valley as an economic

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[243] Michele Coletti, "Technology and Industrial clusters: how different are they to manage?" (2010) 37:9 Science and Public Policy 680 at 680.
[244] *Ibid,* Michele Coletti, 680 at 680
[245] Chiara D'Alise, Luca Giustiniano & Enzo Peruffo, "Innovating through Clusters" (2014) *International Journal of Engineering Business Management* 1 at 3, online: *SAGE* <https://journals.sagepub.com/doi/full/10.5772/59028>.
[246] Maria Forsman & Nikodemus Solitander, Network Knowledge versus Cluster Knowledge – The Gordian Knot of Knowledge Transfer Concepts, *supra* note 238.
[247] *Ibid* at 8, Maria Forsman & Nikodemus Solitander, Network Knowledge versus Cluster Knowledge – The Gordian Knot of Knowledge Transfer Concepts.

phenomenon supported by a complex network. An innovative cluster is viewed as a complex network whose nodes are companies and whose links represent the various economic and financial ties connecting them."[248] One can characterize innovation networks and clusters by their geographical scope (national, international, or global), the actors involved (firms, universities, etc.) and issues of cooperation (including training, technological development, product design, marketing, export, and distribution.)[249]

2.5.4 Global Linkages – Proximity

Clusters can also be virtual instead of location based. As such, one can see there were shifts from the traditional cluster agglomeration found in an industrial context which demonstrates effective performance by depending on geographical proximity. Forsman notes that the need for "local embeddedness can vary," electronic technologies are more conducive to global interactions, and the "codified dimension of knowledge is less geographically bound."[250] While "location theorists" presuppose geographical proximity, commentary from theorists on electronic proximity expanded the conversation from clustering in locational proximity versus clusters in different spatial contexts as equally plausible (Karlsson, 2010)."[251]

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[248] Michel Ferrary and Mark Granovetter, "Social networks and innovation" in Harald Balthelt et. al, eds, *The Elgar companion to innovation and knowledge creation* (United Kingdom: Edward Elgar Publishing Limited, 2017) 327 at 327.

[249] The Innovation Policy Platform, online: *Innovation Networks and Clusters*, online: < https://www.innovationpolicyplatform.org/www.innovationpolicyplatform.org/content/innovation-networks-and-clusters/index.html>. See the Innovation Policy Platform, "The Innovation Policy Platform (IPP), developed by the World Bank Group and the Organisation for Economic Co-operation and Development (OECD), is a web-based interactive space that provides easy access to knowledge, learning resources, indicators and communities of practice on the design, implementation, and evaluation of innovation policies", online: *The Innovation Policy Platform* < https://www.innovationpolicyplatform.org/www.innovationpolicyplatform.org/frontpage/index.html>.

[250] Maria Forsman & Nikodemus Solitander, Network Knowledge versus Cluster Knowledge – The Gordian Knot of Knowledge Transfer Concepts, *supra* note 238 at 17.

[251] Charlie Karlsson, "Introduction" in Charlie Karlsson, ed, *Handbook of Research on Cluster Theory* (Cheltenham, UK: Edward Elgar Publishing Ltd, 2008) 1 at 1; Charlie Karlsson, ed, *Handbook of Research on Cluster Theory* (Cheltenham, UK: Edward Elgar Publishing, 2010).

Passiante and Secundo indicate:

> Emerging [is] a new, more generalised concept of proximity, related to a new concept of virtual distance, calculated as inversely proportional to the member of hyperlink connections between two points (web sites, organisations on so on). The geographically accessibility is being replaced by an information/knowledge accessibility, that can be measured by new parameters.[252]

One can argue that innovation paradigms shifted again in the 4th Industrial Revolution when considering the virtual connections and computing infrastructure involved in today's innovations, particularly in emerging technologies. For instance, "today's innovation processes are less impacted by spatial boundaries through increasingly complex and varied temporary and virtual ecologies of knowledge and creativity."[253] Thinking has evolved to include a discussion of clustering using spatial and proximal factors, including virtual linkages. Karlsson et al., in *Knowledge, Innovation and Space* in 2014, wrote about complexity, non-linearity and uncertainty, and the integration of global knowledge with local knowledge:

> More than ever, innovation is about solving complex problems in multi-dimensional interactive and non-linear processes (Kline and Rosenberg, 1986; Malerba, 2005) under conditions of uncertainty, which makes it necessary to integrate highly specialized and globally distributed knowledge bases (Strambach and Klement, 2012) with a unique local knowledge base. Thus, innovating firms need to acquire knowledge from a variety of sources and economic actors at different spatial scales and to combine it with unique internal knowledge and competencies, which implies that they must build up, maintain and use different types of links for interaction and knowledge transfer.[254]

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[252] Giuseppina Passiante & Giustina Secundo, "From geographical innovation clusters towards virtual innovation clusters: The innovation virtual system", Paper delivered at 42nd Congress of the European Regional Science Association: "From Industry to Advanced Services - Perspectives of European Metropolitan Regions", August 27th - 31st, 2002, Dortmund, Germany, European Regional Science Association (ERSA), Louvain-la-Neuve) at 19, online: < https://www.econstor.eu/bitstream/10419/115731/1/ERSA2002_270.pdf>

[253] Harald Bathelt et.al "Innovation and knowledge creation: challenges to the field" in Harald Balthelt et. al, eds, *The Elgar Companion to Innovation and Knowledge Creation* (United Kingdom: Edward Elgar Publishing Limited, 2017) 1 at 12.

[254] Charlie Karlsson, et. al, eds, "Knowledge, Innovation and Space: Introduction" in Charlie Karlsson et. al eds, *Knowledge, Innovation and Space* (United States: Edward Elgar Publishing Limited, 2014) 1 at 3.

In summary, the notion of a cluster and innovation has evolved; traditional characteristics of the cluster, including the incorporation of multiple distinct elements to foster innovation remain true. However, in the digital environment, innovation models become increasingly complex, based more so on virtual connections and of a higher order than the traditional linear models, both from an innovation and computer science perspective.

2.6 Conclusion

The issues then become: (1) how does one consider questions of patent interpretation viewed through an innovation lens, and (2) how one can make the case that the invention is not a small part of the innovation but is, in fact all-encompassing of the complex innovations seen in some emerging technologies including ML algorithms. In this context, with algorithms on the patent eligibility boundary, one could include innovation in the identification of claim elements. As part of this process, one must think about the fundamentals such as the abstract theorem, and about how the respective elements of the innovation are coming together to cooperate with an algorithm.

To move this narrative forward, I note some of the key points that will inform the role of innovation in patent interpretation. In early cases, I would pose that the innovation in this emerging technology is incremental, and in the context of patent law an "improvement," likely part of a linear process. For the narrative in the balance of the thesis, I frame the ML algorithm as disruptive and non-linear. On the topic of clusters, one can see a shift from local concentrations of innovation to virtual linkages, more reflective of the digital environment and supporting the use of proximity. In Chapter 3, I examine the legislative, jurisprudential

and policy guidance underlying software inventions that should inform any discussion on software and patents. The terms used with a class of inventions can affect its treatment in jurisprudence and in guidelines by national patent offices.

CHAPTER THREE: Patent Law and Software Inventions (Canada)

3.1 Introduction

There are four main theoretical approaches to IP, the utilitarian approach, the Lockean approach (Labour Theory), personality theory, and social planning theory.[255] In this thesis, I conduct the analysis with a utilitarian lens, best suited for patent interpretation. Utilitarian theory is reflected in patents touting incentives for invention in exchange for exclusive rights to make, use and sell. Burk and Lemley summarize the classic utilitarian approach: "inventors are encouraged to invest in research and development by the prospect that their invention will be patented and that they will therefore own the right to exclude others from practicing the invention for a limited period of time."[256] In essence, a patent right is granted, providing an opportunity for a return on investment.

The patent system can have an economic benefit. While not directly related to the grant of a patent and a return on investment associated with the utilitarian view of the patent, it can reflect economic values that facilitate positive innovation outcomes and the advancement of technology. While Landes and Posner give an economic justification for patents, "the standard rationale of patent law is that it is an efficient method of enabling the benefits of research and development to be internalized, thus promoting innovation and technological progress,"[257] Cohen and Lemley indicate, **"**generally speaking both economic theory and practical experience suggest that the availability of patents for software promotes

[255] William Fisher, "Theories of Intellectual Property" online: *Berkman Klein Center for Internet & Society at Harvard University*, online: <http://cyber.law.harvard.edu/people/tfisher/iptheory.pdf >.
[256] Dan L. Burk & Mark A. Lemley, "Heterogeneity in Patent Theory: Why We Can't Agree Why We Patent" in Burk, Dan L, and Mark A Lemley, *The Patent Crisis and How the Courts Can Solve It* (Chicago: University of Chicago Press, 2009) 1 at 68.
[257] William M. Landes & Richard A. Posner, *The Economic Structure of Intellectual Property Law* (Cambridge: Harvard University Press, 2003) at 294.

innovation by supplying (additional) incentives to inventors."[258] To this end, I would point out that *Harvard College v Canada* (*Commissioner of Patents*)[259] discusses these sentiments and objectives as related to innovation and patent law. Particularly, *Harvard College* references *Free World Trust* in saying that "there is no doubt that two of the central objects of the Act are "to advance research and development and to encourage broader economic activity."[260]

As we move into a data-driven economy focussed on the monetization of intangibles, I explore how recommendations and future patent guidance could adapt by considering an abstract theorem through an innovation lens. This fourth industrial revolution exhibits shifting paradigms of innovation and technology. Could this mean a future reframing of the Canadian *Patent Act* section 2 definition of invention or section 27(8) exclusion of the abstract theorem?[261] I venture that the changes need not be wide-ranging and may only entail subtle shifts concomitant with the changes seen with the implementation of high-end algorithms.

The main issue is a proper approach to guide claim construction in the case of computer-implemented inventions in Canada. This shifting dynamic manifests itself between an invention and an abstract theorem. There may be problems with the exclusion of novel algorithmic elements. For instance, some novel technology may no longer be a basic mathematical equation but is still categorized as an abstract theorem. *Schlumberger* is an example of a past court's treatment of a novel algorithm. Integration of the physical and

[258] Julie E. Cohen & Mark A. Lemley, "Patent Scope and Innovation in the Software Industry" (2001) 89:1 Calif. L. Rev. 1 at 5
[259] 2002 SCC 76 Bastarache J [*Harvard College*].
[260] *Ibid* at 139, *Harvard College*, Bastarache J.
[261] *Patent Act*, RSC 1985 c P-4., ss 2, 27(8).

intangible is complex and evolving. Increasingly, algorithms are described as having 'brute force' because of the computing capacity associated with processing large volumes of data. One finds that integrating a machine or automated process as part of the patenting of a novel algorithm is but one step in arguing for the patentability of a computer-implemented invention.

In this chapter, I demonstrate the evolution of patent law jurisprudence in Canada, first around software and later around the technological implementation of business methods. The case law reveals that patent eligibility determinations are often the first and most important step in patentability cases. As the technology grows in sophistication, the discussion extends beyond early characterizations of unpatentable math or professional skills. I emphasize that while *Amazon* FCA is a high point in Canadian jurisprudence on such technology, it is not as such an endpoint. Following *Amazon* FCA, the court uses purposive construction at the Federal Court in *Choueifaty*. The Canadian patent office responded with a refresh of CIPO guidance for patentable subject matter. As such, I advance the discussion beyond what the courts have been struggling with in past decades. The court's past treatment of proposed inventions in the form of pure math, professional skills, and business methods is relevant today. In the context of *Amazon* and, most recently in *Choueifaty* and *Benjamin Moore*, judicial statements on purposive claim construction are consistent with the SCC direction in 2000.

Further, I consider the recent cases of *Apotex v Shire LLC*[262] on the inventive concept and *Apotex* v *Janssen et. al & The Minister of Health*[263] in clarifying the test for obvious to try (to be more consistent with the earlier SCC statement in *Apotex Inc. v. Sanofi-Synthelabo*

[262] 2021 FCA 52, Rennie J [*Shire*].
[263] 2021 FCA 45, Webb J [*Janssen*].

Canada Inc.)[264] The 2008 case *Sanofi* is the leading case stating the modern test for anticipation and obviousness. This is a case about selection patents which are defined by Rosthein J. as follows: "In the context of chemical compounds, in general terms, a selection patent is one whose subject matter (compounds) is a fraction of a larger known class of compounds which was the subject matter of a prior patent."[265] I also highlight the legal principles associated with the obviousness standard and inventive concept in Canada.

I follow the trajectory of early cases using a linear model of innovation. These cases support shifting approaches in innovation, that being to non-linear innovation. I consider this approach in the patentability of emerging algorithmic applications. The Federal Court of Appeal decision in *Amazon* highlights how these patentability parameters may shift even with more advanced technology when using purposive construction. Beyond the *Amazon* discussion, is the US Supreme Court case of applying the abstract idea in a fintech patent heard in the case of *Alice.* This shifts U.S approaches at the patent office and in the courts as they attempt to address different approaches to patentable subject matter and the inventive step.

I include an innovation lens on questions of patentability in algorithms forming part of the overall invention. I do not cover every nuance of patent eligibility and patentability utilized in the prosecution and litigation of a patent in this area. However, I approach this thesis with the presumption that theoretical perspectives on innovation support changes to both application level and judicial level determinations of a patent, particularly in claim construction.

[264] 2008 SCC 61, Rothstein J [*Sanofi*].
[265] *Ibid* at 271 para 1.

I discuss how to understand innovation and invention in relation to an abstract theorem such as the algorithm. There are several areas to consider, including the intersection of intellectual property with pure software, business methods and other computer-implemented inventions. The use of innovation perspectives encourages a shift in invention parameters found in patent law and results in a more fulsome consideration of the inventive. While innovation policy may not be within the patent office's purview, it could be considered moving forward as part of a less formalist judicial approach.

The 2011 Federal Court of Appeal *Amazon* case reached an unclear statement on the patentability of business methods. In recent memory, the US has also had a mixed history with the patentability of the business method. The 1998 U.S case of *State Street* considers data processing using a machine (computer) to perform mathematical calculations. In *State Street* the application of math on a computer to produce a useful, concrete, and tangible result is patentable. Following this decision there was a broad scope of patents that USPTO granted in keeping with *State Street's* approach. These patent grants were not necessarily innovations in technology. Post the US *State Street* decision; there was a distinct shift in the United States away from the patentability of business methods. The most recent USSC jurisprudence in the United States, the *Alice* case, is far from definitive in scoping the proper approach for a patent eligibility determination and in identifying a clear spectrum of what is to be considered an abstract theorem.

The basis of Canadian determinations of patentability (in both software cases and patent cases relevant to computer-implemented inventions) relied heavily on the 1970 case of *Schlumberger*. In this case, innovation looks like ordinary math calculations, and the court found the algorithm unpatentable as a stand-alone element. In some cases, incorporating a hardware element characterized as a computer can look like innovation, but not in this

decision. This appeared to be a hard stop for software and patentability in Canada. However, the trajectory of the law is such that principles espoused by the Supreme Court in later years aid in reframing how different the result could be using purposive construction. One can speculate whether the FCA in *Amazon* meant the *Schlumberger* decision to be so influential.

As the years progress, one can see how the actual integration of the expressed algorithm with the computer is closer to the required novelty for patentability. *Free World Trust* and *Whirlpool* recognize purposive construction as the Supreme Court-approved approach to claims construction in Canada. The more recent Federal Court cases of *Amazon* FCA, *Choueifaty* and *Benjamin Moore* confirm purposive construction as the Canadian approach to construing patent claims and identifying patent-eligible subject matter.

However, the patent office decision in *Amazon* PAB reflects elements of the problem-solution approach in determining the inventive step (as seen in the European patent office). While purposive construction is the judicial approach to claims construction in Canada, there also needs to be a consideration of the obviousness standard and the Canadian conversation on the inventive concept. On the one hand, I support the case for purposive construction in identifying patentable subject matter in Canada. On the other hand, there is a need for a more fulsome approach to identifying the inventive concept, and this also has roots in innovation theory. One must look at the specification to ascertain if additional properties or characteristics influence the scope of the invention. These additional elements may give context to an abstract theorem (as per the *Patent Act*.)[266] As such, one can see other examples of inventiveness pencilled within the parameters of a patent claim, depending on whether there is a more fulsome review of that additional step or something more beyond the

[266] *Patent Act*, RSC 1985 c P-4., s 2.

application of the abstract theorem in the description or specification. The proper approach to identifying an invention and, likewise an inventive step can be key in a case where the technology's overall patentability, validity or infringement is affected. In the earlier cases there were vastly different approaches to making these determinations, but this changed with the release of the Supreme Court of Canada decisions on purposive construction *Free World Trust* and *Whirlpool*.

3.2 Purposive construction of the claims should frame patentable subject matter

3.2.1 The definition of an "invention" is broad but not all-encompassing.

Through this thesis, I am exploring a more fulsome interpretation of the term invention. In Canada, "invention" is defined in section 2 of the Canadian *Patent Act.* It "means any new and useful art, process, machine, manufacture or composition of matter, or any new and useful improvement in any art, process, machine, manufacture or composition of matter."[267]

I look at how invention is addressed in *Harvard College,* as part of the effort to define its boundaries in patent law. One of the first questions arising, in this case, is "whether Parliament intended to protect 'inventions' that were not anticipated at the time of enactment of the *Patent Act*."[268] What are some of the categories that might be relevant for software/algorithms? I argue that art, process, and machine (computer) are most relevant for this discussion. The courts have considered the parameters of patentable subject matter in several key cases over the years.[269]

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[267] *Patent Act* RSC 1985 c P-4, s 2.
[268] 2002 SCC 76 at 51 Binnie J, dissenting [*Harvard College*].
[269] There a several key cases on higher and lower life forms in Canada. These are court findings; one will not find statutory confirmation of these positions. These cases included *Commissioner of Patents v Harvard College*, [2002] 4 S.C.R. 45 and *Monsanto Canada Inc v Schmeiser*, 2004 SCC 34. As per *Harvard College*, the mouse in the case was not patentable as it was not a "composition of matter"; however, the court left room for lower life forms to be found patentable. The *Monsanto* case introduced a workaround method to gain control

The digital advances seen in the past decades were not anticipated by the drafters of the *Patent Act*.[270] While current guidance (post-*Choueifaty*)[271] attempts to refresh approaches to patent law in computer-implemented inventions; it appears that some of the more cutting-edge algorithms seen today warrant closer scrutiny in terms of the invention/innovation divide. Sometimes when there are significant issues concerning the scope of the legislation, it is thrown back to policymakers to debate. For instance, Bastarache J., for the majority in *Harvard College* notes, "whether to carve out a subject-matter exception for 'higher life forms', and how 'higher life form' is to be defined, is a policy matter for Parliament."[272]

On the other hand, on the relationship of invention and innovation in support of the patent grant, Binnie J. for the minority in *Harvard College,* emphasizes the importance of rewarding innovation:

> the grant of a patent simply reflects the public interest in promoting the disclosure of advancements in learning by rewarding human ingenuity. Innovation is said to be the lifeblood of a modern economy. We neglect rewarding it at our peril…persons skilled in the art of the patent are helped to further advance the frontiers of knowledge by standing on the shoulders of those who have gone before.[273]

This description is largely about an *approach* to the interpretation of invention, not the *actual* interpretation. Despite the multitude of guidance documents provided by patent offices, modern-day interpretations of invention do not always include abstract theorems that may still qualify as innovative. A more general discussion of patent law by the majority in

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of the reproduction of the higher life form by obtaining a patent on a genetically modified cell found in the plant. There is also some dispute over patentability of methods of medical treatment. Currently, when the method of medical treatment in Canada requires the use of professional skill and judgement it likely that a patent would not protect it.

[270] *Patent Act*, RSC 1985 c P-4.

[271] PN 2020, *supra* note 34.

[272] *Harvard College, supra* note 259 at 52, Bastarache, J.

[273] *Harvard College supra* note 268 at para 4, Binnie J, dissenting.

Harvard College[274] explores the trade-offs between promoting innovation and invention. For instance, Bastarache J., for the majority, indicates that while the definition of invention is broad and designed to promote innovation, it is not "unlimited."[275] He states:

> By choosing to define invention in this way, Parliament signalled a clear intention to include certain subject matter as patentable and to exclude other subject matter as being outside the confines of the Act.[276]

However, I am mindful of the position of Phelan J. at the Federal Court in *Amazon*, on the nature of the definition of invention, "the *Patent Act* is not static; it must be applied in ways that recognize changes in technology such as the move from the industrial age to the electronic one of today."[277]

Fagerberg et. al. identifies the disconnect between invention and innovation seen with the variations in different disciplines such as software and biotechnology: "Sometimes, invention and innovation are closely linked, to the extent that it is hard to distinguish one from the other (biotechnology for instance)", at the same time there is a significant time lag between the two which can also be seen in certain stages of software development.[278] In sum, it warrants mention that the nature of the technology largely influences how it will shift and evolve as we move forward.

I pose that at the advanced level of AI(ML) algorithms seen in 2022, the lag time traditionally associated with software development is less of an issue and the timely assessment of ingenuity or innovation seen in higher-order modelling is of more interest. The

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[274] 2002 SCC 76 [*Harvard College*].
[275] *Harvard College, supra* note 259 at 124, Bastarache, J.
[276] *Harvard College, supra* note 259 at 158, Bastarache, J.
[277] 2010 FC 1011 at 54, Phelan J [*Amazon* FCC].
[278] Fagerberg Jan, "Innovation A guide to the Literature" in Jan Fagerberg, David C. Mowery, & Richard R. Nelson, eds *The Oxford Handbook of Innovation* (United Kingdom: Oxford University Press, 2006) 1 at 5.

speed of invention plays a role. Despite the lengthy patent process, preserving the exclusive right to make, use and sell is key to any overall IP/innovation strategy.

3.2.2 Exclusions to patentability in software inventions have affected the trajectory of case law in Canada.

To start, I consider the Canadian *Patent Act*.[279] The statute contains a definition of invention and an exclusion to patentability. According to section 27(8) of the Canadian *Patent Act*, under 'what may not be patented', it states, "no patent shall be granted for any mere scientific principle or abstract theorem."[280] **Table 1** illustrates international approaches to the definition of invention and the legislative and judicially created exclusions to the category of invention. I provide this table of international approaches to review invention and exclusions to patentability. This approach aids in putting the Canadian position in context.

[279] *Patent Act*, RSC 1985 c P-4.
[280] *Patent Act*, RSC 1985 c P-4, s 27(8).

Table 1: Definition of Invention/Exclusions from Inventions

	Canada	United States	European Union	Japan
Statutory Provision	*Patent Act*	*U.S. Code*	*European Patent Convention*	*Japan Patent Act*
Definition of invention	s 2 Patent Act- any new and useful art, process, machine, manufacture or composition of matter, or any new and useful improvement in any art, process, machine, manufacture, or composition of matter	35 U.S. Code § 101 new and useful process [or art as a process], machine, manufacture, or composition of matter, or any new and useful improvement thereof." [281]	Article 52(1) [282] reads as follows: "European patents shall be granted for any inventions, in all fields of technology, provided that they are new, involve an inventive step and are susceptible of industrial application."	Article 2(1) The Japanese Patent Act definition of invention is a "highly advanced creation of technical ideas utilizing the laws of nature." [283]
Exclusions	s 27(8) of the Canadian Patent Act, under what may not be patented, it states, "No patent shall be granted for any mere scientific principle or abstract theorem."	Court level interpretations of § 101 have held that there are exceptions to patentability, including abstract ideas, laws of nature and natural phenomena.	Exclusions[284] as per EPC 52(1) include, a) discoveries, scientific theories, and mathematical methods; (b) aesthetic creations; (c) schemes, rules and methods for performing mental acts, playing games or doing business, and programs for computers; (d) presentations of information.	Exclusions [285] -Ideas that do not use the laws of nature; Laws of nature; Techniques; Unfinished inventions. -Medical operation processes, and methods for the treatment or diagnosis Matters liable to adversely affect public order, morality or public health.

[281] *Patent Act*, 35 U.S. Code § 101.
[282] *European Patent Convention,* art 52(l) (as amended by the Act revising the European Patent Convention of 29.11.2000) [EPC].
[283] *Japan Patent Act*, art 2(1).
[284] *EPC, supra* note 282.
[285] Hitomi Iwase, Yoko Kasai &Satoshi Yumura, *Intellectual Property Rights in Japan: An overview* (UK: Thomson Reuters, 2022), online:<https://uk.practicallaw.thomsonreuters.com/5-501-5659?transitionType=Default&contextData=(sc.Default)&firstPage=true>.

It appears from an international scan of major jurisdictions patenting in AI that Canada and the U.S. are similar in their definitions of invention. As such, inventions that qualify in Canada are likely to be filed for and qualify in the U.S. system. The EU has a distinctively different approach. One that the Commissioner of Patents in the case of *Amazon*[286] (discussed later), tried to emulate. Japan, on the other hand, seems to focus mainly on the "application" of the laws of nature, essentially qualifying the technical idea if it is not disembodied. Some Canadian lawyers have indicated that there is no need for changes based on AI inventions, that the existing system is adequate for emerging technologies and that "all technologies should be subject to the same law/standards for patentability."[287]

In Canada, other exceptions found in the case law impact software (algorithms). These include abstract theorems in the form of mathematical formulae (*Schlumberger*),[288] professional skills (*Lawson v. Canada (Commissioner of Patents),* [289] *Progressive Games Inc v. Commissioner of Patents*,[290] *Tennessee Eastman Co. et al. v. Commissioner of Patents*[291] *Shell Oil*)[292] and business methods (*Amazon-Commissioner's decision*).[293] Key cases in purposive construction (*Whirlpool, Free World Trust, Amazon* FCA, *Choueifaty and Benjamin Moore*) are discussed later in the chapter.

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[286] Canadian Intellectual Property Office (CIPO), "Decisions of the Commissioner of Patents 2009" (4 March 2009 CD 1290), Carmen COP [*Amazon* COP] online: *CIPO* <https://brevets-decisions-patents.opic-cipo.gc.ca/pab-cab/p/en/item/467812/index.do?q=1290>.
[287] Reporter Ralph Nack, "AIPPI Study question 276 Inventiveness and sufficiency of disclosure in AI" (2021) AIPPI, on file with author.
[288] *Schlumberger, supra* note 129.
[289] (1970), 62 C.P.R. 101 (Ex. Ct) Cattanach, J [*Lawson*].
[290] (1999), 3 C.P.R. (4th) 517 (F.C.T.D.) Denault J [*Progressive Games* TD].
[291] [1974] S.C.R. 111 [*Tennessee Eastman*].
[292] *Shell Oil*, *supra* note 25.
[293] [*Amazon* COP] *supra* note 286.

Why were these proposed inventions excluded from the definition of invention? How have these cases limited the patenting of software/algorithms? To explore these exclusions, I look first to the case of a mathematical formula.

Abstract theorems: Mathematical formula

A key case in 1982 that forms much of the thinking around software, computers, and patent law for decades is *Schlumberger*. In Canada, the case of *Schlumberger* factors into most conversations on software patenting, most recently in the 2020 guidance from CIPO. As per the *Schlumberger* decision, the purpose of the alleged invention is to facilitate exploration for oil and gas. The exploration in question is usually made possible "by drilling boreholes through the geological formations thought likely to contain hydrocarbons and by-passing instruments up and down those boreholes to effect various measurements of the characteristics of the soil."[294]

The patent application, in this case, was unsuccessful because of the absence of patentable subject matter. This finding was based on the fact that the only novel aspect of the claimed invention was the mathematical formula which, as a "mere scientific principle or abstract theorem" cannot be the subject of a patent as per the prohibition in section 27(8) of the *Patent Act*.[295] As is pointed out by the appellant, "the invention, it is said, is not the computer program, it is the complex process, which is effected by a computer, of transforming measurements" that produced "useful information."[296] That finding then lends itself to "the logical extension that the performance of the principle or theorem using a known

[294] *Schlumberger, supra* note 129 at 845.
[295] *Patent Act,* RSC 1985 c P-4, s 27(8).
[296] *Schlumberger, supra* note 129 at 846.

programmable computer would also not be patentable."[297] In this case the software simply runs on a computer versus expressing of the algorithm as code integrated with the computer.

When *Amazon* FCA reframes the role of the algorithm using purposive construction, one can revaluate the role of *Schlumberger*. Sharlow J. of the Federal Court of Appeal points out "that it is also arguable that a purposive construction of the claims may lead to the conclusion that *Schlumberger* is distinguishable because a new one-click method of completing an online purchase is not the whole invention but only one of a number of essential elements in a novel combination" versus *Schlumberger* where the algorithm is the whole invention.[298] The argument for considering innovation in determining patentability feeds into a purposive approach to claim construction. The use of purposive construction appears make a difference in patentability of software solutions as part of an invention. This is relevant because a court's approach to claim construction can reverse previous findings on patent-eligible subject matter. One issue in this regard is whether we allow claims to be construed earlier on, prior to a litigation process. One must construe the claims to determine patentability, and in this thesis, I argue that a shifting innovation lens in software inventions feeds into a purposive approach to claim interpretation and as a second point one can consider the obviousness standard.

I recognize *Schlumberger's* role in Canadian patent office decisions and how it has played a role in findings of non-patentable subject matter associated with software inventions. *Schlumberger,* as decided by Pratte J. influenced patent office practice for years, mainly because of findings that one could not equate a human processing data with a computer application. Rejections from both the Patent Appeal Board and Commissioner

[297] Garland & Ingram, 1 at 40, *supra* note 147.
[298] *Amazon* FCA, *supra* note 23 at para 63, Sharlow J.

indicate that the appellant had "claimed a monopoly on a computer program" and even if that program were new and useful and innovative it would not qualify as an invention under the *Patent Act*.[299] In summary, the novel component was the algorithm (process of calculating), and the *Patent Act* does not allow for pure math (abstract theorem) to be patentable.[300] However, I found through my research some pure math has an added complexity beyond the *Patent Act* exclusion.[301] Garland and Ingram speak to the continuing influence of *Schlumberger*: "*Schlumberger* was referenced and relied upon by the Court of Appeal in *Amazon*, suggesting it may have a continuing, though uncertain, relevance to computer-implemented inventions."[302] One could also speculate whether the dependent claims in *Schlumberger* were sufficiently non-abstract or if they may have covered a practical application of the algorithm to be considered patentable.

Canada has little in the way of software litigation at the higher court levels, with the most recent FCA decision being the inconclusive *Amazon* FCA decision in 2011 that relies on two twenty-year-old decisions on purposive construction. However, the recent 2020 Federal Court decision of *Choueifaty* and the 2022 case of *Benjamin Moore* affirm the purposive construction approach in Canada.

The case of *Schlumberger* for thirty years was considered the leading case in determining patent eligibility in the software space. Discussion of the case appears in the 2020 CIPO Practice Notice following *Choueifaty*. Unfortunately, there is a disconnect of sorts between how the patent office views *Schlumberger* and how the courts consider the decision. The disconnect remains as the patent office continues to view assessment of

[299] Sc*hlumberger*, *supra* note 129 at 846.
[300] *Patent Act,* RSC 1985 c P-4., s 27(8).
[301] *Patent Act,* RSC 1985 c P-4., s 27(8).
[302] Garland & Ingram, *supra* note 147 at 40.

patentability through a problem-solution lens. This approach nullifies the patentability of software components and pre-empts the opportunity to construe the claims in a manner that would facilitate the use of novel components (algorithms) forming part of a patentable product. Interestingly, in *Schlumberger*, one can see the role of a computer in implementing mental operations or mathematical formulas.

Important to this narrative, as well, is the dynamic between a non-novel use of a computer to perform calculations. The role of the human behind the computer (machine) comes into play; for instance, could the calculation in question be implemented by a human using a pen and paper instead of a computer, yes, thus the math is not patentable, and the use of the computer (machine) did not affect its patentability. It is useful to get into more detail about the nature of the calculations and the extent of the of hardware and software integration. A computer running basic mathematical algorithms is not patentable.

To take a brief diversion to the U.S. to illustrate the courts struggle with the abstract and patent eligibility. As mentioned in Chapter 1, State *Street* is reconsidered in *Bilski*[303] including findings that the courts would no longer granting patents on straightforward applications of abstract concepts). *Mayo Collaborative Servs. v. Prometheus Labs., Inc*[304] pursues this line of thinking, and the U.S. Supreme Court implements a two-step test based on its *Mayo* reasoning in *Alice,*[305] where there was a request for the identification of an inventive step. These issues are revisited in Canadian discussions on the inventive step or non-obviousness standard. The following paragraphs highlight some key parts of the *Alice* decision that legal scholars analyzed in this regard.

[303] *Bilski, supra* note 162.
[304] *Mayo, supra* note 163.
[305] *Alice, supra* note 38.

Alice was a long-awaited clarification from the U.S. Supreme Court regarding how the abstractness associated with software inventions would be defined. Unfortunately, if patent experts were hoping there would be a test to provide some definition to the patentability issues in software, they were to be disappointed. Schreiber highlights the uncertainty following *Alice* and terms the two-step test as "nebulous" leading to the "invalidation of hundreds of software patents."[306]

The Alice ruling also highlights that "appending" conventional steps at a general level to "a method 'well known in the art'" will not satisfy the requisite inventive step. In addition, the following factors will also not work: adding a computer change to the status of non-eligible material, using the statement "'apply it,'" or limiting the application to a particular technological environment.[307]The ruling indicates that the steps taken are not innovative or sufficient to translate the abstract idea to a patentable end.

The case of *Alice* expanded upon the patent eligibility determinations made in *Mayo*. *Alice* uses a two-step test to assess whether the proposed invention is patent-eligible subject matter and whether the structure of the claims or combination of the claims can transform the non-eligible idea to one that is indeed eligible for a patent. Notably, the role of the patent drafter arises quite frequently. For example, *Mayo's* statement that "the claimed processes are not patentable unless they have additional features that provide practical assurance that the processes are genuine applications of those laws rather than drafting efforts designed to monopolize the correlations."[308]

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[306] Andrew Schreiber, "GO(EN)FISH:DRAWING CAD FILES FROM THE PATENT ELIGIBILITY POOL" (2017) 58:1 IDEA 1 at 1, online: *UNH* <https://ipmall.law.unh.edu/sites/default/files/hosted_resources/IDEA/go_enfish_drawing_cad_files_from_the_patent_eligibility_pool_-_andrew_schreiber.pdf>.
[307] *Alice*, *supra* note 38 at Syllabus 2
[308] *Mayo*, *supra* note 163 at 2.

As evidence of the efforts to expand upon the *Alice* decision, Grossman, Dodd and Perry[309] discuss four decisions of the U.S. Court of Appeals for the Federal Circuit that find subject matter eligibility under Step 2 of Alice: *Bascom Global Internet Services v. AT&T Mobility, Amdocs v. Openet Telecom, Berkheimer v. HP Inc*., and *Aatrix Software, Inc. v. Green Shades Software, Inc.* Further, some Federal Circuit decisions also rail against the uncertainty presented by the Alice patenting standards.[310]

Gocha explores the post-*Alice* effects on patent eligibility and proposes an ontological model for determining patent eligibility under *Alice*. He aptly notes that "although seemingly straightforward, the application of *Alice* has proven to be exceedingly difficult. This struggle, at least in part, stems from the Court's decision "not [to] labor to delimit the precise contours of the 'abstract ideas' category."[311] Instead, the Court deemed it adequate to utilize argument by analogy."[312]

Gocha further introduces a proposed model or collection of tests aiming to achieve three goals, incorporating "theoretical justifications cited in *Alice* cases," "demonstrate explanatory capacity" to achieve consistent results, as well as the provision of a "consistent, yet non-arbitrary, method for making subject-matter eligibility determinations."[313] This

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[309] Grossman, Dodd & Perry, discuss four decisions of the U.S. Court of Appeals for the Federal Circuit finding subject matter eligibility under Step 2 of Alice, Bascom Global Internet Services v. AT&T Mobility, Amdocs v. Openet Telecom, Berkheimer v. HP Inc., and Aatrix Software, Inc. v. Green Shades Software, Inc., See Jon Grossman, Anastasia Dodd, and Alexander S. Perry**, "**Out of Wonderland from *Diehr* to *Aatrix:* Three Steps to Overcoming 101 Rejections – Part II" (2018) 30:9 *Intellectual Property & Technology Law Journal 3.*

[310] See Andrew Schreiber, Go (En)fish: Drawing CAD Files from the Patent Eligibility Pool, (2017) 58 IDEA: J. Franklin Pierce for Intell. Prop. 1 at 4., "Enfish v. Microsoft, TLI Communications v. AV Automotive and McRO v. Bandai Namco Games America have all built on the Mayo-Alice framework by looking towards the software patent's specific claimed improvement in computer functionality and the software arts. Further, these cases offer guidance and commentary on what constitutes 'abstractness' and whether or not a physical component or computer are required in a valid software patent claim."

[311]Alan J. Gocha, Avoiding the Rabbit Hole: An Ontological Model for Determining Section 101 Patient-Eligibility under Alice (2017)17 J. Marshall Rev. Intell. Prop. L 192 at 194.

[312] *Ibid* at 193, Gocha.

[313] Gocha, *supra* note 311 at 195.

model is on a first glance, a reasonable approach to provide some measure of consistency to the post-*Alice* landscape.

Vare and Mattioli examine the evolving role of the computer in patent eligibility analysis. They note, "Federal Circuit judges believe that using a computer to accelerate a process is not itself patent eligible. Nor is simply using a generic computer to perform conventional computer tasks (such as calculations on data)."[314] This reasoning downplays the addition of speed, but I would argue that it appears more complex software solutions and programming may influence such characteristics.

Daily notes that *Alice* may not have had the far-reaching effects that Moore J. of the Federal Circuit highlighted, that is, "although Alice appears to have had a substantial impact on litigated patents and patents subject to administrative review, that is a small fraction of the patents potentially affected by Alice...it is possible that Alice's effect would be felt differently between litigated and non-litigated patents."[315] That is while the US patent office arguably provides a more liberal guidance, the same patents may be deemed invalid by the judiciary.

Professional Skills

The case of *Lawson* considers the *Patent Act* definition of invention, an "art, process, machine, manufacture or composition of matter."[316] It interprets the term "art" as an invention.[317] More importantly, *Lawson* impacts the patentability of software/algorithms in

[314] Todd Vare & Michael Mattioli, "Big Business, Big Government and Big Legal Questions" (2014) 243 Managing Intell. Prop. 46 at 47.
[315] James E. Daily, "Alice's Aftermath: Changes in Patentee Behavior since Alice v. CLS Bank" (2017) 23 B.U. J. Sci. & Tech. L. 284 at 286.
[316] *Patent Act*, RSC 1985 c P-4., s 2.
[317] See *Lawson v. Canada (Commissioner of Patents)* (1970), 62 C.P.R. 101 (Ex. Ct)] [*Lawson*], at para. 34 citing to Refrigerating Equipment Ltd. v. Drummond & Waltham System Inc., [1930] 4 D.L.R. 926 at 937; Further, see *Amazon* FCA at para 50 citing Phelan J. of the Federal Court in Amazon, "Shell Oil is unequivocally

determining that "professional skills" do not fit within the legislative definition of art as an invention.

This 1970 case is still cited as a starting point for considering what is (not) covered by art in the *Patent Act* definition of invention. This definition was essentially overruled (and broadened) by the SCC in *Shell Oil*, and subsequently in *Amazon* FCA. In *Lawson*, one can see that professional skill and judgement in a method of describing and laying out land does not form suitable subject matter for a patent or fit within the *Patent Act* definition of "art"[318] as an invention, instead being art as a professional skill and not qualifying for a patent. In the reasoning throughout *Lawson*, Cattanach J. discusses whether the description of the boundaries of a plot of land "constitute an 'art' or 'manufacture'" within section 2(d) of the *Patent Act*.[319] The court distinguishes that the method of describing and laying out land, a "Sub–divided Parcel of Building Land"[320] is an art which belongs in a professional field and is a "manual art or skill,"[321] therefore it is not an 'art' within section 2(d) of the *Patent Act.*[322] *Lawson* specifically elaborates on the concept of "art," and that "it is generally accepted that 'method' and 'process' are the same thing and that 'art' may include either."[323] Phelan J. later discusses Cattanach J.'s idea of art and change of character and condition at the Federal Court in *Amazon*:

> An art or operation is an act or series of acts performed by some physical agent upon some physical object and producing in such object some change either of character or of condition. It is abstract in that; it is capable of contemplation of the mind. It is concrete in that it consists in the application of physical

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the starting point for the definition of a patentable 'art'. It focuses the inquiry on whether there is a practical application of the discovery or idea."

[318] *Patent Act,* RSC 1985 c P-4., s.2

[319] *Lawson, supra* note 317 at 109, Cattanach J.

[320] *Lawson, supra* note 317 at 106-107.

[321] *Lawson, supra note* 317 at 111.

[322] *Patent Act,* RSC 1985 c P-4., s.2.

[323] *Lawson, supra* note 317 at para 34.

> agents to physical objects and is then apparent to the senses in connection with some tangible object or instrument. [324]

This perception continued over the decades. For instance, Sharlow J. at the Federal Court of Appeal in *Amazon FCA* indicates that *Lawson* is not the "authoritative guide" on the definition of art, and as per Wilson J. in *Shell Oil*, it served as a basis for a more expansive discussion of art.[325] The test prescribed by Denault J. in *Progressive Games* considers the art as an invention when developing a three-part test based on the SCC analysis in *Shell Oil*. This case impacted the patentability of software/algorithms by presenting a clear test that would transform the application of the abstract theorem to a patentable end.

Fragments of early patent appeal board decisions equate programming to professional skills (hence programs are not patentable).[326] Patents are denied where an invention is a "reflection of the exercise of professional skill and knowledge." [327] That is, the board would not make patentable the skills of a human being programmed into a computer.[328] There was no original expression of the skill in a form that a human could not perform. It is arguable then that the exercise of professional skill and judgement could result in an innovative approach, yet maybe not one meeting the current patent threshold. However, this early case facilitates the discussion on software and the *Patent Act*[329] definition of invention. Innovation in programming has been ongoing over the past decades. It could be considered

[324] *Amazon* FCC, *supra* note 277 at para 51, Phelan J.
[325] *Amazon* FCA, supra note 23 at 51.
[326] For instance, In Re Application for Patent No. 564, 175, it shows some of the challenges in coming to terms with new technologies where the claimed invention was "excluded from the category of patentable subject matter, in part on the basis of unpatentability of abstract theorems, and in part, because the system reflected an application of professional skills and knowledge", See Teresa Scassa, "Software and E – Business Patents" in Teresa Scassa & Michael Deturbide, *Electronic Commerce and Internet Law in Canada,* 2nd ed *(LexisNexis, 2012) supra* note 142 , 375 at 386.
[327] Teresa Scassa, "Software and E – Business Patents", *supra* note 142 at 376; *Lawson* v Commissioner of *Patents* (1970), 62 CPR 101 (Ex Ct).
[328] Teresa Scassa, "Software and E – Business Patents", *supra* note 142 at 386.
[329] *Patent Act,* RSC 1985 c P-4., s 2.

in terms of an original expression of ingenuity in executing innovative algorithms. These programmatic innovations would likely be closer to the patent threshold, unlike the applications of professional skills and judgment seen in past decisions.

What these cases contribute in terms of the definition of an invention and what the scope of a patentable invention is, is up for debate when viewed through an innovation lens. When is an innovation an invention of patentable quality? Why are some software or algorithms excluded in these situations? How has the court's treatment of these limited patenting in the area? The 1982 case of *Shell Oil*[330] is relevant and continues to be cited in higher court deliberations. *Shell Oil* pertains to the definition of invention found in the Canadian *Patent Act* and the placement of a patentable art within said definition.[331] The section at issue in this case is section 27(8) and not section 2 invention.[332] In this case the "patent was granted for claims that in form were claims for a substance consisting of a combination of known and unpatentable ingredients, but were found to be claims for a new, useful and unobvious use for the claimed compositions as a plant growth regulant."[333]

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[330] See *Shell Oil supra* note 25 at para 536-7 "Appellant applied for a patent on certain chemical compositions comprising chemical compounds mixed with an adjuvant. The "invention" was the discovery of the usefulness of the compounds, old and new, as plant growth regulators. The Examiner rejected appellant's application and the Commissioner of Patents and the Federal Court of Appeal upheld his decision. This appeal raised several questions, among them, (1) whether a new use for an old compound is patentable; (2) whether appellant can opt for a patent on the compositions instead of on the new compounds and (3) whether a claim on the compositions violates s. 36 of the *Patent Act. Held*: The appeal should be allowed. Appellant's idea of applying old compounds to a new use—one capable of practical application and of undisputed commercial value—was an invention within the meaning of s. 2 of the *Patent Act.* Nothing in the Act, including s. 36, precluded a claim for these compositions which are the practical embodiment of the new knowledge. The claim for the compositions containing new compounds was also patentable. The patenting of the compounds only would not give appellant protection for its idea of using compounds having a particular chemical structure as plant growth regulators. The mixture of the compounds with the appropriate adjuvants was necessary in order to embody the idea in practical form. Therefore, there was an inventive step involved in mixing the compounds with the appropriate carriers for their application to plants. Further, these composition claims were not subject to the restrictions of s. 41 (products intended for food or medicine) and no separate claim was being made for the compounds."

[331] *Patent Act,* RSC 1985 c P-4., s 2.

[332] *Patent Act,* RSC 1985 c P-4., ss 2, s 27(8).

[333] *Amazon* FCA, s*upra* note 23 at 46.

Wilson J. in *Shell Oil*[334] cites the court in *Tennessee Eastman*: it was "affirmed that 'art' was a word of very wide connotation and was not to be confined to new processes or products or manufacturing techniques but extended as well to new and innovative methods of applying skill or knowledge provided they produced effects or results commercially useful to the public."[335] In a case largely related to a novel use, the role of ingenuity or innovation does not eliminate the role of a practical application needed to accompany such innovation. Furthermore, the commercial use reference is relevant to this day as something that can generate a patentable application. However, Sharlow J. at the Federal Court of Appeal in *Amazon*, indicates that Wilson J. has implemented a purposive construction of the claims (pre-dating the precedential decisions of *Free World Trust* and *Whirlpool* in reaching her conclusion that the new use was patentable):

> What then is the "invention" under s. 2? I believe it is the application of this new knowledge to effect a desired result which has an undisputed commercial value and that it falls within the words "any new and useful art." I think the word "art" in the context of the definition must be given its general connotation of "learning" or "knowledge" …and it has established the method whereby these properties may be realized through practical application. In my view, this constitutes a "new and useful art," and the compositions are the practical embodiment of the new knowledge.[336]

Sharlow J. of the Federal Court of Appeal in *Amazon* again cites Wilson J. in that "this is not a case where the inventive ingenuity is alleged to lie in the combination; the combination is simply the means of realizing on the newly discovered potential of the compounds."[337] While the *Shell Oil* judgement indicates that the "inventive ingenuity here lies in the new use for

[334] *Shell Oil*, *supra* note 25.
[335] *Shell Oil*, *supra* note 25 at 554.
[336] *Shell Oil supra* note 25 at para 549; *Amazon* FCA, *supra* note 23 at para 46.
[337] *Amazon* FCA, *supra* note 23 at 46.

old compounds and not in the compounds themselves."[338] The compounds are then the "practical embodiment of the new knowledge."[339]

Again, in *Shell Oil*, one can argue that new and innovative methods of applying skill or knowledge are demonstrated. Further to that, it is a commercially useful result. In essence, the idea or the innovation includes the two compounds facilitated by a method or process, resulting in a novel and inventive result. This leads me to think of an algorithm reaching a patentable end:

> In the earlier development of patent law, it was considered that an invention must be a vendible substance and that unless a new mode of operation created a new substance the invention was not entitled to a patent, but if a new operation created a new substance the patentable invention was the substance and not the operation by which it was produced. This was the confusion of the idea of the end with that of means. However, it is now accepted that if the invention is the means and not the end, the inventor is entitled to a patent on the means.[340]

Hence, one can see the potential for opening the door to patenting a business method or algorithm of an abstract nature stemming from a case in the biosciences. Part of this reasoning includes a result of commercial value from a practical application.

In *Progressive Games*, a change in the method of playing poker was not found to be a patentable art or process. For context, the 1999 Federal Court Trial division case of *Progressive Games* has the applicant seeking a patent for a "modified version" of a "poker game which can be played in a casino or cardroom environment."[341] Details of the method, are found in the patent application are found in the footnote below.[342] In this case, the

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[338] *Shell Oil*, *supra* note 25 at 549.
[339] *Shell Oil*, *supra* note 25 at 549.
[340] *Shell Oil*, *supra* note 25 at 555.
[341] *Progressive Games*, *supra* note 290 at para 2.
[342] *Progressive Games*, *supra* note 290 at para 2; The method is briefly summarized in the Patent application as follows:

appellant has a known use for playing cards for wagering in casinos. Playing cards have been used in casinos for years and played versus the house, the casino itself.[343]The nature of invention shifted in the case law narrative when there was a decided emphasis on defining the parameters of the term art as part of the statutory definition of invention in the 1982 case of *Shell Oil*. An implicit reference to art in *Shell Oil* moves beyond *Lawson's* early characterization. Denault J. derives a test from *Shell Oil* to aid in identifying the appropriate characterization of art as a form of invention in *Progressive Games*. Interestingly, it was found as early as the Patent Appeal Board decision in *Progressive Games* that the claims of the application were rejected as being directed to unpatentable subject matter in that they were directed to a method of playing a game."[344] In *Progressive Games*, Federal Court Trial Division, the "sole issue" is if the appellant's changes in the method of playing poker fall within the definition of the terms "art" or "process."[345]

The three-part test[346] included that: art is a process that (i) is not a disembodied idea but has a method of practical application; (ii) is a new and innovative method of applying skill and knowledge; and (iii) has a result or effect that is commercially useful. Denault J. of the Federal Court determines that this is a modification to the poker game but does not fulfill

> "In a preferred method of play, after each player places an ante in a designed location, the dealer deals five cards to each player and to himself; all cards being dealt face down except for one of the dealer"s cards. Each player views his hand and then decides whether to continue to play by making an additional bet or to fold or drop (i.e. retire), in which case he loses his ante. The dealer then reveals his entire hand; if the dealer"s hand does not have a poker value of at least Ace-King, then the dealer is not permitted to continue to play. In this case, the dealer pays even money on the remaining player"s antes, and returns their bets to them. If the dealer"s hand has a poker value of Ace-King or better, the dealer compares his hand to each player, paying or collecting the bets as appropriate. The dealer also pays odds of more than even money on each winning player's hand of two pairs or better according to a bonus payment schedule."

[343] *Progressive Games, supra* note 290 at para 26.
[344] Commissioner's Decision No 1221 (25 September 1997), [COP Davies], online: Patent Appeal Board < https://brevets-decisions-patents.opic-cipo.gc.ca/pab-cab/p/en/item/467726/index.do?q=progressive+games>.
[345] *Progressive Games, supra* note 290 at para 12.
[346] *Progressive Games, supra* note 290.

step two of the test, a new and innovative method of applying skill and knowledge.[347] This appears to be a very subtle distinction, certainly open to debate as the continuum of patentable professional skills is potentially more relevant to industry, trade, and commerce.

As per the *Progressive Games* case, "the Appellant's changes in the method of playing poker did not amount to a contribution or addition to the cumulative wisdom on the subject of the game. Instead, these changes merely amounted to a change in the way an existing and well-known game is played."[348] Key to this case and the broader thesis narrative is the modification of professional skill or game. In *Lawson*, a professional skill is not patentable as this type of invention relies upon the individual's professional expertise to successfully practice the invention. Arguably this would not apply to a method of playing a game via an explicit set of rules. Step two of the *Shell Oil* test is very close to how one describes a business method. In step 2, "a new and innovative method" applied in the context of a card game and without the integration of the physical and tangible as seen in systems software and computer implementation would not qualify. However, shifts in approaches to claims construction in 2000 affirm purposive construction as the appropriate approach. These decisions led to cases having differing approaches to claim construction (*Amazon* FCA) for the business method.

Suppose one carries the argument that the new and innovative method is equivalent to an invention in the fourth industrial revolution. In that case I propose to step beyond the traditional patentability exclusions to innovations in the form of abstract theorems including business methods as a practical application or professional skills (not categorized as art as an invention) and map a way forward to include new approaches to categorizing innovation as

[347] *Progressive Games, supra note* 290.
[348] *Progressive Games, supra note* 290 at para 16.

invention. A reframing of traditional approaches can lead to new findings in similar cases. These new approaches include revised guidance and considering the inventive concept in obviousness determinations. This is discussed later in the chapter. Both could incorporate innovation perspectives, the combination and cooperation of elements, essential and non-essential in purposive construction and the consideration of additional properties in framing the inventive concept, such as ingenuity, speed, or complexity in more advanced technologies.

Business Method

The divide (however subtle) between software and business method patents is important to make as the leading precedent in Canada involves a business method. One typically uses the term business method when referring to a "plan or scheme to conduct a commercial interaction."[349] Scassa writes, "as business methods became automated, software and business method issues were often intertwined. In electronic commerce, the two are almost inextricably linked."[350] Business method patents are also known as process patents.[351] An example of this is fintech transactions, where you are essentially dealing with a financial method or process automated with a software application. Siebrasse highlights *Amazon* as an example of a business method:

> Broadly speaking, a business method patent is a patent for an invention where the central innovative idea ("inventive concept") is a new method of doing business. There is no precise legal definition, but the "one-click shopping" patent at issue in *Amazon.com*, which claimed an online shopping feature that allows customers to buy a product with a single click, rather than having to add an item to their cart and then check out, provides a familiar example.[352]

[349] Daniel J.Gervais & Elizabeth F. Judge, *Intellectual Property: The Law in Canada*, 2nd ed (Toronto, Canada : Carswell, 2011) 1 at 662.
[350] Teresa Scassa, "Software and E – Business Patents," *supra* note 142, 375 at 383.
[351] Matthew Synnott "Judicial treatment of Business Method patents in Canada" (2006) 11 Appeal 75 at 77.
[352] Norman Siebrasse, "Business Method Patents and Patent Trolls" (2013) 54:1 Can Community LJ 38 at 38.

More so in the case of business methods, one can see the importance of a clear application. As Scassa writes, "abstract theorems can be said to be unpatentable because of their abstract nature: patent law rewards the practical application of the theoretical knowledge, and not the theoretical knowledge itself."[353] As far back as 2006, Synnott notes the difficulties with carving out the place of a business method on a patentability spectrum:[354]

> Part of the difficulty in formulating a definition for business method patents is a product of the scope given to the phrase. 'Business method' is a blanket term and can describe numerous patented inventions in a diverse array of fields including logistics, advertising, marketing and finance. Most commonly, business method patents seem to be associated with e-commerce and other computerized systems for doing business. Given that most modern innovation occurs in an electronic context over an appropriately broad range of fields, this is a logical association. It also is difficult to formulate a definition of business method that will describe all of what should be patentable without also describing things that should definitely not be patentable. Stephen J. Ferance offers a broad definition: ' 'business method' refers to any method in the field of economic endeavour'. This definition includes all electronic commerce methods and many professional skills and purely mental steps. While this definition is undoubtedly encompassing, more precision is necessary to identify the niche of business methods amongst the collective whole of patentable subject matter. [355]

The business method discussion advances beyond practical application to the need for a physical component and not only that--an integrated physical component. The purposive approach to claims construction provides an alternative to literary and textual approaches used in the past. This can be seen in the consideration of claims in patent cases such as *Whirlpool,* when the respondent expert speaks to the theoretical presence of an element or innovative component that can exist and may not have been taught by the patent.[356] This

[353] Teresa Scassa, "Software and E – Business Patents," *supra* note 142 at 378.
[354] Matthew Synnott "Judicial treatment of Business Method patents in Canada", *supra* note 297 at 77.
[355] *Ibid* at 78, Matthew Synnott.
[356] *Whirlpool, supra* note 27 at 1103, Binnie J.

supports consideration of the innovative abstract element in a potential future approach. The U.S discussion on the category of abstract theorem is also relevant in the business method section as the sharp turn on patentability of business methods after *State Street* has culminated in the debates on the abstract seen in the *Alice* case and beyond.

3.2.3 The importance of technological innovation is increasing at a rapid pace: How are the patent office and the judiciary keeping pace?

The subject matter exclusions applied to inventions during the evolution of related Canadian case law include abstract theorems/mathematical formulae (*Schlumberger*), professional skills (*Lawson, Progressive*) and business methods (*Amazon* FCA).[357] Purposive construction (*Whirlpool, Free World Trust, Amazon* FCA, *Choueifaty and Benjamin Moore*) is used to avoid some of these exclusions. These trends can work to avoid a return to the use of literal or textual infringement or substantive infringement in claim construction exercises. In this section, the discussion focuses on *Amazon* and how the case evolves from the Patent Appeal Board decision to the Federal Court of Appeal decision. Throughout this case, one can follow some of the most disputed areas of patent law in Canada. These include abstract theorems, purposive construction, and software and business method inventions. The CIPO and the courts in *Amazon FCA, Choueifaty and Benjamin Moore* developed ways to avoid these subject matter exclusions (developed primarily in and around the patent cases leading to a SCC statement on purposive construction).

3.2.3.1 Claim Construction

The essence of what is being claimed is addressed in claims construction. First, I explore where purposive construction originates and how the higher courts' have

[357] *Amazon* FCA *supra* note 23.

implemented this approach. Prior to the onset of rulings on purposive construction, patent interpretation varied from a literal or textual infringement to a substantive infringement. Literal infringement would not apply if there were any variations in the text of the claim. Substantive infringement alludes to the infringement of the substance of the claim.

The leading case to pursue purposive construction comes from the House of Lords in the UK and is known as *Catnic Components Ltd. v. Hill & Smith Ltd.*[358] *Catnic* became relevant in Canada as it was adopted in *Procter & Gamble Co v Beecham Canada Ltd.*[359] *Whirlpool* also quotes the *Catnic* support for purposive construction iterated by Lord Diplock:

> The question in each case is: whether persons with practical knowledge and experience of the kind of work in which the invention was intended to be used, would understand that strict compliance with a particular descriptive word or phrase appearing in a claim was intended by the patentee to be an essential requirement of the invention so that *any* variant would fall outside the monopoly claimed, even though it could have no material effect upon the way the invention worked.[360]

This test was first generated by the court in *Catnic* and reformulated by Hoffman J. in *Improver Corporation v. Remington Consumer Product Limited*.[361] The *Improve*r test is represented by Mistrale Goudreau[362] as follows:

> (1) Does the variant have a material effect upon the way an invention works: If yes, the variant is outside the claim, if no,
>
> (2) Would this (i.e., that the variant had no material effect) have been obvious at the date of publication of the patent to a reader skilled in the art. If no, the variant is outside the claim. If yes,
>
> (3) Would the reader skilled in the art, nevertheless have understood from the language of the claim that the patentee intended that strict compliance with

[358] [1982] R.P.C. 183, Diplock L [*Catnic*].
[359] (1982), 61 CPR (2d) 1 (FCA) [*P & G*].
[360] *Whirlpool supra* note 27 at para 44.
[361] [1990] FSR 181, Hoffman L [*Improver*].
[362] Mistrale Goudreau, Intellectual Property in Canada, 3rd ed (Netherlands: Kluwer Law International, 2017) at 20 [Kobo ebook, 2021].

> the primary meaning was an essential requirement of the invention? If yes, the variant is outside the claim.

As mentioned above, prior to the 2000 SCC cases, there were two approaches, literary or textual infringement and substantive infringement. One exception was the FCA decision of Pratte J. in *O'Hara Ltd. v. Eli Lilly & Co.*[363] (the first Canadian court to apply *Catnic*). This case was not in keeping with the *Catnic* approach. However subsequent lower court cases in Canada did not follow the *O'Hara* decision, which was distinguished on its facts. Further, approaches to claim construction have been treated quite differently by the courts and the CIPO for the last twenty-plus years in Canada.

Two Supreme Court of Canada cases from the year 2000, *Free World Trust* and *Whirlpool,* affirm the 'purposive construction' approach derived from *Catnic.* It is important to note that these precedents are still the guiding cases on claim construction in Canada. Both cases are based on mechanical inventions, not necessarily software which has a more definite flavor for the abstract. These principles spelled out in these two cases are now applied more broadly in fields including pharmaceuticals and software.

Over the past two decades, the approach of purposive construction has dominated the Canadian context. While there are ongoing inconsistencies between the court approach and that of the patent office, the SCC precedents from 2000 espousing the principles of purposive construction have been upheld.[364] The case of *Whirlpool*[365] indicates that "claims construction is a matter of law but whether a defendant's activities fall within the scope of a

[363] (1989), 26 CPR (3d) 1 (FCA), Pratte J [*O'Hara*].
[364] *Amazon* FCA, *supra* note 23*; Choueifaty supra* note 32.
[365] *See Whirlpool*, (respondent) performed development work resulting in three Canadian patents. According to the appellants, the "first two patents to issue covered the invention." From their perspective the third patent should have never been granted and it had improperly extended the monopoly; *Whirlpool, supra* note 27 at 1073.

monopoly thus defined is a question of fact."[366] The reasoning in *Whirlpool* indicates that "the first step in a patent suit is, therefore to construe the claims."[367] The construction of the claims precedes the assessment of validity and infringement (mixed question of fact and law) issues.[368] Binnie J. indicates that the construction of the claims "requires identification by the court, with the assistance of the skilled reader, of the particular descriptive words or phrases in the claim that describe the 'essential' elements of the invention.[369]

There could be a subtle shift to a more subjective analysis when considering if abstract theorems found in software are innovative. My earlier proposal that the definition of invention in software invention should be encompassing of innovation remains. In describing the objective of the court in a case of claims construction in *Free World Trust*, Binnie J indicated that the aim is to "distinguish the essential from the inessential and to give to the 'field' framed by the essential the legal protection to which the holder of a valid patent is entitled."[370] This case is particularly meaningful in the case of software. Following this thread of thought, the non-essential could be cast as an innovative component, i.e. an algorithm as part of the invention, that with an innovation lens, reframes how one views the invention. In summary, this thinking would indicate that innovative elements could be considered in the application.

To this end, one should be aware that one of the most frequently cited paragraphs in *Free World Trust* focuses on the principle of essential and non-essential elements: "there is no infringement if the essential element is different or omitted in the allegedly infringing

[366] *Whirlpool, supra* note 27 at 1069.
[367] *Whirlpool, supra* note 27 at 1089.
[368] *Whirlpool., supra* note 27 at 1089.
[369] *Whirlpool, supra* note 27 at 1091.
[370] *Free World Trust, supra* note 26 at 1036.

device, but there may still be infringement if non-essential elements are substituted or omitted."[371]

Dimock et. al give the perspective of patent trial counsel, "in practice patent trial counsel and judges often concede that all the elements of a claim are essential to the working of the invention…even the slightest variation of an element that should otherwise be considered non-essential has led to a finding of non-infringement."[372] In this sense, purposive construction could narrow the invention, yet make room for a more liberal interpretation of what may have been previously considered non-essential by interpreting said elements more fully as part of the invention.

In the years since the simultaneous decisions of *Whirlpool* and *Free World Trust*, the issue of the appropriate form for claims construction continues to be a subject for debate.[373] The approach to claim construction can result in vastly different outcomes. For example, in some of the early Canadian cases, an abstract theorem in a patent claim is easily invalidated. However, in more recent cases including *Amazon*, the combination of the essential with the non-essential can result in a patentable invention. Hearkening back to 2000, the case of *Free World Trust* proposes a list of principles that factor into purposive claim construction assessments.[374]

(a) The *Patent Act* promotes adherence to the language of the claims.

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[371] *Free World Trust*, *supra* note 26 at 1025.
[372] Ronald E. Dimock et. al "Protection Against Infringement of Patents in Canada", *supra* note 155 at 63.
[373] See Norman Siebrasse, "The Essential Elements Doctrine in Patent Infringement: Free World and Whirlpool in light of Kirin-Amgen" (2011) 22 IPJ 223. From a Canadian perspective, Siebrasse argues the merits of the essential elements doctrine, and advocates for an approach to claim construction that in part involves a role for the essential elements doctrine in the more difficult cases; Mistrale Goudreau, "The So-Called Purposive Construction of Patent Claims: Comments on *Whirlpool* and *Free World Trust*" (2005) 2:1 University of Ottawa Law & Technology Journal 219 at 219, online: *SSRN*: <https://ssrn.com/abstract=777865>. Goudreau criticizes the findings in Free World Trust and Whirlpool, suggesting that the choice of construction should depend on the "circumstances of the case."
[374] *Free World Trust*, *supra* note 26 at 1043.

(b) Adherence to the language of the claims in turn promotes both fairness and predictability.

(c) The claim language must, however, be read in an informed and purposive way.

(d) The language of the claims thus construed defines the monopoly. There is no recourse to such vague notions as the "spirit of the invention" to expand it further.

(e) The claims language will, on a purposive construction, show that some elements of the claimed invention are essential while others are non-essential. The identification of elements as essential or non-essential is made:

(i) on the basis of the common knowledge of the worker skilled in the art to which the patent relates.

(ii) as of the date the patent is published.

(iii) having regard to whether or not it was obvious to the skilled reader at the time the patent was published that a variant of a particular element would *not* make a difference to the way in which the invention works; or

(iv) according to the intent of the inventor, expressed or inferred from the claims, that a particular element is essential irrespective of its practical effect.

(v) without, however, resort to extrinsic evidence of the inventor's intention.

(vi) There is no infringement if an essential element is different or omitted. There may still be infringement, however, if non-essential elements are substituted or omitted.

Arguably, section (v) above has been modified in view of the introduction of section 53.1 of the *Patent Act*.[375] Murphy, in a 2017 article for the *Canadian Intellectual Property*

[375]*Patent Act*, RSC 1985 c P-4., s 53.1; See **Admissible in evidence 53.1** "**(1)** In any action or proceeding respecting a patent, a written communication, or any part of such a communication, may be admitted into evidence to rebut any representation made by the patentee in the action or proceeding as to the construction of a claim in the patent if **(a)** it is prepared in respect of **(i)** the prosecution of the application for the patent, **(ii)** a disclaimer made in respect of the patent, or **(iii)** a request for re-examination, or a re-examination proceeding, in respect of the patent; and **(b)** it is between **(i)** the applicant for the patent or the patentee; and **(ii)** the Commissioner, an officer or employee of the Patent Office or a member of a re-examination board. **Marginal note: Divisional application (2)** For the purposes of this section, the prosecution of a divisional application is

Review, highlights file wrapper estoppel as an item of significance in the key area of claim construction. At the time, two Federal Court cases had ruled that prosecution history be used in claim construction.[376] In amendments to the *Patent Act* in 2018, section 53.1 allows the use of patent prosecution history in patent proceedings.[377] It is the role of the judiciary to interpret and apply. Chan and Turner-Ryan cite the 2020 case of *Bauer Hockey Ltd. v. Sport Maska Inc.* (*CCM Hockey*),[378] when stating that the court considered the patent's prosecution history, but it was not solely determinative in its claim construction analysis.[379] Dimock et. al note:

> Justice Grammond stated that the modern method of claim construction mandates consideration of 'clues,' which include the text, context, and purpose. Disregarding the disclosure and drawings merely because the language of the claims is 'clear' would amount to adopting the 'plain meaning rule,' which the modern method rejects."[380]

This thinking would support including additional evidence in the modern method of claim construction. *Canmar Foods Ltd. v. TA Foods Ltd. (FCA)* ruled that only written communications between the patentee and the Canadian patent office are admissible considering section 53.1.[381] As I view the construction of claims for algorithms through an innovation lens, the prosecution history and the use of expert evidence become more important in judicial decision-making because it clarifies the scope of innovation.

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deemed to include the prosecution of the original application before that divisional application is filed. **Marginal note: Reissued patent (3)** For the purposes of this section, a written communication is deemed to be prepared in respect of the prosecution of the application for a reissued patent if it is prepared in respect of **(a)** the prosecution of the application for the patent that was surrendered and from which the reissued patent results; or **(b)** the application for reissuance."

[376] William J. Murphy, "The Use of Prosecution History for Claim Construction in Canada and the United Kingdom: Is a Patent a Journey or a Destination?" (2018) 34 CIPR at 2.

[377] *Patent Act*, RSC 1985 c P-4., s 53.1.

[378] 2020 FC 624, Grammond J [*Bauer*].

[379] Leslie L. Chan and Dana Turner-Ryan, "The Metes and Bounds of Section 53.1 Begin to take shape", online: *Oyen Wiggs* <https://patentable.com/the-metes-and-bounds-of-section-53-1-begin-to-take-shape/>.

[380] Ronald E. Dimock et. al, "Protection Against Infringement of Patents in Canada" *supra* note 155 at 75.

[381] 2021 FCA 7 at para 63, de Montigny J A [*Canmar* FCA].

Further, while Canadian higher courts favour a purposive construction of the claims, there is always discretion for the courts to incorporate other considerations into the judicial reasoning. Since 2000, several authors discussed the Canadian approach in the legal literature. Lim argues that the United States, United Kingdom, and Canada have moved towards peripheral or purposive claims, which is "protection by reference to the express terms of the patent claim."[382] On the other hand, in 2009, Burk and Lemley argued that peripheral claiming or "setting the outermost boundaries of patent rights" with "fence posts" is problematic and that there should be a focus on central claiming or the setting of "sign-posts," perhaps ultimately landing on a hybrid model.[383]

Siebrasse proposes his structured framework for claim construction, "which draws on the Court's observation in *Whirlpool* that the modern approach to statutory interpretation is also the guiding principle behind claims construction, with due allowance for functionally distinct aspects of the patent system."[384] The analysis pre-dates the *Amazon* FCA case but gives perspective on key cases, including *Whirlpool* and *Free World Trust*, ten years after the ruling confirming purposive construction as the go-to approach to claim construction in Canada. Siebrasse takes a closer look at business methods and litigation in *Evidentiary Problems of Multidisciplinarity in the Litigation of Business Method Patents*.[385] This paper explores whether empirical evidence should play a role in the court's decisions. This situates

[382] Eugene C. Lim, "Opening the 'Pandora's Box of Patent Claim Construction: Purposive Interpretation Central Claiming and the Doctrine of Equivalents in Comparative Perpsective" (2016) XVI Asper Review 155 at 159.
[383] Dan L. Burk & Mark A. Lemley, "Fence Posts or Sign Posts? Rethinking Patent Claim Construction" (2009) 157 University of Pennsylvania Law Review 1 at 1799.
[384] Norman Siebrasse, "The Essential Elements Doctrine in Patent Infringement: Free World and Whirlpool in light of Kirin-Amgen," *supra* note 153 at 225.
[385] Norman Siebrasse, "*Evidentiary Problems of Multidisciplinarity in the Litigation of Business Method Patents"* in B. Courtney Doagoo, et. al, eds, *Intellectual Property Law for the 21st Century: Interdisciplinary Approaches to IP* (Toronto: Irwin Law, 2014).

my arguments for consistency in construing the claims, potentially including the use of file facts and empirical evidence.

Approaches to claim construction are shifting internationally. Important to point out is the case of *Actavis UK Limited v Eli Lilly and Company*.[386] In the United Kingdom, the court has reconsidered the thinking on claim construction from purposive construction, as seen in *Catnic*, to the pre-purposive construction thinking seen in Canada. In the US, the doctrine of equivalents and file wrapper estoppel are in play. As mentioned, there have been shifts like file wrapper estoppel in Canada that can influence claim construction like, section 53.1 on the admissibility of evidence recently added to the *Patent Act*.[387]

The Federal Court in *Choueifaty* confirms the purposive construction approach to claim construction. The recent case of *Benjamin Moore* provides a test that supports purposive construction. What does this say about the invention/innovative divide regarding essential and non-essential elements? Is the non-essential equivalent to the innovative element, and, as such, will it still form a key part of the invention and be of significance in an infringement action? In applying *Free World Trust*, the algorithms described as basic math (abstract theorem) and likely not patentable earlier in the case law may be patentable with the shift to purposive construction and a recast of the non-essential to be the something more asked for in an inventive step. For example, inventiveness could be framed with an innovation lens. In this case, more advanced algorithms could fit with patentability criteria if cast purposively. Without this construction the algorithm is labelled as an abstract theorem.

[386] [2017] UKSC 48, Neuberger L [*Actavis*].
[387] *Patent Act,* RSC 1985 c P-4., s 53.1.

In purposive construction, software and what to consider as an invention forms the frame around this discussion. Further, when one looks to the principles spelled out in *Free World Trust* with respect to determining if elements are essential or non-essential, this can factor into a more fulsome analysis of innovative potential depending on the perspective of the person skilled in the art and whether they can recognize as inventive the innovative among the complexity of calculations found in brute force algorithms.

It is appropriate to highlight how I came to this place in patent interpretation. In arguing that innovation perspectives should play a role in patentability determinations, one should consider elements that at one time were considered non-essential in the realm of the essential. For example, there are innovative elements in foundational algorithms used for pre-processing, pre-selection, organization, or structuring data. I highlight this in the interviews in Chapter 4. In looking to the innovative elements in terms of patent-eligible subject matter, one can relate invention to innovation, and one can look to new combinations of elements to reach a patentable end. In the context of an AI ML algorithm, one can also consider the criteria related to patentability (novelty, utility, and obviousness).

3.2.3.2 The Federal Court of Canada – Revisiting Purposive Construction in Amazon

Several patent issues in *Amazon* are important to software invention in Canada. These include the argued absence of patent-eligible subject matter in software and business method invention, in this case, for the one-click method of internet shopping. Further, the confirmed use of purposive construction of patent claims in *Amazon* remains a game changer, recasting the scope of patentable subject matter in the software space. I build on the early cases that focus on abstract theorems (mathematical formula) professional skills, and business methods. I also take the reader through highpoints of *Amazon* (patentable subject matter and purposive

construction) which is still a key case for relevant Canadian decisions on purposive construction and business methods.

3.2.3.3 Patentability of Business Methods: Amazon FCC

The *Amazon* FCA decision stems from the Commissioner of Patent's rejection of the 1998 application for **'**Method and System for placing a purchase order via a Communications Network' under Subsection 30(3) of the *Patent Rules*.[388] There were 75 claims in the patent. Some of these 75 claims "relate to the 'method' whereas the others relate to the 'system'" (i.e., the machine enabling this process).[389] In the Federal Court there are two independent claims at issue Claim 1 and Claim 44.[390] The other claims were variations of the two main claims.

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[388] See *Amazon* FCC *supra* note 277 at para 5; The following paragraph gives a description of the claimed invention for *Amazon's* 'one-click method' for internet shopping: "The claimed invention further enables internet shopping. The customer visits a website, enters address and payment information and is given an identifier stored in a 'cookie' in their computer. A 'server' (a computer system operating a commercial website) is able to recognize the "client" (customer computer with the identifying cookie) and recall the purchasing information which is now stored in the vendor's computer system. The customer can thus purchase an item with a 'single click' – the order is made without the need to 'check out' or enter any more information"

[389] See *Amazon* FCC *supra* note 277 at para 6.

[390] See *Amazon* FCC *supra* note 277 at para 6; There are two claims in question in this case Claim 1 and Claim 44:

Claim 1

"A method in a client system for ordering an item, the method comprising:
receiving from a server system a client identifier of the client system;
persistently storing the client identifier at the client system;
where an item is to be ordered,
displaying information identifying the item and displaying an indication of a single action that is to be performed to order the identified item; and
in response to the single action being performed, sending to the server system a request to order the identified item along with the client identifier, the client identifier identifying account information previously supplied by a user of the client system wherein the user does not need to log in to the server system when ordering the item; and
when account information is to be changed,
coordinating the log in of the user to the server system;
receiving updated account information; and
sending the updated account information to the server system
whereby the user does not need to log in to the server system when ordering the item, but needs to log in to the server system when changing previously supplied account information.

Claim 44

A client system for ordering an item, comprising:

After reading the claims, the examiner determined that the business method patent does not meet the patentability requirements. That is, the claimed invention does not fit within the statutory definition of invention. The examiner's decision does not support the position that a novel business method may fit the definition of invention.[391]

Commissioner Carmen accepted the finding of the Patent Appeal Board and made their report the reasons for her decision not to grant the patent. The Panel's reasons are referred to in the Federal Court as the "Commissioner's Reasons." [392] The recommendation of the Board was "that the Commissioner reverse the examiner's objection on the ground of obviousness, uphold the examiner's objection on the ground of no patentable subject matter, and reject the application solely on the ground of no patentable subject matter."[393]

The patentability of a business method became a matter of policy for the Federal Court, warranted or not. Accordingly, the Federal Court indicated that the Commissioner's errors "stem from her adoption of a policy role."[394] Amazon makes arguments that the Patent Appeal Board or CIPO more broadly are as a matter of policy changing the approach to what

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a component that receives from a server system a client
identifier of the client system and that stores the client identifier persistently;
a component that orders an item by displaying information identifying the item along with an indication of a single action that is to be performed to order the identified item and by sending to the server system a request to order the identified item along with the client identifier, the client identifier identifying account information previously supplied by a user wherein the user does not need to log in to the server system when ordering the item; and a component that updates account information by coordinating the log in of the user to the server system receiving updated account information for the user, and sending the updated account information to the server system."

[391] The first step in the examination of a patent application lies with the CIPO examiner, the patent application process may entail several office actions prior to a final decision by an examiner, for example, See *Amazon* FCC *supra* note 277 at para 8, "the patent application process was lengthy and involved multiple amendments to the claims." In this case the patent application was rejected in June 2004, stating that claims (1 – 75) were obvious and representative of non-statutory subject matter. The next step in the life of the Amazon patent included refusal of a patent by both the Patent Review Board and the Commissioner of Patents, as per the Federal Court *Amazon* FCC *supra* note 277 at para 8, "The Appellant appealed the decision and appeared before a Patent Review Panel (Panel). This process was delayed due to the retirement of two members, requiring a second hearing before a new Panel. A decision was finally rendered on March 4, 2009."

[392] *Amazon* FCC, *supra* note 277 para 8.

[393] *Amazon* FCC, *supra* note 277 at para 8.

[394] *Amazon* FCC, *supra* note 277 at para 37.

would be considered patentable subject matter, and as mentioned above, they also make the point that it is not the Commissioner's job to set the policy. The Federal Court's reading of the situation preserves the potential patentability for the business method patent and advances the discussion on approaches to claim construction.

After the COP decision, the applicant (Amazon) appeals the findings of the Commissioner of Patents (COP) to the Federal Court (Phelan J.). The COP findings being that the Commissioner of Patents would not grant a business method patent since it was "not patentable subject matter" under *Patent Act* section 2.[395] Phelan J**.** does not rule out that patents can be granted for business methods, overturning the Commissioner's decision and the Commissioner's four-step framework. Phelan J. of the Federal Court revisits the reasons why this is the case:

> The Commissioner's logic in coming to this conclusion is fundamental to this appeal. It is based on a 'four step' approach which the appellant submits has no basis in Canadian jurisprudence. Further, they submit that the assumptions and legal 'principles' enunciated constitute misinterpretation and misapplication of foreign and domestic law. The Respondent, on the other hand, submits that the Commissioner's approach is supported by fundamental principles of patent law, dating to the origins of the patent system, and drawn from both Canada and abroad.[396]

The four-step approach (Panel Report para 20)[397] is reviewed in the Federal Court in the following areas:

A. Form and Substance Approach.

B. Definition of the relevant categories.

C. Excluded Subject matter; and

D. Technological requirement

[395] *Amazon* FCC, *supra* note 277 at para 1.
[396] *Amazon* FCC, *supra* note 277 at para 11, Phelan J.
[397] *Amazon* FCC, *supra* note 277 at para 13-23.

Historically, "the Patent Office's policy was to grant patents for business methods so long as they were an art within the meaning of section 2 of the *Patent Act*."[398] However, in accordance with section 40[399] of the *Patent Act*, "whenever the Commissioner is satisfied that an applicant is not by law entitled to be granted a patent, he shall refuse the application and, by registered letter addressed to the applicant or his registered agent, notify the applicant of the refusal and of the ground or reason therefor."[400] This section indicates that the *Patent Act* does not grant to the Commissioner any discretion, including refusing a patent on the grounds of public policy.[401] Unless there is a prohibition by law there should be a grant of patent.

The MOPOP manual was revised post-COP decision to include an exclusion for business methods, and the Commissioner's decision in *Amazon* is the precedent for this exclusion. However, the Federal Court found that contrary to the Commissioner's decision, "to implement a business method exception would be a 'radical departure' from the current regime requiring parliamentary intervention."[402] Hence, during this case, the Federal Court's position is that drastic decisions on new technologies are not taken without legislative intervention. This decision does not disrupt the narrative that a more fulsome consideration of an invention using a revised guidance could be used in construing patent claims. Phelan J. at the Federal Court analyzes the law behind the Commissioner's decision. The four areas include:[403]

(1) Adoption of International Principles.

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[398] *Amazon* FCC, *supra* note 277 at para 62.
[399] *Patent Act,* RSC 1985 c P-4., s 40 [Refusal of Patents].
[400] *Patent Act* RSC., 1985, c. P-4, s 40.
[401] *Patent Act,* RSC 1985 c P-4.
[402] *Amazon* FCC, *supra* note 277 at para 68.
[403] *Amazon* FCC, *supra* note 277 at para 32-71.

(2) Form and Substance Approach.

(3) Definition of Art/Change of character or condition

(4) Technological Requirement.

3.2.3.4 Adoption of International Principles

How does the proposed adoption of international principles affect the business method trajectory? Moving forward from the test proposed by the Commissioner, Phelan J. of the Federal Court reinforces that one should stay within the limits of Canadian law except where laws may be complementary. International law/principles should not be an impetus for a radical change in Canadian law. For example, while international jurisprudence can be informative, "the Commissioner is… bound by Canadian patent regime and its interpretation by the Courts. On this, she has no discretion."[404]

3.2.3.5 Form and Substance: Challenge to Purposive Construction

The Commissioner supports use of a form and substance approach to claims construction, which is inconsistent with the precedent-setting *Free World Trust* and *Whirlpool* cases. While the CIPO guidance should reflect SCC rulings on purposive construction, the patent office still implemented a form and substance approach to claim construction.

It is important to note Phelan J.'s assessment of the Commissioner's decision because it points out the error by the Commissioner in "adopting a novel legal test by which to assess patentable subject-matter. It is not supported by recent Canadian jurisprudence or the *Patent Act*."[405] The court notes the Supreme Court of Canada's direction on claim construction to

[404] *Amazon* FCC, *supra* note 277 at para 37.
[405] *Amazon* FCC, *supra* note 277 at para 47.

be one of purposive construction. As such, Phelan J. indicates that the Commissioner's approach to claim construction (the method used by the Commissioner to assess the claims and the invention) is wrong and that the appropriate method of claim construction was purposive construction. Accordingly, he construes the claims using purposive construction and says that the computer clearly meets the definition of invention in section 2 of the *Patent Act*.[406] Phelan rules that the computer system qualifies as patentable subject matter. However, contrary to direction of Phelan J. at the Federal Court, the Commissioner of Patents does not grant the patent in question and the decision is appealed to the Federal Court of Appeal.[407] The *Amazon* FCA reversed this, and the application was sent back to the Commissioner to be analyzed using the judicially approved principles of claim construction. The Commissioner in the end granted the patent.

The Federal Court of Appeal indicates that business methods are not excluded subject matter by legislation or case law. However, Sharlow J. notes that the Commissioner could reconsider, mindful that "a novel business method may be an essential element of a valid patent claim."[408] As such, computer-implemented methods can potentially be deemed patentable in Canada. Sharlow J. argues that a "new one-click method of completing an online purchase is not the whole invention" but could be "only one of a number of essential elements in a novel combination."[409] The issue of the appropriate principles to be applied in claim construction prevails to this day in key cases like *Choueifaty* and *Benjamin Moore*.

[406] *Amazon* FCC, *supra* note 277 at 73; *Patent Act*, RSC 1985 c P-4, s 2
[407] *Amazon* FCA, *supra* note 23.
[408] *Amazon* FCA, *supra* note 23 at para 63.
[409] *Amazon* FCA, *supra* note 23 at para 63.

3.2.3.6 Definition of Art/Change of Character or Condition

The Commissioner's approach indicates the scientific or technological art as an invention must be "changed in some way."[410] For example, Phelan J notes that her "interpretation of practical application does not take into account a wider definition of physical, 'change in character or condition' or the concrete embodiment of an idea."[411] This decision considers the practical application through a very narrow lens, not in light of earlier case law and absent a comment on how the change to the invention should occur.

Sharlow J. recognizes the words of Phelan J in that "the language in *Lawson* must not be interpreted to restrict the patentability of practical applications which might, in light of today's technology, consist of a slightly less conventional 'change in character' or effect that through a machine such as a computer."[412] Sharlow J further notes, "if these statements are meant to suggest that our understanding of the nature of the 'physicality requirement' … may change because of advances in knowledge, then I would agree." [413]

3.2.3.7 "Technological" Requirement

The proposal by the Commissioner for a technological test, may in practice seem to be insightful in granting patents. However, the term technological can be hard to interpret in this context. Sharlow J. at the FCA agrees with Phelan J., "if the ambit of this principle is as vague as it appears, it is likely to be highly subjective and unpredictable in its application. In my view, this test should not be used as a stand-alone basis for distinguishing patentable from non-patentable subject matter."[414]

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[410] *Amazon* FCC, *supra* note 277 at para 60.
[411] *Amazon* FCC, *supra* note 277 at para 60.
[412] *Amazon* FCA, *supra* note 23 at para 67
[413] *Amazon* FCA *supra* note 23 at para 68.
[414] *Amazon* FCA *supra* note 23 at para 57.

3.3 Patentable Subject Matter and Purposive Construction: Federal Court of Appeal *Amazon*

Speaking for the majority of the FCA, Sharlow J. sets aside Phelan J.'s decision, does not rule out the patentability of business methods and orders a re-examination of the Amazon.com patent. The Commissioner of Patents ultimately grants the patent to Amazon.com on January 7, 2012. The FCA agrees with Phelan J. that:

1) the approach that CIPO took was wrong on all four points; and that

2) the restatement of what the law should be by Phelan J. was correct.

Importantly, in the Federal Court of Appeal in *Amazon*, it is observed that during patent examination, that one should ground the identification of the actual invention on a purposive construction of the patent claims instead of form and substance. Use of the purposive approach to claim construction when identifying the actual invention is already entrenched in Supreme Court level jurisprudence *Free World Trust* and *Whirlpool* dealing with patents unrelated to software.[415]

The eventual grant of the one-click Amazon.com business method patent in 2011 was a key turning point for business method patents in Canada. Eisen and Man write at the time of the decision that "patent agents now have a strong and clear authority to support arguments before the Canadian Intellectual Property Office that business methods are not unpatentable."[416] The landscape for computer-implemented software inventions has changed significantly over the years; traditional approaches to purposive construction are

[415] *Free World Trust v. Electrosante* (dealt with an electro-magnetic therapeutic) & *Whirlpool Corp. v. Camco Inc* (dealt with dual action washing machine agitator).
[416] Mark B. Eisen & Vincent Man, "Canada now Open for Business: The Patentability of Business Methods in Canada after Amazon.com" (2010) 26:2 CIPR 255 at 256.

precedential. However, recent guidance from the patent office still leaves uncertainty about how these types of patent applications are to be treated.

The progress of this case through the courts and the post-*Amazon* FCA practice notices issued by the Canadian patent office led us to consider whether a machine (computer) is essential to the patentability of a business method. As part of this case, the court finds that a patent can be granted if the computer-implemented method results from a novel combination of elements where one of the components is essential. The computer can be an essential element of the claim, that is, value-added beyond that of a standard computer. As such, the *Amazon* decision was a turning point in assessing the application of a business method via claim construction. Siebrasse highlights the conflicting perspectives reminiscent of *Schlumberger*, where the algorithm is the only inventive aspect and is not patentable as an abstract theorem (mathematical equation). The role of the computer in this scenario is not novel but routine. For example, he highlights how Phelan J.'s position that having a practical application of a business method should result in a patentable result was a point of contention for the FCA in *Amazon*:

> On appeal by Amazon.com to the Federal Court, Phelan J. held that business methods, like inventions in any other field, cannot be claimed as abstract ideas, but a business method will be patentable so long as it is claimed as a "practical application"' [cit omitted] As the patent at issue was claimed as a practical application, it was consequently patentable subject matter. [cit omitted] The Patent Office appealed, and unfortunately, the Court of Appeal's decision was completely ambiguous. The Court of Appeal stated that Amazon.com's claim would be unpatentable if "the only inventive aspect of the claimed invention is the algorithm **-** a mathematical formula - that is programmed into the computer to cause it to take the necessary steps to accomplish a one-click online purchase...On the other hand, it would be patentable if "a new one-click method of completing an online purchase is not the whole invention but only one of a number of essential elements in a novel combination. The difficulty with this analysis is that both alternatives are normally true. It is typically the case in a business method patent, as in the *Amazon.com* case, that the only inventive element is the idea or "algorithm." It is also typically the case in a business method patent, again as in the

> *Amazon.com* case, that the idea will be only one of a number of elements in the invention, which, as a whole, is a novel combination when the idea itself is inventive. [417]

Siebrasse recognizes opposing viewpoints in justifying the business method's patentability. He acknowledges the abstract can be one of "a number of" elements in the invention "which is a novel combination when the idea itself is inventive." This position supports my theory that the combining of elements (even the abstract theorem) can have an innovative and patentable end. However, the difference of opinion on the patentability of business methods continued, as Siebrasse notes, "the Amazon.com patent was litigated to the Court of Appeal, and … been granted, we still do not really know whether it is valid."[418] However, Phelan J concluded it was valid and ordered it to be granted, though overturned on this point by the *Amazon* FCA, with the decision being left to the Patent Office, who ultimately granted it. Nevertheless, it is prima facie valid.

Crowne notes a pro-patent view on the subject, "if the subject matter in question can be made to fit within the definition of invention (even if slightly uncomfortably), then courts and tribunals should aim to accommodate it."[419] As mentioned, that there was no clear answer in this key Canadian case and led to a string of guidance documents that added even more uncertainty to patentability decisions.

Further analysis of the Canadian literature indicates that CIPO and the courts differed on construction of the claims post-*Amazon* FCA; Aoun writes, "CIPO's new approach to claim construction constitutes 'an abrupt and seemingly deliberate turn away from Canadian law, effectively arguing the *different* rules of claim construction should apply to CIPO than

[417] Norman Siebrasse, "Business Method Patents and Patent Trolls," *supra* note 352 at 41.
[418] *Ibid* at 41, Norman Siebrasse, "Business Method Patents and Patent Trolls."
[419] Emir Crowne, Preserving the Amazon (Patent): Federal Court of Appeal Rules Business Methods Patentable in Canada (2012) Journal of Intellectual Property Law & Practice (Oxford) 528 at 528.

the courts.'"[420] This position would, in effect, rail against some of the findings in the *Amazon* FCA case at the higher court level. CIPO's most recent approach in *Benjamin Moore* is not consistent with SCC precedent in *Whirlpool* and *Free World Trust.* Also, the most recent 2020 CIPO guidance is arguably not consistent with the principles of purposive construction.

3.4 Patentable Subject Matter and Purposive Construction: *Choueifaty*

The conflicting approaches of the patent office and the courts are on full display in this case. In the case of *Yves Choueifaty v. Attorney General of Canada*,[421] the patent in question is Application No. 2,635,393 entitled "Method and Systems for Provision of an Anti-Benchmark Portfolio" [the 393 Application]. The Commissioner of Patents refuses a patent application because the essential elements of a "claimed patent" fall outside the section 2 *Patent Act* definition of invention.[422]

Zinn J. in response to Choueifaty's appeal[423] finds that "the Commissioner erred in determining the essential elements of the claimed invention by using the problem-solution approach, rather than the approach Whirlpool directs be used."[424] Zinn J. further notes, "in light of this determination it is not necessary to analyze the second issue on the appeal."[425]

There are two sets of claims are under consideration in this case. The respondent's position in the appeal is that the problem-solution approach is the correct test for determining essential elements and is consistent with the principles of past higher court cases. The

[420] Wissam Aoun, "2 plus 2 = 5: The Canadian Patent Agent Examination Board and the Doctrine of Essential Elements" (2017) 99 J. Pat. & Trademark Off. Soc'y 625 at 626.
[421] *Choueifaty*, *supra* note 32.
[422] *Choueifaty*, *supra* note 32 at para 1; *Patent Act*, RSC 1985 c P-4, s 2
[423] *Choueifaty*, *supra* note 32 at para 23
[424] *Choueifaty*, *supra* note 32 at para 40.
[425] *Choueifaty*, *supra* note 32 at para 41.

appellant's position is that the Supreme Court Case *Free World Trust*[426], is the leading case establishing the test for essential elements:

> The Appellant submits that the established test for determining the essential elements is set out by the Supreme Court of Canada in *Free World Trust*. He submits that the test asks whether, on a purposive construction of the language of the claim, a particular element was intended by the inventor to be essential, and whether that element could be substituted or removed without materially affecting function. The Appellant notes that this description of the test accords with the decision of the Federal Court of Appeal in *Halford v Seed Hawk Inc*, 2006 FCA 275…The Panel found that the essential elements of the First claims were 'directed to a scheme or rules involving mere calculations' for weighing securities. The Panel found no discernible physical effect to satisfy the definition of 'invention'. The Panel concluded: When a claim's essential elements are only the rules and steps of an abstract algorithm, however, that claim is non-statutory. This is the present situation for the claims on file […].[427]

The Federal Court finds that the Commissioner of Patents errs in using the problem-solution approach to determine the essential elements and confirms that the Supreme Court in *Whirlpool* directs the appropriate approach, that being purposive construction.[428]

3.5 Patentable Subject Matter and Purposive Construction: *Benjamin Moore*

The Federal court case deals with two applications of Benjamin Moore's "color selection system."[429] The patent examiner and the Patent Appeal Board refused the patents based upon section 2 of the *Patent Act* by using the problem-solution approach. The computer

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[426] *Free World Trust, supra* note 26.
[427] *Choueifaty, supra* note 32 at para 16.
[428] See *Choueifaty, supra* note 32 at para 39, " 'As Justice Locke, then of this Court, noted in *Shire Canada Inc v Apotex Inc*, 2016 FC 382 at paras 134-143, in order 'to establish that a claim element is non-essential, it must show both (i) that on a purposive construction of the words of the claim it was clearly not intended to be essential, and (ii) that at the date of publication of the patent, the skilled addressees would have appreciated that a particular element could be substituted without affecting the working of the invention' [emphasis in original]. The problem-solution approach to claims construction focuses only on the second aspect above, it fails to respond, as taught in *Free World Trust*, to the issue of the inventor's intention. Regarding the inventor's intention, para 51 of *Free World Trust* states: 'The words chosen by the inventor will be read in the sense the inventor is presumed to have intended, and in a way that is sympathetic to accomplishment of the inventor's purpose expressed or implicit in the text of the claims.'"
[429] *Benjamin Moore, supra* note 33 at para 7.

did not qualify as a part of the solution and did not fill the statutory subject matter requirements for section 2. Gagné, J. of the Federal Court endorsed a three-part test to assess the patentability of computer-implemented inventions:

> The examiner should: a) Purposively construe the claim; b) Ask whether the construed claim as a whole consists of only a mere scientific principle or abstract theorem, or whether it comprises a practical application that employs a scientific principle or abstract theorem; and c) If the construed claim comprises a practical application, assess the construed claim for the remaining patentability criteria: statutory categories and judicial exclusions, as well as novelty, obviousness, and utility.[430]

As such, the Gagné J. of the Federal Court in *Benjamin Moore* directed CIPO "on the proper procedure for claims construction and identifying patentable subject matter."[431] Gagné J. also emphasized that the 3-part test proposed by IPIC is in keeping with the current state of the law in *Amazon* FCA:

> the legal framework proposed by the Intervener and endorsed by the Applicant is in keeping with the Supreme Court's teachings in *Free World Trust* and *Shell Oil*, and with the Federal Court of Appeal's invitation to adapt "our understanding of the nature of the 'physicality requirement'" as technology advances (Amazon.com, at para 68.)[432]

This case is under appeal. It remains to be seen whether the Federal Court of Appeal will direct the new suggestions from intervenor IPIC (for a three-part test) to be taken up by the CIPO. This Federal Court decision was rendered in 2022 and has not been applied or interpreted in other cases to date.

[430] *Benjamin Moore supra* note 33 at Para 43.
[431] *Benjamin Moore, supra* note 33 at para 54.
[432] *Benjamin Moore, supra* note 33 at para 52 & *Amazon* FCA supra note 23 at para 68.

3.6 Canadian Intellectual Property Office Guidance (CIPO) response

3.6.1 Pre - *Amazon*

CIPO MOPOP chapters addressing form and substance, inventive concept, and contribution approaches were introduced in December 2009.[433] The 2013 practice notices PN 2013-02 and PN 2013-03, replaced these guidelines aiming to construe the claims with purposive construction, as per the 2000 SCC decisions in *Free World Trust* and *Whirlpool*. Instead, these guidelines describe a problem-solution approach. Further, the 2015-02 notice on diagnostic methods references a purposive approach to claim construction yet describes a problem-solution approach in the practice notice. [434]

3.6.2 *Amazon*

In the Canadian aftermath of the grant of the *Amazon* patent, IP lawyers had to balance their sense of what is conveyed by the CIPO in terms of the 2013 Practice Notice on purposive construction and the legal principles decided in the Supreme Court cases of *Free World Trust* and *Whirlpool*.

Practice notices stemming from the *Amazon* FCA decision issued in March 2013,[435] PN 2013-02, 'Examination Practice Respecting Purposive Construction' reads that according to the SCC, examination "requires the Commissioner's identification of the actual invention

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[433] Graeme R.B.Boocock, "Haunted by the Spirit of the Invention" (2016) 32 C.I.P.R. 71, online: *IPIC* <https://ipic.ca/_uploads/57xqppjwl.pdf>.
[434] CIPO, "Archived — Patent Notice: Examination Practice Respecting Medical Diagnostic Methods – PN 2015-02" (29 June 2015) [PN 2015], online: *Industry Canada* <https://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/wr03945.html>.
[435] Canadian Intellectual Property Office, "Examination Practice Respecting Purposive Construction-PN2013-02" (8 March 2013) [PN 2013-02] online: *Industry Canada* <https://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/vwapj/PN2013-02-eng.pdf/$file/PN2013-02-eng.pdf> [PN2013-02]; Canadian Intellectual Property Office "Examination Practice Respecting Computer-Implemented Inventions - PN 2013-03" (8 March 2013), online: *Industry Canada* < https://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/wr03627.html> [PN2013-03]

to be grounded in a purposive construction of the patent claims."[436] However, there are inconsistencies between the 2000 Supreme Court decisions and the approach iterated in the 2013 Practice Notice on purposive construction. CIPO PN-2013-02 provides practice guidelines for claim construction during an examination, namely, using a fair, balanced, and informed response, having identified the problem and solution in the context of the application, to determine which elements of the claim solve the identified problem, and by focusing on one solution to a problem. The problem-solution approach taught by the PN is particularly problematic in the case of software invention. For instance, given the nature of software as abstract, or an automated business method, it may be considered as non-essential to the solution. This, of course, works against the agent's ability to capture software in a patent claim and illustrates key issues at play when attempting to reconcile patent office and court-level positions.

There seems to be a determined emphasis by CIPO on a problem-solution approach to the construction inconsistent with the leading Supreme Court precedents of *Free World Trust* and *Whirlpool*. CIPO references the case of *Genencor International Inc. v. Canada* (*Commissioner of Patents,*)[437] highlighting that *Whirlpool* was an "impeachment proceeding" not focussed on application-level determinations of purposive construction, whereas judge level decision-making on claim construction would be consistent with *Free World Trust* and *Whirlpool*.[438] As such, post-*Amazon* FCA, CIPO continued to take the position that they were not bound to apply purposive construction in accordance with *Whirlpool/Free World Trust* because of Gibson J.'s decision indicating purposive construction did not apply to the Patent

[436] *Ibid* [PN2013-02]; See *Amazon* FCA *supra* note 23 at para 43.
[437] 2008 FC 608, Gibson J [*Genencor*].
[438] *Ibid*, *Genencor* at paras 62 and 70.

Office when examining patent applications. However, the case was not followed by any other court, and arguably no longer applicable in view of the *Amazon* FCA decision.

The other practice notice from *Amazon* FCA was CIPO PN 2013-03, 'Examination Practice Respecting Computer-Implemented Inventions.' One of its main messages is that section 2 *Patent Act* definition of invention must be considered along with section 27(8) exclusions of scientific principles and abstract theorems.[439] The PN mentions numerous exclusions including fine arts, methods of medical treatments, the disembodied invention (no practical application), lack of physicality (i.e. are not "something with physical existence, or something that manifests a discernible effect or change") and inventions where the claimed subject-matter is a mere idea, scheme, plan or set of rules.[440] This in essence refutes previous arguments for professional skills, business methods and abstract theorems. On the other hand, it puts emphasis back on the physicality of the invention which in the case of a computer-implemented invention could mean some sort of hardware/computer.

At this juncture, I will briefly summarize the issue with the problem-solution approach and how to address it with purposive construction. Post-*Amazon* FCA, the MOPOP indicated that purposive construction uses the following steps:

> When examining a claim, an examiner must read the claim in an informed and purposive way. Prior to construing a claim an examiner will:
>
> - Identify the person of ordinary skill in the art; and
> - Identify the relevant common general knowledge (CGK) of the person of ordinary skill in the art (POSITA) at the time of publication
>
> The above steps provide the context in which the claim is to be read. Once the context is determined the examiner will:
>
> - Identify the problem addressed by the application and its solution as contemplated by the inventor; and

[439] PN 2013-02, *supra* note 435; *Patent Act*, RSC 1985 c P-4, ss 2, 27(8).
[440] PN 2013-03, *supra* note 435.

- Determine the meaning of the terms used in the claim and identify the elements of the claim that are essential to solve the identified problem [441]

Only elements essential to solving the problem will be essential in the claim. This is particularly problematic for computer-implemented inventions. The reason being that software components (abstract theorems) are not patentable subject matter as defined under section 2 of the *Patent Act*. If the problem were directed to the computer elements these could qualify under section 2 invention as a machine.

3.6.3 Post-*Choueifaty* Guidance

In the follow-up to *Choueifaty,* the CIPO provided new guidance on *Patentable Subject Matter under the Patent Act* in 2020.[442] The notice covers: Purposive Construction, Subject Matter, Computer-implemented inventions, diagnostic methods, and medical use. This discussion focusses on computer-implemented inventions. The guidance overrides several previous statements and indicates the problem-solution approach will no longer be used. In the guidance, in mentioning the invention and whether it has a "physical existence," reference is given to *Amazon*, in which such questions "must be considered in light of today's technology."[443] Arguably the new 2020 CIPO guidelines re-introduce the concept of problem-solution when indicating that one must determine what the "actual invention" is as part of the construction. The guidance inserts the term "physical" into the language of the FCA in *Amazon* even though it did not focus on the broader use of the term "physical" when describing a patentable invention. In my reading of the post-*Choueifaty* guidance, the case for an algorithmic invention is more problematic. In the guidance it indicates:

[441]Government of Canada, "Manual of Patent Office Practice (MOPOP) - Canadian Intellectual Property Office", *supra* note 40.
[442] PN 2020, *supra* note 34.
[443] PN 2020 *supra* note 34 at Footnote #11.

> an actual invention may consist of either a single element that provides a solution to a problem or of a combination of elements that cooperate together to provide a solution to a problem. Where an actual invention consists of a combination of elements cooperating together, all of the elements of the combination must be considered as a whole.[444]

More importantly, the algorithm must improve the functioning of the computer. The abstract theorem must form part of a combination of elements related to the manual or productive arts and having physical presence or effect physical change. In February 2022 IPIC made a submission to CIPO on patentable subject matter. The IPIC submission points out that the first step of the IPIC test is purposive construction of the claim as a whole:[445]

> It is difficult to understand why CIPO persists in considering the "actual invention" alone for patentable subject matter eligibility when the Federal Court of Appeal made it clear that determining subject matter on the basis of inventive concept alone (i.e., what CIPO calls the "actual invention") was incorrect in law.[446]

The judiciary-patent office dichotomy remains a hotly contested debate, currently under appeal in the case of *Benjamin Moore* at the Federal Court. The court's endorsement of the IPIC proposal for a three-part test for patentability and direction that CIPO use it is one of the key findings.

3.7 Patentability Criteria

I review novelty, utility, and non-obviousness in this section. Both during patent prosecution and patent litigation, the question is how to best identify the inventive concept to survive challenge from opponents. In patentability determinations, the claim must be construed using existing precedent so one can determine the essential elements of an invention. Patent validity can be contested on several commonly held grounds including

[444] PN 2020, *supra* note 34.
[445] IPIC Submission, *supra* note 21 at 13.
[446] IPIC Submission, *supra* note 21 at 7

anticipation, obviousness, non–patentable subject matter and inutility.[447] These characteristics present in Chapter 4 interview results when posing questions to participants on drafting techniques in emerging algorithms.

3.7.1 Novelty

The novelty requirement is found in the section 2 *Patent Act* definition of invention.[448] The test is in section 28.2 (1)(a) of the *Patent Act*.[449] The subject-matter defined by a claim in an application for a patent in Canada (the "pending application") must not have been disclosed a) before the one-year period immediately preceding the filing date (only if it is a disclosure by the inventor or someone learning of it from the inventor) or, if the claim date is before that period, before the claim date by the applicant, or by a person who obtained knowledge, directly or indirectly, from the applicant, in such a manner that the subject-matter became available to the public in Canada or elsewhere (third-party disclosures).[450]

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[447] Other grounds for invalidity can include double patenting, insufficiency of disclosure, claims broader than the invention made or disclosed, ambiguous claims and wilful materials misstatements,
See Steven Garland et al., "Patent Litigation in Canada: Overview" (Thomson Reuters Canada Ltd), *supra* note 16.

[448] *Patent Act*, RSC 1985 c P-4, s 2

[449] *Patent Act*, RSC 1985 c P-4., s 28.2(1)(a).

[450] See *Patent Act* RSC 1985 c P-4 s 28.2 (1), "The subject-matter defined by a claim in an application for a patent in Canada (the "pending application") must not have been disclosed

(a) before the one-year period immediately preceding the filing date or, if the claim date is before that period, before the claim date by the applicant, or by a person who obtained knowledge, directly or indirectly, from the applicant, in such a manner that the subject-matter became available to the public in Canada or elsewhere;

(b) before the claim date by a person not mentioned in paragraph (a) in such a manner that the subject-matter became available to the public in Canada or elsewhere;

(c) in an application for a patent that is filed in Canada by a person other than the applicant, and has a filing date that is before the claim date; or

(d) in an application (the "co-pending application") for a patent that is filed in Canada by a person other than the applicant and has a filing date that is on or after the claim date if

(i) the co-pending application is filed by

3.7.2 Anticipation

Anticipation is an argument used in litigation but can be difficult to establish. The 2020 case of *Seedlings Life Science Ventures, LLC v Pfizer Canada ULC*.[451] points out the difference between anticipation and obviousness, "when a patent is anticipated, its inventive character is not in question; the issue is that someone else made the same invention before. In contrast, obviousness is a defect that goes to the inventive character."[452] In an early case, *Reeves Brothers v Toronto Quilting and Embroidery*,[453] Gibson J. gave an eight-step test for anticipation.[454] According to William Hayhurst, the test for anticipation was "thoroughly confused" by Gibson J. although it was cited in a series of Canadian cases without analysis.[455] I think that the last step of the test gave the clearest direction, and the rest of the test could

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- **(A)** a person who has, or whose agent, legal representative or predecessor in title has, previously regularly filed in or for Canada an application for a patent disclosing the subject-matter defined by the claim, or
- **(B)** a person who is entitled to protection under the terms of any treaty or convention relating to patents to which Canada is a party and who has, or whose agent, legal representative or predecessor in title has, previously regularly filed in or for any other country that by treaty, convention or law affords similar protection to citizens of Canada an application for a patent disclosing the subject-matter defined by the claim

(ii) the filing date of the previously regularly filed application is before the claim date of the pending application,

(iii) the filing date of the co-pending application is within twelve months after the filing date of the previously regularly filed application, and

(iv) the applicant has, in respect of the co-pending application, made a request for priority on the basis of the previously regularly filed application."

[451] 2020 FC 1, Grammond J [*Seedlings* FCC].
[452] *Ibid* at para 134, *Seedlings* FCC.
[453] (1978) 43 CPR (2d) 145 (FCTD), Gibson J [Reeve Brothers] ; Hayhurst at 156 reprints the 8 step test from Reeves Brothers, "As I understand it, in order that there may be a finding of anticipation, the prior art must (1) give an exact prior description; (2) give directions which will inevitably result in something within the claims; (3) give clear and unmistakable directions; (4) give information which for the purpose of practical utility is equal to that given by the subject patent; (5) convey information so that a person grappling with the same problem must be able to say "that gives me what I wish"; (6) give information to a person of ordinary knowledge so that he must at once perceive the invention; (7) in the absence of explicit directions, teach an "inevitable result" which "can only be proved by experiments"; and (8) satisfy all these tests in a single document without making a mosaic."
[454] *Ibid* at 157.
[455] William L. Hayhurst, Recent Developments in Canada Law: Intellectual Property (1987) 19:1 Ottawa L. R. 137 at 156.

be condensed. The finding in this case was that the prior art should be contained in one document, this document should give a person skilled in the art clear direction to the element within the claim. Later, the case of *Beloit Canada v Valmet Oy*[456] established the *Beloit* test for anticipation: does a single prior publication contain information needed to produce claimed invention without inventive skill?

The court in *Sanofi*[457] revises the thinking to make the anticipation bar more difficult to meet in a two-step test or two separate requirements for anticipation: 1) disclosure and 2) enablement. Essentially the prior patent publication or use is covered in *Beloit,* and the *Sanofi* test adds a second step asking whether the disclosure would enable duplication of the invention in question without adding detail or explanation. That is, "the second step requires the Court to determine whether the earlier patent or publication would permit the skilled person to perform or make the invention of the patent in dispute without 'undue burden.'"[458]

3.7.3 Obviousness (Inventive step)

In transitioning to a discussion on the obviousness standard, one should note that the statutory requirement in section 28.3 of the *Patent Act* is not that different from the jurisprudence which interpreted the concept prior to inclusion in the *Patent Act*.[459] This statutory definition does not mention inventive concept. Rather it focusses on the subject matter of the claim. The case of *Beloit* also focusses on a test for obviousness, "the subject-

[456] (1986), 8 CPR (3d) 289 (FCA), Hugessen J [Beloit].
[457] *Sanofi, supra* note 264.
[458] *Seedlings, supra* note 451 at para 108; *Sanofi supra* note 264 at para 33.
[459] See *Patent Act* RSC 1985 c P-4 s 28.3 [Invention must not be obvious]; "The subject-matter defined by a claim in an application for a patent in Canada must be subject-matter that would not have been obvious on the claim date to a person skilled in the art or science to which it pertains, having regard to **(a)** information disclosed before the one-year period immediately preceding the filing date or, if the claim date is before that period, before the claim date by the applicant, or by a person who obtained knowledge, directly or indirectly, from the applicant in such a manner that the information became available to the public in Canada or elsewhere; and **(b)** information disclosed before the claim date by a person not mentioned in paragraph (a) in such a manner that the information became available to the public in Canada or elsewhere."

matter defined by a claim in an application for a patent in Canada must be subject-matter that would not have been obvious on the claim date to a person skilled in the art or science to which it pertains."[460] Hugessen J. crystallizes the classic description of the person skilled in the art in *Beloit*:

> The test for obviousness is not to ask what competent inventors did or would have done to solve the problem. Inventors are by definition inventive. The classical touchstone for obviousness is the technician skilled in the art but having no scintilla of inventiveness or imagination; a paragon of deduction and dexterity, wholly devoid of intuition; a triumph of the left hemisphere over the right …The question to be asked is whether this mythical creature (the man in the Clapham omnibus of patent law) would, in the light of the state of the art and of common general knowledge as at the claimed date of invention, have come directly and without difficulty to the solution taught by the patent. It is a very difficult test to satisfy.[461]

Sanofi[462] is also relevant for the obviousness determination. Important to note is the restatement of questions[463] from earlier cases. For example, Oliver L.J.'s questions in *Windsurfing International Inc. v. Tabur Marine (Great Britain) Ltd*[464] were further restated by Jacob L.J. in *Pozzoli SPA v. BDMO SA*.[465] This string of case law was recognized in 2008, when Rothstein J. at the Supreme Court of Canada adopts these tests to create the four-step obviousness test in *Sanofi* as follows:

1. (a) Identify the notional "person skilled in the art;"

   (b) Identify the relevant common general knowledge of that person.

2. Identify the inventive concept of the claim in question or if that cannot readily be done, construe it.

[460] *Beloit, supra* note 456 at 294.
[461] *Beloit, supra* note 456 at 294.
[462] *Sanofi, supra* note 264.
[463] 2017 FCA 76, Pelletier JA [*Bristol-Myers Squibb*] at para 40; *Sanofi, supra* note 264 at para 67.
[464] [1985] R.P.C. 59 (C.A.), Oliver L J [*Windsurfing*].
[465] [2007] F.S.R. 37 (p. 872), [2007] EWCA Civ 588, at para. 23, Jacob LJ [*Pozzoli]*.

3. Identify what, if any, differences exist between the matter cited as forming part of the "state of the art" and the inventive concept of the claim or the claim as construed.

4. Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps which would have been obvious to the person skilled in the art, or do they require any degree of invention? [Emphasis added.] [466]

Sanofi further cites the below factors to be considered in an 'obvious to try' test as per step four of the four-step test obviousness test.[467]

1. Is it more or less self-evident that what is being tried ought to work? Are there a finite number of identified predictable solutions known to persons skilled in the art?

2. What is the extent, nature and amount of effort required to achieve the invention? Are routine trials carried out or is the experimentation prolonged and arduous, such that the trials would not be considered routine?

3. Is there a motive provided in the prior art to find the solution the patent addresses?

As such, the Supreme Court in *Sanofi* introduced the discussion on identifying the inventive concept at the Federal Court. As per Pelletier J.A. in *Bristol-Myers Squibb*,[468] "the innovative feature of the Supreme Court's decision in *Sanofi* in relation to obviousness was its adoption of the 'obvious to try' test, which it linked to the framework set out in jurisprudence in the United Kingdom."[469] This influences the Federal Court of Canada in *Bristol-Myers Squibb* to recognize the "obvious to try" test as applying in some

[466] *Sanofi*, *supra* note 264.
[467] *Sanofi*, *supra* note 264 at para 69.
[468] *Bristol-Myers Squibb supra* note 463.
[469] *Ibid* at para 34.

circumstances. [470] Pelletier J.A. indicates that "the reasonable conclusion to be drawn …is that the 'obvious to try' test has not displaced all other inquiries into obviousness."[471]

Also key to the obviousness analysis is that extra inventive step or point of novelty that could be identified. Further, in *Bristol-Myers Squibb,* the court struggles with the definition of inventive concept and whether there is a difference between prior art and the inventive concept and whether a person of ordinary skill in the art (POSITA can make that connection. I will reference a shift from the SCC *Sanofi* positioning. Pelletier J.A. of the Federal Court of Appeal in the 2017 *Ciba Specialty Chemicals Water Treatments Limited v. SNF Inc* [472] downplays the inventive concept:

> There may be cases in which the inventive concept can be grasped without difficulty, but it appears to me that because 'inventive concept' remains undefined, the search for it has brought considerable confusion into the law of obviousness. That uncertainty can be reduced by simply avoiding the inventive concept altogether and pursuing the alternate course of construing the claim. Until such time as the Supreme Court is able to develop a workable definition of the inventive concept, that appears to me to be a more useful use of the parties' and the Federal Court's time than arguing about a distraction or engaging in an unnecessary satellite debate.[473]

This brings me to the 2021 case of *Shire.*[474] Rennie J.A. mentions the decision of the Federal Court in *Sanofi* that "upon ascertaining the person skilled in the art (PSIA) and their common general knowledge, the judge concluded that the claims' inventive concept was grasped without difficulty."[475] It also comes to light in this discussion that "beyond the enumerated factors, there are contextual factors that should also be considered, depending on the facts of the

[470] *Bristol-Myers Squibb, supra* note 463 at para 36.
[471] *Bristol-Myers Squibb, supra* note 463 at 60.
[472] 2017 FCA 225, Pelletier JA [*Ciba*].
[473] *Ibid* at 77, *Ciba*.
[474] *Shire, supra* note 262.
[475] *Ibid* at para 13.

case."[476] This is particularly applicable as I examine the case of AI (ML) algorithms where identification of characteristics and properties are more relevant. This can in fact take us beyond the statutory definitions of invention and the section 27(8) exclusion of the abstract theorem from patentability. The United States also has tier two considerations to bring added clarification to the invention under consideration. The U.S. case of *Graham v. John Deere*[477] "provided an expansive and flexible approach" to the statutory meaning of non-obviousness found in 35 §103 using an objective test to apply said section.[478] This half-century old analysis is surprisingly on point with the above Canadian position on obviousness. Rennie J.A. in *Shire* affirms that the trial judge was correct in applying the *Sanofi* test in identifying a single inventive concept, the state of the art and the gap between the state of the art and inventive concept. However, as noted by Rennie J.A. "the inventive concept, properly construed and applied, remains the end point for the obviousness inquiry."[479] In such a scenario the identification of inventive concept is typically separate from a purposive construction of the claims. As per Rennie J, "though the process for the identification of an inventive concept bears a striking resemblance to that of claims construction, as seen in longstanding Supreme Court of Canada rulings…it is nonetheless a distinct, separate exercise." [480]

Also, in 2021 there is a FCA statement on the issue in *Janssen* which clarifies the 'obvious to try' test.[481] In this case, Locke J.A. references and affirms the Federal Court position that "based on a consideration of the relevant factors, the Federal Court concluded

[476] *Shire, supra* note 262 at para 107.
[477] 383 U.S.1 (1966), Clark J [*Graham*].
[478] *Ibid.*
[479] *Shire, supra* note 262 at para 65.
[480] *Shire, supra* note 262 at para 68.
[481] *Janssen supra* note 263.

that, though the combination of two elements may have been 'worth trying', it was not obvious to try."[482] Locke J.A. in his discussion on patentable subject matter makes the below reference of relevance in the obviousness discussion:

> The key consideration should be whether the combination offers something that was not available to the public before. An aggregation is problematic because it does not provide more than was already available to the public... there is no dispute that the combination in issue provides improved results over what was previously known.[483]

In Canadian law it may be possible to apply this to a ML algorithm. While the identification of predictable patentable solutions may be near impossible, we know there will be one or more outputs, but we are not sure what form these will take and not necessarily obvious to try. Further, with "brute force" algorithms there can be difficulties with establishing novelty or non-obviousness. There can be challenges in differentiating/identifying prior art when creating patent search queries and using existing patent databases for these newer complex technologies. Following from this, the bar to establishing non-obviousness is likely low because the algorithms associated with the proposed emerging inventions are much more difficult to clearly define.

3.7.4 Utility

In section 2 of the *Patent Act*, under the definition of invention is the requirement for and invention to be "useful" that is having utility.[484] The demonstration of utility appears to have had a lower bar in recent years, opening the door for patents that can overcome the

[482] *Janssen, supra* note 263 at para 34.
[483] *Janssen, supra* note 263 at para 23.
[484] *Patent Act,* RSC 1985 c P-4., s 2.

thresholds for novelty and obviousness. As per *Janssen*, "a mere scintilla of utility is sufficient."[485]

For decades the 'promise doctrine' has played a role in utility demonstrations, but with the *AstraZeneca Canada Inc. v. Apotex Inc*[486] case a new test for utility is introduced at the Supreme Court level. Rowe J. concludes that the "the Promise Doctrine is not the correct method of determining whether the utility requirement under section 2 of the *Patent Act* is met."[487] The doctrine has its roots in English law.[488] Rowe J. gives a detailed analysis, expressing that "the Promise Doctrine risks, as was the case here, for an otherwise useful invention to be deprived of patent protection because not every promised use was sufficiently demonstrated or soundly predicted by the filing date."[489] The new test for utility was set out as follows:

> First, courts must identify the subject-matter of the invention as claimed in the patent. Second, courts must ask whether that subject-matter is useful — is it capable of a practical purpose (i.e., an actual result)? The Act does not prescribe the degree or quantum of usefulness required, or that every potential use be realized — a scintilla of utility will do. A single use related to the nature of the subject-matter is sufficient, and the utility must be established by either demonstration or sound prediction as of the filing date.[490]

This approach to utility indicates a low technical barrier to innovation or inventiveness in algorithms that find a patentable end through attachment to a physical machine or result in a commercial success. Chisum wrote in favor of the patentability of algorithms in the late eighties. He notes, "the patent system is suitable for protection of basic

[485] *Janssen*, *supra* note 263 at para 37.
[486] 2017 SCC 36, Rowe J [*AstraZeneca*].
[487] *AstraZeneca*, *supra* note 486 at para 24.
[488] *AstraZeneca*, *supra* note 486 at para 33.
[489] *AstraZeneca*, *supra* note 486 at para 50.
[490] *AstraZeneca*, *supra* note 486 at para 54-55.

software ideas, including algorithms, at the practical as well as at the theoretical level."[491] The definition of invention also includes "useful arts" indicating the necessitated presence of utility in discussing art as an invention. He indicates that algorithms "should be the subject of patent protection if the patent law standards of novelty and unobviousness are met."[492] To close the narrative on patentability I observe similarities in statute language but distinctive approaches to assessing the invention among the jurisdictions in **Table 2.**

[491] Donald S. Chisum, "The Patentability of Algorithms," *supra* note 55 at 1020 (Footnote 209).
[492] Donald S. Chisum, *supra* note 55.

Table 2: Patentability Criteria

Country	Canada	U.S.	EU	Japan
Patentability Criteria Test	For an invention to be patentable, there are three main components, novelty[493] (not new is anticipated), obviousness (inventive), [494] and utility (useful).	Novelty §102, obviousness §103, written description, enablement, and best mode.[495] The U.S Supreme Court *Alice* case of 2014 reflected a two-step test for patent-eligible subject matter in computer implemented inventions: the first step being that of patent-eligible subject matter and the second step an inventive step.	There is a two-step approach at the European Patent Office (EPO)[496,] Step 1: Patent eligibility and Step 2: Inventive Step (Novel and non-obvious) when considering the prior art.	Criteria Article 29(1) of the Patent Act[497] statutory invention; industrially applicable invention;

For the purposes of this narrative, it is important to note that while harmonization may seem to be the penultimate approach to addressing AI in patents, each system has specific approaches to patenting. A harmonized approach for patenting in AI may be still in early

[493] *Patent Act*, RSC 1985 c P-4., ss .2 [invention]; 28.1 [Claim date]; 28.2 [Subject - matter of claim must not previously be disclosed].
[494] *Patent Act*, RSC 1985 c P-4., s.28.3 [Invention must not be obvious].
[495] *Patent Act*, 35 U.S. Code § 102; §103.
[496] To qualify as patent-eligible subject matter the invention should have a technical character. The second step is patentability determined by assessing the inventive step. The EPO has an approach stemming from the case law known as COMVIK to use in assessing this step. One must determine the gap between this invention and the prior art in this step of the analysis. While the problem may have considered the technical and the non-technical elements in a computer implemented invention only the technical element of a problem is considered in assessing the technical solution.
[497] *Japan Patent Act*, art 29(1) online: <https://www.jpo.go.jp/e/system/laws/rule/guideline/patent/tukujitu_kijun/document/index/03_0100_e.pdf>

stages. As we see in Canada there are differing perspectives at the patent office and the judicial level and similar frictions may apply in the countries generating triadic patents.

3.8 A non-essential innovative element (abstract theorem, mathematical equation, professional skill or knowledge) can be considered an element of algorithmic invention in a purposive construction

This is a narrative of what innovation looks like, over time and in terms of patenting emerging algorithmic technologies. The statutory definition of invention in the *Patent Act*[498]can be construed through an innovation lens, and the role of an abstract theorem can be considered when identifying the elements facilitating a patentable end. In arguing that there is scope for assessing the divide between unpatentable math and a patentable algorithm or innovation, I suggest considering emerging digital technologies such as ML in AI. This includes the art, method, process, or machine claims. One can consider theoretical perspectives on innovation, specifically concepts of the cluster. This brings fresh perspective to how innovative elements are identified in novel forms of the algorithm. This can facilitate identification of patent-eligible components used in emerging algorithmic technologies.

As referenced earlier, Schumpeter discusses the role of new combinations in innovation. This is relevant in considering what elements will contribute to the inventiveness of a patent. As has been demonstrated throughout the early part of this thesis, an interdisciplinary perspective sheds new light on reoccurring references to the literal and textual or the form and the substance, the problem, and the solution. The role of the innovative element should be recognized as core to the invention and while the purposive approach has recognized a way to incorporate the non-essential and the essential into a patentable end in *Amazon* FCA, the purposive approach was challenged once again, by the

[498] *Patent Act*, RSC 1985 c P-4, s 2

patent authority in *Choueifaty*. In this case, the legal principles enunciated in *Free World Trust* and *Whirlpool* were ignored by a respondent that instead focussed on the form and substance approach promoted by the Commissioner's decision in *Amazon*. In the most recent Federal Court case of *Benjamin Moore*,[499] a three-part test for examiners prioritizes purposive construction as a first step. There are patents that could be considered borderline when using existing patent office guidance, particularly as it relates to the algorithm, the generic versus the inventive, an algorithm improving functionality of a computer versus one with the computer as a non-specific tool. By proposing revised guidance, a broader range of patent applications may qualify.

In previous chapters I reviewed recent jurisprudential statement on tests for purposive construction that influence and inform what qualifies as a patent both at the CIPO and at the courts. The challenge for the CIPO is to pull these pieces into a new approach. Judicial approaches in claims construction may allow us to adapt the term essential in terms of new innovations identified in claim construction. The more recent case of *Benjamin Moore*, which supports purposive construction, is now under appeal.

Innovation changes in the context of AI and it is important to shift approaches to understanding invention under these circumstances. That in part is the original contribution of this thesis: innovation is not a static concept. For a long-time, patents were largely considered linear in their development. When looking at invention in support of innovation, one must consider how shifts to non-linear, disruptive innovation can inform AI invention moving forward.

[499] *Benjamin Moore*, *supra* note 33 at para 43.

3.9 Cluster innovation reflects a novel combination of elements towards a patentable end.

Theoretical perspectives on innovation and cluster theory could help patent examiners and the judiciary understand invention for the purposes of patent interpretation, in a form that supports purposive construction. In developing the approach, it becomes a fundamental question of where one sees the abstract theorem with a view to determining a patentable end.

The algorithm as part of a patent claim is presenting in increasingly sophisticated forms. Novel math and unique combinations of datasets lend themselves to using the innovation lens and facilitating the construction of innovations as invention. The cluster in innovation applies in the context of emerging technologies, with highly interactive elements, as seen in higher order algorithms.

The continuum from unpatentable math to a patentable algorithm or innovation is rife with exceptions, variances in technology and strategic patent drafting practices. This approach informs questions of patent interpretation and judicial considerations of future software inventions cases. I question whether existing frameworks are structured to assess emerging algorithmic technologies. There are opportunities for recommendations and new or revised guidance.

To reflect upon the debates identified in this thesis, I trace the thought process in developing the argument that theoretical perspectives on innovation do in fact reflect the conditions associated with patent interpretation. I use the recent *Choueifaty* and *Benjamin Moore* decisions to argue that the use of purposive construction is the appropriate standard for claim construction. Using this approach, one can argue that (as per *Amazon* FCA), if the algorithm is not simply facilitating an analysis that can be performed by a human being but

instead is one element of a novel combination it could be found patentable. Schumpeter's new combinations and Porter's cluster interactions are reflective of a novel combination of elements seen in patent law.

3.10 Cluster Innovation: Proximity as it relates to obviousness standard

The discussion on patent criteria in this chapter revisits the obviousness debate in Canada over the past decade. While I have landed on a purposive construction of the claims in identifying patentable subject matter, I see the inventive concept as the best approach to ascertaining inventiveness in emerging algorithmic technology. I am justifying this largely because of the added scrutiny when properties and characteristics are also considered, necessary when one deals with subject matter that does not fit well within the definition of invention. The concept of proximity, as reflected in writing on cluster theory, talks about "geographic proximity." I relate this to the case law on obviousness. As is written by Pelletier J.A. in *Bristol-Myers Squibb*:

> it may be helpful to keep in mind that the obviousness analysis asks whether the distance between two points in the development of the art can be bridged by the Skilled Person using only the common general knowledge available to such a person. If so, it is obvious. The first of those points is the state of the prior art at the relevant date. References in the jurisprudence to 'the inventive concept', 'the solution taught by the patent', 'what is claimed' or simply 'the invention' are attempts to define the second point.[500]

The distance between these pieces, first in terms of "proximity," is key to the overall analysis. Further, my early inklings on virtual proximity lend themselves well to emerging technology that is international, (the prior art can come from a different jurisdiction). In fact, it is important that proximal elements be considered. Where we stand internationally was

[500] *Bristol-Myers Squibb*, *supra* note 463 at para 65.

explored early on with reference to major jurisdictions. This opens the door to considerations of the inventive concept and inventiveness. I add a second layer to the patentability considerations beyond the purposive construction of the claims casting an eye towards the jurisdictions that count towards triadic patents seen in AI.

3.11 Conclusion

During this chapter a wide range of case law and patent office guidance have been covered. There are many issues when evaluating different technologies in terms of what patentable subject matter and patentability consist of in the software and business method invention space. The inclusion of innovative themes aids in framing the role of an abstract theorem and its relation to patentable subject matter. Moving forward, Chapter 4 includes some practical viewpoints that confirm in practice the key points of the theory as applied to the jurisprudential findings.

CHAPTER FOUR: Empirical Findings

4.1 Introduction

In this chapter, I use interviews as a further line of evidence to support the argument that theoretical perspectives on innovation may aid in closing the gap between patent-eligible and non-patent-eligible software inventions. During the study I examine the opinions of patent experts (academics, patent agents and litigators) and public servants. The interviews cover the broad context surrounding patents and software in emerging technologies such as AI.

4.1.1 Interview Study

4.1.1.1 Purpose

The purpose of the interview study was to provide practical perspectives to a theoretical frame. I conducted a total of nine interviews. In this study the small samples allowed me to identify "an in-depth understanding" and "experience and perspective as important sources of knowledge."[501] The experts reacted differently to some questions but with enough consensus to support an evolving thesis.

The interviews did not discuss a new approach. While the purpose involved identifying the potential approach to assessing patents using innovation perspectives in inventions associated with emerging digital technologies, the objective of the interview questions was to identify the salient points that influence characteristics of invention and

[501]Sharlene Nagy Hesse – Biber & Patricia Leavy, *The Practice of Qualitative Research*, *supra* note 42 at 17.

innovation from various patent expert perspectives. The style of interview is described below by Nagy Hesse-Biber and Leavy:

> This means that projects frequently begin with the accumulation of specific data, the analysis of which leads to a more general understanding of the topic. Therefore, guiding research questions are generally open-ended, allowing for a multiplicity of findings to emerge. Research questions typically begin with words like *why, how* and *what.*[502]

This narrative has included a logical flow based upon literature research on IP and innovation to ensure that this research demonstrates validity. Several lines of evidence are used to reach thesis objectives, i.e., "the technique of methods triangulation, that is using two different methods to get at the same research question and looking for convergence in research findings."[503] The patent and innovation literature review identifies key theories and concepts to inform the expert interviews. The questions were open-ended and allowed for a free-flowing discussion to solidify the future direction of the thesis.

In the interviews, I explored factors that influence the application, drafting, prosecution, and litigation of a patent, including guidance and legislative tools, technical requirements for patentability (i.e. novelty, utility, and obviousness), the type of technology, as well as a variety of innovation perspectives. The interview questions support a thesis incorporating innovation perspectives into patent eligibility and patentability of AI algorithms.

4.1.1.2 Context

Participants in the interview study were established professionals. I interviewed three patent agents, two litigators, two academics, and two government employees. They were referred through university or professional networks. Patent agents were qualified in Canada

[502] *Ibid* at 9, Sharlene Nagy Hesse – Biber & Patricia Leavy, *The Practice of Qualitative Research*.
[503] *Ibid* at 51, Sharlene Nagy Hesse – Biber & Patricia Leavy, *The Practice of Qualitative Research*.

and the United States, and all had graduated from a Canadian law school. Their pre–law degrees included electrical and mechanical engineering and computer science. Patent agents had objectives of obtaining patents for inventions as part of their job, but their personal perspectives on software patentability varied. Their views were sought to provide perspectives on the prosecution process. The patent agents were also chosen for their knowledge in emerging technologies and the patent agency practice including the drafting of claims. One had documented understanding of innovation in emergent technologies. The agents also gave details on ML and patenting in Canada and patent drafting and Neural Networks. Further there was a discussion of identifying inventive elements in high-end algorithms.

Patent litigators interviewed were also qualified patent agents and graduates of Canadian law schools with litigation experience. They were involved in litigation of software inventions. The litigators were chosen for their experience in high-end patent litigation in Canada and their knowledge of the *Amazon* case.

University academics worked at Canadian law schools. These experts have an academic viewpoint developed over years of dialogue and debate and a knowledge of the relevant literature. As such, academics were chosen for their in-depth knowledge of the current case law in the area, as well as emergent technologies in software.

There were two short discussions: one with a CIPO representative and one with a federal scientist who confirmed publicly available information. This study did not include client or industry participants.

The variety of interviewee perspectives provided an interesting lens on patent doctrine and innovation theory. I also spoke with a manager-level employee in the Canadian

Intellectual Property Office to clarify some terms and a federal scientist in computer science to discuss terms associated with algorithms.

4.1.1.3 Preparation for the Interviews

Following referrals from existing Canadian contacts, participants were identified using a "snowballing" method. Existing contacts identified experts within their networks that could potentially provide useful input. A brief introductory email was prepared that allowed contacts to identify potential participants and provide a referral via email. With this introduction, an email was also prepared explaining the study to potential participants to determine their availability or interest in participating. Finally, the question was posed that given their expertise and knowledge in this area; would they be willing to be interviewed as part of this thesis project?

Once interviewees were identified, an invitation to participate and a statement of the study's purpose were shared. It was made clear that participation was strictly voluntary and that there was no direct benefit. Before the interview, an informed consent form was shared, signed, and returned by the participants, who were not compensated but were thanked in a follow-up email. There was also a guarantee of confidentiality and anonymity of interview data.

Approval was sought from senior management at the Canadian Intellectual Property Office to interview patent examiners, however, permission was not granted. As a result, I conducted one short informational interview confirming publicly available information on terminology with a manager at the CIPO. As well, perspective was garnered from publicly available CIPO material.

4.1.1.4 Interview process

During the interviews, a depth and breadth of experience and perspective from each participant was sought. Interviews were conducted in order of participant availability. Interviews started with a more general discussion based on the participant's expertise in the broad area of software invention, followed by more tailored questions depending on the participant's individual expertise. I asked questions to obtain insight from a variety of patent experts interested in the federal legislative and patent policy agenda in Canada. The interviews varied from short confirmations of public information to an hour discussion on the intricacies of patent law. There are different constituencies within the patent community in Canada, including the patent agent, the examiner, the academic and the litigator. Therefore, each expert brings "differing backgrounds, capacities, expectations and interests."[504] The study consisted of a small cohort but with in-depth education and experience in Canadian patent law.

The interviews were conducted by phone (in Toronto, Ottawa, Waterloo, London, and Calgary) and recorded with the participants' permission. The participants also signed informed consent forms. One significant advantage of the telephone interviews was the "ability to reach widespread geographic areas at an economical cost."[505]

4.1.1.5 Post-interview

The interviews were 30 – 60 minutes long, were conducted in English and took place based on the availability of participants. The interviews were conducted over six months.

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[504] Brett M. Frischman, Michael J. Madison & Katharine J. Strandburg, "Conclusion" in Brett M. Frischman, Michael J. Madison & Katharine J. Strandburg, eds, *Governing Knowledge Commons*, (New York, New York: Oxford University Press, 2014) 1 at 471.
[505] Bruce L. Berg, *Qualitative Research Methods for the Social Sciences*, 7th ed (Boston: Allyn & Bacon, 2009) 1 at 123.

Each interview was audio recorded with a SONY IC recorder to provide an accurate record of the discussion.

Themes were extracted using a cross-sectional "question by question analysis" using differing participants' views on the same questions. This allowed themes and patterns of thought in the selected subject areas to emerge. My objective in these interviews was to explore an in-depth level of experience with select qualified participants and narrow the research questions initially proposed.

The participants were identified by a discipline code and date of interview. For transcription purposes, the only identifier was the candidate names. Codes were used to remove these identifiers, and only the researcher had access to these identifiers. Codes were used to track quotes and did not identify names, cities, or firms. The participants were identified by a discipline code and date of interview. I transcribed each interview shortly after the meeting using the Microsoft word program. The interviews were then coded for anonymity, transcripts were transformed into "categorical labels or themes," sorted by categories, and examined to identify "patterns and processes."[506]

4.2 Analysis and Findings

The area of AI ML and patents is of global significance, and the work in the Canadian context can aid discussions into future approaches by Canadian policymakers. As I proceed with each theme, I clarify why I used interviews, what I was trying to determine, and how the responses provided help in this regard.

The key takeaways from this interview study include:

[506] *Ibid* at 341, Bruce L Berg, *Qualitative Research Methods for the Social Sciences*.

1. There are ongoing challenges with patents and software, including the abstract nature of algorithms.

2. These challenges are amplified when identifying the patentable elements of ML algorithms in AI.

3. The above challenges are exacerbated by the gap between Canadian higher-court rulings and patent office guidance.

4. Theoretical perspectives on innovation may aid in developing guidance to better assess software invention in emergent technologies involving algorithms.

4.2.1 There are ongoing challenges with patents and software, including the abstract nature of algorithms.

Given the text of s.27(8) of the *Patent Act*[507] that "no patent shall be granted for any mere scientific principle or abstract theorem" I inquired regarding what type of technology was obtaining a patent grant in AI. In these interviews it appears that the abstract theorem, including mathematical equations are a part of proposed inventions. However, there is an important dichotomy that arose and that was in an interview for PA-3 highlighting that "there are different perspectives, one is an algorithm is a process and it fits within section 2 of the *Patent Act,* or it is a mathematical equation with the actual equation not being patentable."[508] This distinction is important in this thesis because it illustrates that the term algorithm is fluid. Obviously, one takes a stance and argues in support of it, however there are instances, especially in the cutting-edge technologies seen today, where the terms algorithm or program are scoped and applied beyond the traditional boundaries for abstract theorems. There are gaps in the patent system that are demonstrated when applications push the boundaries of patent eligibility.

[507] *Patent Act,* RSC 1985 c P-4, s 27(8).
[508] (Participant (PA-3) Interview, August 11, 2017).

I explored how these rules applied in the case of AI. Despite judicial and legislative references to excluding abstract theorems from patentability, aspects of ML have seen a drastic increase in patenting in Canada and the United States. As with most areas of patenting, the bulk of the activity is in the U.S. market. PA-1 emphasized the exponential growth in the number of patents being granted in ML, "Machine Learning has gone from 100s of patents being granted to 1000s of patents being granted. There has certainly been an influx, and we see that in our practice as well, more patents filed or granted in that area," not because of increased patentability but because of the increased growth in that technology area.[509]

The following quote is a description of how the technology was translating into patentable applications; PA-1 notes, that the types of patents that are sought have been built upon "a lot of the hard work has been done in the AI space for the computers to be able to learn…the commercial applications are coming out of that," that is, "once you teach the machine to learn then you can build all sorts of business off that, so it's sort of a platform you can use, and that companies are leveraging to go into different commercial spaces."[510] This is consistent with cases such as *Shell Oil* and *Progressive Games*, which provide reasoning for a clear application and an industry-relevant result.

I saw how long-time uses of algorithms were being incorporated into emergent technologies and found to be inventive. In response to questions on the inventiveness of an algorithm, Artificial Neural Networks are one approach to ML algorithms discussed by PA-2. While these algorithms have been around for a long time, one can see that there is a built-in complexity and flexibility that allow for various inputs and results. One participant

[509] (Participant (PA-1), Interview July 11 2017); I assume this is the number of US patents as the majority of PA-1's filings were in the US.
[510] (Participant (PA-1), Interview July 11 2017).

indicated that while we do not understand completely how the brain works, we do have models and theories about how it works.[511] Neural Networks are one approach to replicating the brain's activities. The area of Deep Learning uses Neural Networks technology, which was developed several decades ago, and is very versatile and can work in very different ways. It was revealed through an interview with a patent agent that knowledge or experiential element makes the technique inventive:

> [in]my experience it can be bit of a black art, you can start with two sets of tools [and] two people may come to very different results just based on tweaking parameters in very different ways, and a lot of work comes in in actually figuring out what those parameters are through this neural network, and what inputs and parameters do you give it, to get a useful result at the other end of it, [one] needs tremendous amount expertise to make it happen and to work well and the underlying tools and underlying theory might be known but takes a lot of effort to get the right result so that effort is not experimentation, I actually think it is inventive.[512]

These interviews were premised on identifying what was unique about algorithms found in AI. In patent-speak, that means finding what was inventive and, in this case, what were the developments around patentability criteria in this regard. This led to discussions on patentability criteria in the ML algorithm area, which I explore in the next section.

4.2.2 These challenges are amplified when identifying the patentable elements of ML algorithms in AI.

Capturing the novel component in software inventions can be challenging in emerging technologies. This hearkens back to the discussion of claim construction in Canada and what role capturing the essential elements plays in the actual patent eligibility of the final product. In addition, the drafting techniques used by agents are learned from years of practice structured to guard against the known objections to patent validity.

[511] (Participant (PA-2), Interview July 12 2017).
[512] (Participant (PA-2), Interview July 12 2017).

Part of the rationale behind this research is that there is something novel or inventive beyond what typically is deemed abstract when claiming an algorithm and what qualifies as an invention involving an algorithm that could increasingly shift the abstract theorem towards patent-eligible in emerging digital technologies. Part of the data gathering on software inventions was to understand the agent's view. It appeared that capturing the novel component in a patent application was more art than a science. For instance, some algorithms have a pre-processing step for quality control which contains considerable novelty. One patentability requirement is the establishment of the novel component in the proposed invention, and there are sometimes challenges or uncertainties associated with identifying that actual novel piece. PA-2 describes one of the techniques used to capture novelty,

> We often describe it to the client as drawing fences or building fences around the invention…For instance You build a fence around that and then you think about that and say" [if you] "abstract this out a little bit it is not just this one little piece its this broader piece and you build a fence around that and then you keep building these fences and that is your claim you have your independent claim and your dependent claim and those outside fences may fall but you have a couple of more fences and at the end of that you have something being the actual invention.[513]

The drafting approaches cited clarify what the agent must claim to get the software invention or algorithm through the examination process. Specific to this investigation was what in fact, could be categorized as the novel component of a patent-eligible algorithm. It is far from simple to make this determination in the context of algorithms or unpatentable math. PA-1 noted, "if you could do the same thing over a desk with a pen and paper there is probably not a lot of inventiveness going on there."[514] PA-1 notes "the key thing is to make sure you include the hardware component that enabled the software to perform; a computer

[513] (Participant (PA-2), Interview July 12 2017).
[514] (Participant (PA-1), Interview July 11 2017).

is a machine and software on a machine works in a particular way so it's no different than a stapler that works in a particular way. It is another machine that performs, has an input, and then has an output."[515] For instance, the effects of a new age were revealed with reference to old approaches:

> people look at these things and say that's obvious, but the invention comes in actually making it work, what makes it work may be a novel use of a known tool and that is part of what Big Data is about you are taking what was available in some cases creating new tools, you are applying available tools and modifications to make things possible that weren't possible before and that looks a lot like invention to me.[516]

PA-2 clarifies the contemporary divide between the patentable and unpatentable algorithm: "it may be that the novelty comes from the algorithm that you have discovered, in which case if there is a patent to be found, the patent won't be in the algorithm itself but in the application of the algorithm."[517] Further support for this position is seen in *Shell Oil*. *Progressive Games* derived a test from *Shell Oil* [518] to aid in identifying an invention. The relevance of this decision is the test which has specific applicability in the case of software invention. In keeping with the test from *Progressive Games,*[519] there was support among participants for the patentable subject matter being more likely the result of the application of an algorithm. Further, the drafting of an invention includes some physicality tied in part to the algorithm. PA-2 reflects on how this could work in practice:

> If you discover a mathematical equation or a statistical equation that helps to parse data in a way that is more efficient that it requires less computer resources or you can do it faster even the invention lies in producing more data up front so you can reduce the amount of time to go through all that data, that is clever, more work up front for less work later, there is something in that. Obviously, the mere algorithm or statistical equation that you used to

[515] (Participant (PA-1), Interview July 11 2017).
[516] (Participant (PA-2), Interview July 12 2017).
[517] (Participant (PA-2), Interview July 12 2017).
[518] *Shell Oil, supra note* 25.
[519] *Progressive Games, supra* note 290.

> generate this data can't be patented, our act says that, if you apply it in a clever way to a particular problem that industry faces, I don't see why that shouldn't be patentable, same space as a big industrial machine would have a 100 years ago. [520]

This quote demonstrates the reliance, in part, on the production of an industry-relevant solution as part of the assessment of patent eligibility. It also describes in part the function of a pre-processing algorithm. I sought answers to what types of algorithms have clear elements that are novel. In discussions with experts in the field, it was noted that in a Big Data algorithm, the novelty is the same as with a conventional data algorithm.[521] That would include the final step of the application of a mathematical formula.

Multiple steps can be considered novel with a Big Data algorithm. For instance, it has a pre-processing step for quality control containing a lot of novelty. It can point out inconsistencies in the data and ascertain the data quality. This can also be called dimensionality reduction because not all dimensions are useful. For instance, noise data is thrown out, capturing errors and the essential elements remain.[522] This step is followed by the transformation step and, finally the application of a mathematical formula which can also be novel.[523]

I pursued the patentability and the algorithm discussion on several fronts, including how difficult it would be to invalidate a claim including an algorithm based on obviousness. An interview on these topics allows for examples that are not always reflected in legislation, policy, and guidance. For example, information on the drafting of claims, the use of hardware and data structures as well as the fluidity in formation and output of algorithmic solutions.

[520] (Participant (PA-2), Interview July 12 2017).
[521] (Participant (PS-2) Interview January 17 2017).
[522] (Participant (PS-2), Interview January 17 2017).
[523] (Participant (PS-2), Interview January 17 2017).

With the inquiries regarding patentability criteria, I aimed to illustrate how patent agent practices were used to tailor patent claims to optimize patent eligibility for patent claims on emergent algorithms. For instance, PA-2 indicated that "some are developing new tools that don't depend on Neural Networks."[524] For example, this would include the development of "very targeted approaches" by looking at known base elements and fostering interactions that produce a novel result, avoiding invalidity based on obviousness.[525] This finding demonstrates that in the mind of a patent agent, the actual effort into finding the novel outcome corresponds with what one would term inventive in the patenting process. The complexity of the underlying tool or model plays a part, but the analysis and output are generated partly by the human ingenuity found in tweaking parameters. Research indicates that these types of high-end algorithms are less than predictable, even for the talented patent agent. Prior art may be more advanced than current resources in databases.

In rounding out this exploration of patentability requirements associated with algorithms, I note that by claiming software elements alongside hardware elements, there is an increased chance of patentable claims. This decreases the chances for a claim to be deemed invalid. For instance, PA-1 indicated that for software to be most patentable, a lot of hardware (physical components of a computer) should be attached so elements of the software are being used in different locations.[526] With this technique, one can avoid an obviousness response because a computer is included.[527] The following quote talks about the advantage of a computer (hardware):

> The question is what advantage does the computer give that is not obvious if it is a generally known method or algorithm, where is the interesting thing

[524] (Participant (PA-2), Interview July 12 2017).
[525] (Participant (PA-2), Interview July 12 2017).
[526] (Participant (PA-1), Interview July 11 2017).
[527] (Participant (PA-1), Interview July 11 2017).

> happening, and a lot of the time, it has to do with the amount of data being processed and the real-time results that are being provided, and what is providing those real-time results, what hardware can do that and what is the processing achieving as well, and why is that something that would be valuable in giving patent protection for.[528]

The techniques involved in drafting the claim demonstrate "that the algorithm you are using is not simply something where the computer is incidental." Instead, the computer should be an essential element to the claim.[529] This approach is reflected in *Amazon* FCA where we see the algorithm as one of a novel combination of elements to form a patentable end.

The patent agents highlighted techniques that are frequently used in the drafting of pure software inventions. For example, PA-3 tries to put data structures "just to drive that there is a physical embodiment of where this information is stored…instead of just a disembodied method of doing something."[530] This example is consistent with the previously discussed three-part test in *Progressive Games*.[531]

4.2.3 The above challenges are exacerbated by the gap between Canadian higher-court rulings and patent office guidance.

A higher court-level decision in the software space is rare in Canada. The leading FCA case is *Amazon* FCA. I spoke to litigators on this issue because they were the most informed on the challenges associated with litigation in this technology area and at this court level. For instance, PL-2 notes that aside from *Amazon* FCA, "there have been other cases"

[528] (Participant (PA-1), Interview July 11 2017).
[529] (Participant (PA-3), Interview August 11 2017).
[530] (Participant (PA-3), Interview August 11 2017).
[531] *Progressive Games*, *supra* note 290.

which "involved software type applications, quite a lot but none which have gone to trial, lots of cases have gone through discoveries… but they have settled."[532]

Two key issues that arose in this discussion with litigators and supported my findings in the case law and the overall narrative of this thesis. First, an enduring challenge throughout the literature is evident based upon Supreme Court findings in *Free World Trust* and *Whirlpool Corp.* v. *Camco Inc* and responding guidance. For example, the inconsistencies between practices at the patent office and the approach to purposive construction determined by the SCC in *Free World Trust* and *Whirlpool* cases were highlighted as a challenge. The Federal Court in *Amazon* and *Choueifaty* encountered challenge with the CIPO MOPOP approach to focus on problem solution (focus on what was new in the patent claim and read everything else out). This approach contravened the Canadian SCC decisions of *Free World Trust, Whirlpool, and Amazon* to purposively assess patent claims. PL-2 reflects on the challenges during the *Amazon* [533] case:

> between the time of the Federal Court decision in Amazon and the Federal Court of Appeal decision in Amazon there was a new version of the MOPOP chapter on Computer Implemented Inventions released by CIPO spelling out the CIPO methodology for dealing with patents in this space. The MOPOP approach was to focus on a problem-solution approach, that is focus on what was new in the patent claim and read anything else out. Whereas the CIPO sought to find support in foreign law on this point, there was a body of higher court decisions in Canada that highlighted purposive construction as the appropriate method to assess patent claims.[534]

PL-2 indicated "the Patent Appeal Board considered the *Amazon* patent using the new MOPOP methodology which advanced European policy at the time."[535] This contrasts with the purposive approach that the SCC in *Free World Trust* and *Whirlpool* ultimately pointed

[532] (Participant (PL-2), Interview July 28 2017).
[533] (Participant (PL-2), Interview July 28 2017).
[534] (Participant (PL-2), Interview July 28 2017).
[535] (Participant (PL-2), Interview July 28 2017).

to for claim construction. While it is not unexpected that there would be gaps at different levels of adjudication, it is a finding that would strengthen the case for a revised approach. The case for better guidance became more prominent with the more recent 2020 Federal Court case of *Choueifaty* and the 2022 FCC of *Benjamin Moore* (supportive of purposive construction).

The second key issue identified by the litigators and which I address in the balance of the thesis is the patentability of the business method. This is a longstanding issue in the software space and dates to some of the earliest Canadian statements on business schemes or professional skills. For instance, PL-2 indicates that pre-Patent Appeal Board in the *Amazon*[536] decision there were no prohibitions on business method patents, this fitting with the case law and the *Patent Act* at the time.[537] Following the PAB decision in *Amazon*, the MOPOP was amended to create a *per se* prohibition on business methods. The PAB *Amazon* decision was then cited as the precedent for further decision-making. As stated in the end, the Amazon one-click patent was found to be patentable, but the route to making that determination was unclear. *Choueifaty* supplemented *Amazon* FCA in mid-2020. It dealt with a computer-implemented invention and confirmed purposive construction as the standing test for claims construction in Canada. The recent FCC case of *Benjamin Moore* provided further support for purposive construction. The U.S. goes a step beyond Canada and pursues the question as to what part of these business methods may qualify as patentable. The *Alice* patent can be categorized as a business method and as an example of a fintech application. As a result of its precedential value (being another rare instance of software at the Supreme Court) and the continuing issues with software and business method application, the case of the

[536] *Amazon* COP supra note 286.
[537] (Participant (PL-2), Interview July 28, 2017).

Alice patent found its way into the discussion. One patent agent does a lot of patent agency work in the United States. The *Alice* case turns on the categorization of the algorithmic invention as "abstract." Part of the issue in the U.S. is that "abstract idea" itself is an ambiguous term, and PA–3 indicates what will "fall in and out" of that categorization "seems to be more what the examiners think."[538] This indicates that there is an element of subjectivity in the decision. It is challenging to have a very narrow interpretation of an abstract idea: PA-3 indicates that the *Alice* case "is pretty wide open," and notes that the court was not going to "delimit" the parameters of an abstract idea.[539] PA-3 expands on the issue of categorizing the abstract and indicates that the *Alice* court is relying on earlier precedents such as *Bilski* in its reasoning to deem the business method abstract, with no clarity on ***why*** it may be abstract.[540] However, the USPTO provided further guidance in 2019 and 2020, that aided the case for some inventions that had been limited because of the *Alice* decision.[541] Attempts at clarification can be seen in lower court cases decided since *Alice* and have helped the patent office provide a clearer guidance in assessing similar inventions.[542] On the other hand, there has been a reluctance on the part of the higher courts to outright define the 'abstract.'

4.2.4 Theoretical perspectives on innovation may aid in developing guidance to better assess software invention in emergent technologies involving algorithms.

My premise in developing this research project was that theoretical perspectives on innovation could influence the characterization of section 27(8) excluded abstract theorem and section 2 invention. Therefore, in each interview I asked for participants impressions of the term 'innovation'. I asked if they were familiar with the term and how they viewed it in

[538] (Participant (PA-3) Interview August 11, 2017).
[539] (Participant (PA-3), Interview August 11, 2017).
[540] (Participant (PA-3) Interview August 11, 2017).
[541] United States Patent and Trademark Office, "Subject Matter Eligibility" (5 October 2022) online: *USPTO* <https://www.uspto.gov/patents/laws/examination-policy/subject-matter-eligibility>.
[542] Grossman, Dodd & Perry, *supra* note 309.

relation to the patent system. My goal was to ascertain general knowledge in the area and whether my idea of incorporating innovation perspectives into future patent policy/guidance was relevant.

I was encouraged that Schumpeter's take on the innovation-invention dynamic was consistent with the understanding in legal circles. While participants were general in their descriptions of innovation, the thread of thought in the questioning surrounded the distinction to be made between the two terms-innovation and invention-with innovation reaching beyond invention to something that is more market relevant (whereas an invention is not necessarily market relevant) and requiring a commercial application.[543]

4.2.4.1 Incremental

Following from this general understanding of innovation writ large, I posed questions on multiple dynamics involving innovation in my research. On the nature of innovation and invention the term incremental innovation was used by several participants as a term to be associated with software. PA-2 indicates that generally the "vast majority of inventions are incremental, improvement to what was there before, rare blue-sky invention that nobody has seen before; almost always based on work that was available before… most of the time they continue to work on it and find new ways to improve it."[544]

The interviews indicate that in the software realm and invention writ large, there is an opportunity for valuable incremental innovations. For instance, PA-2 also noted that these are "infinite improvements that can be made to these things [innovation] sometimes it can be quite minor, it may be immeasurable-maybe it saves on manufacturing costs, electricity, you don't know. People are consistently working in this area[patents], they are trying to file

[543] (Participant (PA-1), Interview July 11 2017).
[544] (Participant (PA-2), Interview July 12 2017).

patents to protect their space."[545] It also opens the door for a more expansive consideration of a disruptive element when elements of emerging technologies are present. However, it is important to note that incremental invention can still be as significant as one that is radical or disruptive when considering future patent guidance.

While considering innovations that are shorter-term and lacking in complexity, I thought it would be interesting to explore the linear innovation model. While I can see the difference in software development on the linear side with tried-and-true, easily revisable solutions, this thesis invites one to consider the higher-order modelling associated with brute-force algorithmic solutions. To illustrate the linear thinking in software development, A-1 equates linear progression with the fact that "there is a mature software industry that is still using programming language to achieve solutions, in that kind of programming (Peoplesoft) there is a …mature environment."[546] The following section introduces the more sophisticated technologies-technologies with an increased chance of disruptive tendencies.

4.2.4.2 Non-Linear/Disruptive

In my research, I uncovered the progression from linear to non-linear innovation. My goal was to understand this transition or progression in terms of a more sophisticated software solution. Participants indicated that emerging technologies are becoming associated with more of a non-linear model. Although, again, the academic interpretation of this dynamic was very clear, in terms of emerging technologies, A-1 noted that with the more advanced technologies in the software space, i.e., "trust arrangements, virtual trade environments, facilitated by blockchain technology… there is more of a stepwise conversation going on there; somebody is having more creative thoughts that are disruptive to our/the traditional

[545] (Participant (PA-2), Interview July 12 2017).
[546] (Participant (A-1), Interview October 13, 2017).

trajectory of the industry."[547] This thinking led me to connect the non-linear with the disruptive and the more emergent software solutions. Further, it supported my ideas that I could incorporate these models into the patent interpretation.

4.2.4.3 The role of clusters and innovation

Clusters and innovation have been in my purview for a long time, primarily regarding regional economic development and the synergistic/collaborative relationships between industry, academia, and government. I thought of the collaborative, innovative potential of the cluster in both early and later-term research and the proximity of the related input to facilitate algorithmic innovation. Then, I thought about the standard type of ML algorithm that gathered, selected, organized, and synthesized input, and how to put a novel lens on these interactions.

The term cluster is commonly associated with the practice of finding or establishing groups in data.[548] A cluster theory can be considered in this realm but has challenges. For instance, "there is still much confusion concerning the proper conceptualization of a cluster, except that it is generally conceived as a non-random spatial concentration of economic activities (Ellison and Glaeser, 1997)."[549] Important to note that I am not conflating concepts, but rather sticking to the cluster theory and its effects, not the patentability of a 'cluster algorithm.' During the interviews, I asked about clustering in algorithms and computers in a very broad way, as it had arisen in my research for the thesis proposal. Most participants did not comment on this aspect, although one patent agent gave some detailed input. PA-2

[547] (Participant (A-1), Interview October 13, 2017).
[548] Leonard Kaufman, Peter J. Rousseeuw, *Finding Groups in Data: An Introduction to Cluster Analysis* (New Jersey: John Wiley & Sons, 2005) 1 at 2.
[549] Charlie Karlsson, Introduction in Charlie Karlsson,ed, *Handbook of Research on Cluster Theory* (UK: Edward Elgar Publishing Ltd, 2008) 1 at 2.

indicates that with the application of cluster analysis "to solve a problem," you are getting a "useful result… that is where the invention comes."[550] To me this indicates that cluster analysis reflects the identification or selection of elements to achieve a solution, combining with the algorithm to produce an output or patentable end. As a step further, the "novel combination" in *Amazon* FCA is on point with the synergistic relationships between elements using a cluster analogy. This analysis could be applied to any ML algorithm. PA-2 further notes that an "invention doesn't rely on the cluster analysis on its own without any application."[551] Can we apply that patentable output to reach a commercial-ready solution or true innovation? Several types of these algorithms reflect aspects of cluster behaviour as an innovation, including the combination or selection of elements or datasets towards a patentable end.

PA-2 made a salient point on the use of the cluster theory: "just because we know the theory doesn't mean we don't need ingenuity to apply it to a particular problem."[552] These ideas were discussed in the novelty section. So if ingenuity lies within the tool that has allowed accomplishment of a single use for some time, "but if you find a new use …you may be able to get a patent for it."[553] The same can be said of biomedical structures traditionally used at the macro scale, which are now being used at a nanoscale, and require special effort, novelty, or inventiveness in a new application.[554]

[550] (Participant (PA-2), Interview July 12 2017).
[551] (Participant (PA-2), Interview July 12 2017).
[552] (Participant (PA-2), Interview July 12 2017).
[553] (Participant (PA-2), Interview July 12 2017).
[554] (Participant (PA-2), Interview July 12 2017).

4.3 Next Steps:

4.3.1 Consider if there is a theoretical basis in innovation to influence future patent office and court-level decisions in software inventions

This chapter demonstrates through expert accounts that introducing innovation models in patent eligibility determinations for emerging technologies is a distinct possibility. The analysis confirms that invention and innovation can both be considered an invention. The algorithm could also be considered an innovation or an invention in some of these emerging technologies, paving the way for expanded consideration of software and the abstract in claim construction.

Following this could be a novel view of patent eligibility in software inventions. One component of Schumpeter's theory that mirrors the components of emerging digital technology is that of new combinations of elements which emulate the structure or clustering effects of ML algorithms. For instance, this can be seen when selecting or organizing datasets in an AI example involving ML. It is significant how these innovation perspectives are reflected in emerging algorithms where Schumpeter and Porter's ideas of combinations and cooperation of elements to form an invention have evolved to the present day.

4.3.2 Examine the range of patent challenges in association with software invention and emerging technologies

As part of these interviews, I was trying to establish if there was any definitional divide between the software and the algorithm. For instance, PA-2 distinguishes that an algorithm can be 'quite discrete' and or where 'software is infinitely more complex' and involves 'multiple levels of abstraction.'[555] There can also be some confusion over computers and hardware. As discussed in the section on patentability, it is the use of hardware or

[555] (Participant (PA-2), Interview July 12 2017).

physical components that can make the difference between the patentability of software elements.

I used interviews to obtain a sense of the scope of understanding as to how a variety of experts categorized software or algorithms. Before discussing some of the challenge areas, Table 3 (set out below) provides an overview of the vocabulary and definitions used by the interviewees. This table is significant because every situation requires consideration of the audience and what the message will be in that context. On my part, this thesis could play a part in informing patent office guidance and judicial decision-making. The following chart (Table 3) sets out the terminology obtained from CIPO, patent agents, academics, and litigators.

Table 3: Definitions

Term	CIPO	Patent Agent	Academic	Litigator
Software	Computer-Implemented Invention	Software patents Software, algorithms (application of algorithm), Code	Software patents Define in terms of solution and application rather than as an algorithm	Software and Business Methods Software Patents Software type application
Hardware	Computer-Implemented Invention	Attach hardware to make software patentable.	Do not tie to a hardware element tie it to a field of activity; the invention is not centred on the software.	Hardware

It is noteworthy that CIPO does not use the term software--the category is known as computer-implemented inventions. This term is found in CIPO's MOPOP and applies to various disciplines. This is relevant because the position of the CIPO in categorizing such

inventions informs the entire patenting process, from drafting to complete application. It also informs the analysis and interpretations of the practice notices produced by the CIPO.

Academics in this space seem comfortable with the term software patents or inventions. The terms appear to identify the existence of patents in the software technology space. While not necessarily patenting of the software itself, it is an invention utilizing software to implement the technology. This question is relevant because as one examines the literature associated with software and patents, software placement within the scope of any intellectual property rights should consider the insight of an academic.

Academic–1 indicated that a patent-eligible technology should be defined in terms of the solution obtained or the application rather than solely by the algorithmic component. [556] In A-1's opinion, the patentable solution is obtained by tying the software to a field of activity and not to a hardware element. It supports statements on problem-solution presented by the CIPO and the U.K. patent office. The problem-solution approach presented by CIPO was not in keeping with SCC cases deeming purposive construction the appropriate approach. The recent cases of *Choueifaty* and *Benjamin Moore* confirm the proper approach to claim construction to be purposive.

Patent agents (PA) used the term software patent, software, and algorithms. Patent agents were comfortable with the term software and algorithms, just not engaging with the patent office. The reason is that the term software or algorithm is not considered patent-eligible subject matter in the patent office and, as a result, is not used in connection with applying for

[556] (Participant (A-1), Interview October 13 2017).

4.4 Summary

The algorithm presents in increasingly sophisticated forms in this digital realm. Novel math and unique combinations of datasets are representative of a Machine Learning algorithm. Moreover, the novel combination of elements facilitating the construction of innovations as patentable invention lends itself to using the innovation lends support to using the innovation lens for analysis. The concluding chapter contains some recommendations for consideration.

CHAPTER FIVE: Recommendations and Conclusions

5.1 Context

In this thesis, I proposed that innovation theory resonates at a conceptual level with AI ML algorithms. Given this, the innovative element as an algorithm is cast in the context of Schumpeter and Porter's theories on clusters. Innovation theory is seen in the combination and interconnection of elements in both a proximal and virtual way. This is illustrated through the *Amazon* FCA combination of essential and non-essential elements to form a patentable end. Using cluster theory, I argue that the use of purposive construction is reflected in the novel combination of elements, with at least one or maybe all being essential.

When considering the theory underlying the choice of elements to combine, one may see a cluster or cooperation of elements including an algorithm as an essential element of a patent claim. Following this should be a novel view of patentable subject matter in software inventions. One component of Schumpeter's theory that mirrors the components of emerging digital technology is that of new combinations which emulate the structure or integration of diverse elements to be synthesized by an algorithm. Porter is also reflected when characterizing innovation as new combinations of existing resources, reflective of clustering effects.

Theoretical perspectives on innovation and clusters allow us to visualize how innovation is cast in the *interpretation* of invention in software. Further to that, one could also consider a validated *approach to interpretation*. Some emerging technologies containing a novel algorithm do not coincide with patent eligibility and patentability criteria. This could be seen in the case of *Schlumberger*. *Schlumberger* was pre-*Free World/Whirlpool*

statements on purposive construction. As was found during the research, purposive construction can shift the once--abstract novel element into a patentable novel combination of elements.

Post-*Choueifaty*, and *Benjamin Moore* (under appeal), a more consistent approach is needed between the patent office and the judiciary on the legal principles to be used in construing the claims (purposive construction). Following the *Amazon* FCA approach above, the patent claim as drafted in whole or in part may contain essential elements key to the purposive construction of a computer-implemented invention. One of the problematic pieces in the post-*Choueifaty* CIPO guidance pointed out by the patent bar is the inclusion of an emphasis on the narrowed wording for "physicality," supportive of the problem solution approach. This wording is not consistent with *Amazon* FCA.[557]

To come full circle, identifying the abstract theorem, in the context of purposive construction, allows one to see the combination of non-essential with essential for a patentable end. A process or method indicating that an algorithm is an element in a novel combination can be considered in this context, broadening the scope for innovation to generate novel insights and patentable innovations**.** In this study, the practical application of the abstract theorem producing a useful, commercially relevant output can also lead to patent eligibility.

[557] The discrepancy between the post *Choueifaty* guidance and the *Amazon* FCA on physicality is pointed out in the following quote, See Y. Artemis Lai, "CIPO's New Guidelines on Patentable subject matter explained" (2020), online: <https://www.smartbiggar.ca/insights/publication/cipo-new-guidelines-on-patentable-subject-matter-explained>. For instance, Lai indicates, "The new guidelines appear to require "physicality" at this step, setting the standard at either physical existence or manifestation of discernible physical effect or change. The requirement of "something that manifests discernible physical effect and change" (emphasis added) appears narrower than the requirement of "something that manifest discernible effect and change" enunciated by the Federal Court of Appeal in *Canada (Attorney General) v Amazon.com, Inc* 2011 FCA 328."

Fulfillment of patent criteria (new, useful, or non-obvious) is important for AI ML algorithms, including the determination of inventiveness in support of non-obviousness. When one thinks of the inventive step or "something more" in obviousness, one can retain the approach to novel and maybe complicated combinations to move the abstract into something that is, in fact non-obvious. Given that the purposive approach to construction is now informed by s.53.1 of the *Patent Act*[558] potential attributes (disruptive, incremental, linear, non-linear) of a process can give context to the patent application.

5.2 Recommendations

AI is and will continue to be a novel area of inquiry. The search for the inventive concept using properties or characteristics of the claimed invention is one example. The patent drafter is schooled in 'building fences' around the proposed invention. In addition, patent agents point out the elements that factor into their drafting practices, such as identifying a point of ingenuity or some point of novelty.

These are recommendations for the patent office and the judiciary considering the history in the software and business method invention space and the broader challenges in Canadian patenting. There are several areas the patent office can address without extensive intervention.

- Reverse the patent office position so that purposive construction of the claims can happen at the examination stage.
- Reconsider the 2020 practice notice on 'Patentable subject matter' in line with patent bar concerns on the use of the term 'physical change;' Language should be consistent with that of the *Amazon* FCA.

[558] *Patent Act*, RSC 1985 c P-4, s 53.1.

Further to these initial interventions, the FC *Benjamin Moore* test should be considered, and attention paid to its eventual treatment at the Federal Court of Appeal.

There are also recommendations for judicial consideration, broadly inspired by past court decisions. Further clarifying conceptualizations of the 'abstract' and 'invention' is the first area I am recommending for further discussion. I discuss these terms throughout the thesis. Software and business method invention, particularly AI ML algorithms, can be assessed in terms of (1) section 27(8) exclusion from patentability and (2) section 2 categories of patent-eligible invention. Finally, the differing views on inventive concept and claim construction in the context of patentability requirements are important as one examines the role of innovative elements in the case of AI ML. For example, attention to evidence on the following warrant consideration: (1) the elements of novelty or ingenuity within the claim; (2) the extent of integration of hardware and software, the efficiency of data processing and effects of computing speed and power; the complex and flexible parameters used with Neural Networks. In addition, consideration should be given to the fact that introducing an innovative, not previously considered essential element could change the landscape in this technological area. There is an opening and arguably a necessity for international approaches to be considered in the AI field. However, the Commissioner making statements on Canadian policy is not the best approach. The use of parliamentary committees could be one avenue to explore these issues. In accordance with *Amazon*, the role of purposive construction as the backbone of the analysis remains important. The nuances introduced and amplified by AI ML algorithms will carry these questions forward for further investigation.

5.3 Relationship between the patent office and the judiciary in software inventions

The differing opinions of the patent office and the judiciary are grounded in the nature of the algorithm, particularly the algorithms in the early years of software patenting. As such, I try to contextualize the conclusion, mindful of U.S. cases such as *Gottschalk*[559], *Parker*[560] *and Diamond*[561] and the scrutiny of an early case in Canada, *Schlumberger*.[562]

I also explore the historical challenges presented by prior Canadian jurisprudence, including the contravening views on patent eligibility of the abstract theorems, professional skills, and business methods. These inconsistencies culminate in opposing views held by the patent office and the judiciary on claims construction and patent-eligible subject matter in *Amazon*, *Choueifaty*, and *Benjamin Moore*. *Amazon* FCA identifies that the invention could lie with the novel combination of several essential or non-essential elements. Post-*Amazon* FCA, the patent office developed guidance, not in line with the SCC approach to purposive construction found in *Whirlpool* and *Free World Trust* and still favouring a problem-solution approach like European perspectives and the Commissioner's decision in *Amazon.*

After the flood of business method patents with the USSC *State Street* case, further issues with patenting software inventions presented in the cases of *Bilski* and *Mayo*, narrowing the scope given to the successful application of the *State Street* algorithm. With these two cases, the U.S. court moved towards a two-step test, crystallized by the U.S Supreme Court in *Alice*. The first step is patent eligibility, where it decides if the patent in question is abstract. The second step asks for an inventive step. The decision resulted in the

[559] *Gottschalk, supra* note 61.
[560] *Parker, supra* note 63.
[561] *Diamond, supra* note 62.
[562] *Schlumberger, supra* note 129.

invalidation of many business-method patents in the United States system. In addition, the USPTO provided added guidance to patenting in the area in 2020[563].

The most recent shift at the Canadian patent office stems from the Federal Court decision in *Choueifaty*: the patent office refused a patent, basing the rejection on the use of a problem-solution approach as part of the inventive step. The *EPC* continues to identify the inventive step using the problem-solution approach. The inventive step is also known as the non-obviousness standard in Canada. However, most recently, the 2022 FCC case of *Benjamin Moore* directed the CIPO to use a test prioritizing purposive construction. This case is under appeal.

The lessons to be drawn from these cases are that software (1) has been historically challenging and controversial to patent; and (2) is now at the center of some of the key technologies used in the infrastructure and management of computer systems in government, industry and academia. I argue that there is room for some measure of consensus on the issues of patenting in software. It may require further training on the nature of the technology, but it also requires a meeting of the minds on how we are fostering and furthering innovative and economic ends in Canada.

5.4 Public Policy Concerns

Public policy concerns about patenting software elements include that many of these elements should be in the public domain. These elements are then to be an accessible foundation to further innovation. There are also concerns about stifling innovation with bad patents and patents on fundamental components blocking follow-on innovation in key areas such as genomics and software. One can describe follow-on innovation to be used "in

[563] United States Patent and Trademark Office, "Subject Matter Eligibility" (5 October 2022) *supra* note 541.

connection with research and development innovations of all types because it encompasses technological advances: large and small, pioneering, and incremental. It also captures how one technological advance follows from prior technological advances and prior knowledge."[564] The issue is when follow-on innovation faces challenges resulting from exclusive rights and higher prices, in this case, in the IT sector.

Over the past few decades, there have been significant changes in the patenting of electronics and software, diagnostic tools and biotechnology, and computer-implemented business methods. As is expressed by Nurton, "few topics in IP have proved as divisive and difficult in the past 20 years as patent protection for software."[565] There are longstanding arguments against patenting many software elements, including that those lifecycles can be short and that "diverting time and effort during R&D to patent ideas increases costs and reduces the ability to capitalize on the value of a first-to-market release."[566] Burk and Lemley indicate that "the cycles of improvement across quick product generations, coupled with the difficulty courts have had in defining the scope of software patents and the lax standards for issuing those patents in the last century, have led to a flood of software patent lawsuits, …IT firms claim that their ability to grow and innovate is stifled by the pervasive threat of such suits.[567]

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[564] Secretariat of the World Intellectual Property Organization, "Follow-on Innovation and Intellectual Property-Input to the World Health Organization Commission on Intellectual Property Innovation and Public Health", online:
World Intellectual Property Organization
<https://www.wipo.int/export/sites/www/policy/es/global_health/pdf/who_wipo.pdf>.
[565] James Nurton, "Supreme Court must step up on Software patents" (2014) 236 Managing Intell. Prop. 4
[566]Conrad Seaman, "Contextualizing the Software Patent Debate in Canada: A Practical Approach to Policy Development" (2014) 3:1 Osgoode Hall Review of Law & Policy 97 at 116, online: *Osgoode Digital Commons* <http://digitalcommons.osgoode.yorku.ca/ohrlp/vol3/iss1/4/>.
[567] Dan L. Burk & Mark A. Lemley, "Levers at Work-the IT industry" in Burk, Dan L, and Mark A Lemley, *The Patent Crisis and How the Courts Can Solve It* (Chicago: University of Chicago Press, 2009) 1 at 282.

In examining the software invention, I am remiss not to highlight the issue of patent thickets and how shifts in patent policy in areas of bio and software are influencing the course of patent law. The patent thicket is characterized in several ways by scholars in the area. For example, Shapiro indicates that it is "an overlapping set of patent rights requiring that those seeking to commercialize new technology obtain licenses from multiple patentees."[568] The thicket is also defined as "a dense undergrowth of interrelated patents that researchers have to navigate to develop new technologies."[569] Further, patent thickets consist of patents that protect components of modular and complex technology. [570]

In terms of patent thickets, the main issues are the patenting of foundational upstream inventions, such as gene sequences and biomarkers in the biomedical space and abstract theorems, such as algorithms or mathematical principles in the software space. The downstream inventions include applications of these discoveries. There is evidence of the patent thickets phenomena seen in the biomedical space over two decades ago. The seminal 1998 paper "Tragedy of the Anticommons" by Heller and Eisenberg argues that '"an increased number of patents, from a diverse set of owners could make it difficult to "acquire rights to all necessary research inputs," thus resulting in "underuse of valuable technologies.'"[571] Heller and Eisenberg conclude that the "privatization of biomedical research offers both promises and risks. It promises to spur private investment but risks

[568] Carl Shapiro, "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting" (2001), online: *SSRN* <https://ssrn.com/abstract=273550>.

[569] Andres Guadamuz, " The software patent debate" (2006) 4:3 Journal of Intellect Property Law Pract. 1 at 12, online: SSRN <https://ssrn.com/abstract=886905>.

[570] Browyn Hall et. al. "A Study of Patent Thickets: Final Report prepared for the UK Intellectual Property Office" (29 October 2012) National Institute of Economic and Social Research at 2, online: *Berkeley.edu* <https://eml.berkeley.edu/~bhhall/papers/HHvGR_Patent_Thickets_FIN_29Oct12.pdf>, 1 at 2.

[571] Cheryl Power et. al., " Alternative IP Mechanisms in Genomic Research" (2007) 2:2 Studies in Ethics, Law and Technology, online: *De Gruyter* < https://www.degruyter.com/view/journals/selt/2/2/article-selt.2008.2.2.1052.xml.xml>.

creating a 'Tragedy of the Anticommons' through a proliferation of fragmented and overlapping intellectual property rights."[572] The patent thicket presents unique challenges:

> The patent thicket is especially thorny when combined with the risk of hold-up, namely the danger that new products will inadvertently infringe on patents issued after these products were designed. The need to navigate the patent thicket and hold-up is especially pronounced in industries such as telecommunications and computing where formal standard setting is a core part of bringing new technologies to market. Cross licenses and patent pools are two natural and effective methods used by market participants to cut through the patent thicket, but each involves some transaction costs.[573]

Shapiro states above that one can address the problem of the patent thicket in various ways, including setting standards to facilitate the transfer of valuable technology out of a dense set of overlapping rights.[574] As such, the role of a standard-setting organization (SSO) is to "establish, adopt, disseminate, and coordinate technology standards in almost every industry. Over one thousand standards organizations developing hundreds of thousands of standards."[575] The standard setting is used in the computer and telecommunications field. Importantly, "when a technological standard is adopted, implementers must pay to license all 'standard-essential' patents (SEPs)… SEP owners usually make commitments to offer licenses on 'fair, reasonable, and nondiscriminatory' (FRAND) terms.[576] The SEP covers "technology that must be used in order to comply with an interoperability standard, such as the 3G and LTE standards for cellular telecommunications."[577]

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[572]Michael A. Heller & Rebecca S. Eisenberg, "Can Patents Deter Innovation? The Anticommons in Biomedical Research" (1998) 280: 5364 Science 698 at 701.
[573] Carl Shapiro, "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting," *supra* note 568.
[574] Carl Shapiro, "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting," *supra* note 568.
[575]Daniel F. Sulber, "Standard Setting Organizations and Standard Essential Patents: Voting and Markets" (2017) 129:619 Northwestern Law & Econ Research Paper 1477 at 1477, online: *SSRN* <https://ssrn.com/abstract=2865763>.
[576] Erik Hovenkamp, "Tying, exclusivity and Standard Essential Patents" (2017) 19 Colum Sci & Tech L Rev 79 at 79, online: SSRN < https://ssrn.com/abstract=3012654>.
[577] Robert L. Maier, "Standard Essential Patents and FRAND Licensing: Anything But 'Standard' (24 March 2020) NY Law Journal, online: *NY Law Journal*

There are further policy consequences of the proposal, specific to AI and with those responsible for guiding examiners, the Canadian Intellectual Property Office, and the examiners themselves. Again, this is not a proposal to expand patenting as a rule, but rather to allow for fulsome consideration of the specification and claims in purposive construction. There are implications for the Canadian AI industry that are not necessarily negative. While patenting in computer-implemented inventions is not without issue, as this thesis demonstrates, innovative patenting approaches that benefit Canadian researchers will help build evidence to attract funding support in the country. As per the Council of Canadian Academies report on AI, "patents and copyrights have become key assets in an increasingly digital and intangible economy…This issue is particularly relevant to Canada, given recent initiatives to derive greater returns from Canadian innovation."[578]

5.5 In *Amazon*, the FCA signalled its discontent with the Commissioner's approach to the Amazon.com patent

In *Amazon*, the Federal Court signals discontent with the Commissioner's approach to the Amazon.com patent. Sharlow J. at the FCA indicates that the construction of the claims should be based on a purposive construction per the legal principles set in *Free World Trust* and *Whirlpool.*[579] In Chapter 3, I review the court's response to the four points made by the Commissioner when deciding against granting the Amazon.com one-click patent. Issue is taken by Sharlow, J. at the FCA with Phelan J. applying his construction to the claims, which

<https://www.law.com/newyorklawjournal/2020/03/24/standard-essential-patents-and-frand-licensing-anything-but-standard/?slreturn=20200508154606>.

[578] Council of Canadian Academies, *Leaps and Boundaries-The Expert Panel on Artificial Intelligence for Science and Engineering, Council of Canadian Academies* (Ottawa: Council of Canadian Academies, 2022) online: *CCA* < https://www.cca-reports.ca/wp-content/uploads/2022/05/Leaps-and-Boundaries_FINAL-DIGITAL.pdf>

[579] *Amazon* FCA, *supra* note 23 at para 43.

Sharlow J. believes should benefit from the expertise available at the patent office.[580] She indicates that there may have been a different finding if the Board used the correct legal principles (purposive construction) instead of employing the principles of form and substance.[581]

5.6 *Choueifaty*: Suggested approach

The Attorney General decided not to appeal the *Choueifaty* case. Instead, the CIPO reviewed the situation and provided guidance for patent examiners in late 2020. In accordance with the *Choueifaty* case the role of the computer as an essential element becomes increasingly important.

In *Choueifaty*, the Federal Court took issue with the CIPO's treatment of patentable subject matter and ordered the subject patent application to be re-assessed under the principles put forward by *Free World Trust* and *Whirlpool*. CIPO's position (based on *Genecor*) up until late 2020 is that purposive construction does not factor into the patent application process, as is suggested at the FCA in *Amazon*.[582] The FCA in *Amazon* ruled that purposive construction is the acceptable method in characterizing the invention, even at the application level. However, my interviews indicated that there can be tensions over the shifting dynamics at different stages of the patent office and court process. This is further demonstrated by the Federal Court in the case of *Benjamin Moore*, again affirming purposive construction as the preferred approach.

[580] *Amazon* FCA, *supra* note 23 at paras 72 – 74.
[581] *Amazon* FCA, *supra* note 23 at paras 72-74.
[582] *Amazon* FCA, *supra* note 23.

5.7 Purposive Construction: An overall interpretive approach

In accordance with *Free World Trust, Whirlpool*, the use of purposive construction is the Supreme Court-directed legal principle for construing the claims, and that may include the identification of essential or non-essential elements (what I have characterized as innovative elements.) Therefore, using the reasoning from *Amazon* FCA, one can argue that if the algorithm (a)is not simply facilitating an analysis that can be performed by a human being but instead (b)performs an algorithmic process, including a physical component (computer or data structure), is an essential element in novel combination, or the action of one element against another; all could be patentable.[583]

There are positive moves by the USPTO on AI patents and the CIPO may follow suit. While CIPO is preserving long-held references to cases such as *Schlumberger*, they also attempted to address concerns over the absence of purposive construction (as per *Free World Trust* and *Whirlpool*), which included new guidance on algorithms. These efforts to address the principles of purposive construction were criticized in *Choueifaty* but could aid CIPO and the judiciary in framing software inventions.

Theoretical perspectives on innovation can help patent examiners and the judiciary shed new light on the dynamics between innovation and invention. In developing added guidance, it becomes a fundamental question of what the policy makers view as the appropriate parameters to draw around the essential or non-essential element. The innovative element/invention dynamic supports the purposive approach to claim construction and the findings of the *Amazon* FCA.

[583] *Amazon* FCA, *supra* note 23 at para 63.

5.8 Future Directions

There are three lines of evidence in this thesis. First the thesis is developed and supported using innovation perspectives, some close to a century old, that are surprisingly relevant in the digital era. As well, jurisprudence from Canada and the United States presents and supports a spectrum of arguments to consider the boundary between unpatentable and patentable inventions, including algorithms associated with AI. I integrate these lines of evidence with excerpts (from interviews) with the patent agent, the patent litigator and the academic. Finally, the existing purposive construction framework supports this exploration of ideas, when parallel ideas on the search for the inventive concept arise, particularly in the case of a ML algorithms found in AI.

In summary, this thesis has culminated in a novel analysis using a rich mixture of disciplines. This included using an interdisciplinary approach, innovation lens and qualitative methods, methods that are not traditionally used in law. Future researchers in the area should consider the insights garnered by an interview study, particularly in emerging technologies. Given my research into these issues, including the changing roles/forms of the algorithm, I would not rule out future research to support the patent office and judiciary in further clarifying the ‘abstract theorem’ and patentable subject matter in law.

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Appendix A Research Ethics Approval

File Number: 04-17-03 **Date (mm/dd/yyyy):** 05/03/2017

Université d'Ottawa
Bureau d'éthique et d'intégrité de la recherche

University of Ottawa
Office of Research Ethics and Integrity

Ethics Approval Notice

Social Sciences and Humanities REB

Principal Investigator / Supervisor / Co-investigator(s) / Student(s)

First Name	Last Name	Affiliation	Role
Teresa	Scassa	Law / Law	Supervisor
Cheryl	Power	Law / Others	Student Researcher

File Number: 04-17-03

Type of Project: PhD Thesis

Title: Should innovation theory play a role in generating Patent Eligibility Standards in Software?

Approval Date (mm/dd/yyyy)	Expiry Date (mm/dd/yyyy)	Approval Type
05/03/2017	05/02/2018	Approval

Special Conditions / Comments:
N/A

Appendix B: Interview Guide March 2017

The following questions will be used by Cheryl Denise Power to guide the interview process with patent agents, patent litigator, patent examiners, and academics.

Questions for Patent Agents

How long have you been involved in the area of software and patents?

What is your area of specialty?

Did you draft patents?

What do you use as guidance when drafting patents?

What do you believe are key feature of successful patent claims? In Software technology?

What types of software technology have you successfully patented?

With what types of software technology have you had the least success?

Have you patented algorithms?

Can you give examples of the types of algorithms that are the most successful in obtaining patents?

Can you describe the key components of a patent claim for successful applications?

Have you thought about patents and Big Data?

Have you patented any inventions related to Big Data or Big Data synthesis?

Would component of the claim is typically deemed the inventive component?

Are you familiar with the term innovation?

Do you think most software inventions would fit within a linear or a non-linear model of innovation? Describe models to inform question.

Have you considered other types of IP protection for software technologies that have come across your desk?

To what extent do you rely on US practice in this area?

Questions for Patent litigators

How long have you been involved in the area of software and patents?

What is your area of specialty?

What types of software technology have you successfully defended?

What types of software technology have you had the least success defending?

Have you considered other types of IP protection for software technologies that have come across your desk?

To what extent do you rely on US practice in this area?

Are you familiar with the term innovation?

Has innovation ever been categorized described in any of your patent cases?

What do you use as guidance when developing your litigation strategy, how does the structure of the patent claim factor into that strategy?

What do you consider to be the key factors contributing to the outcomes of cases in this subject area?

Are you aware of the patenting of novel software solutions in the area of Big Data and algorithms, do you have opinions on this?

Questions for patent examiners

Can you talk about the examination process for software patents, ie what is your primary guidance, practice notice, legislation, case law?

What are the primary characteristics of a successful patent?

Can you talk specifically about inventions that are related to Big Data?

Can you speak about the patentability of algorithms?

Can you talk about the patent claims that are successful in software inventions versus those that are not?

Can we talk about innovation models and when and if they factor into patenting decisions, strategies?

Questions for Academics

How long have you been involved in the area of patents?

What is your area of specialty?

Have you examined any type of software technology in your research and writing?

Do you have any opinions on the patentability of software technologies?

Do you have any opinions on the patentability of novel software solutions in the area of Big Data and algorithms?

What would you deem the optimal protections for software technologies?

Are you familiar with the term innovation? Would you apply linear or non-linear models of innovation to software solutions?

What do you consider to be the leading guidance on software protections in Canada?