Code as Social Archaeology: Uncovering Generative Mechanisms Through Algorithmic Analysis

Vincent Martin-Schreiber

University of Ottawa

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Opening

May 2018, France: Student Guillaume Ouattara wins court case forcing Ministry of Higher Education to release France higher education admission's system's source code (Parcoursup).

The Question:
What does this code actually do to social reality? What is its relation to the real ontological layers?

Beyond Technical Analysis:
*How do algorithmic systems function as genuine **mechanisms** shaping our increasingly digital society?*

Agenda

1. Introduction on algorithms
2. Short history of French higher education selection
3. Critical Realist Eye
4. Digital Excavation Methods

What Are Algorithms?

Simple Definition

A sequence of operations for a task

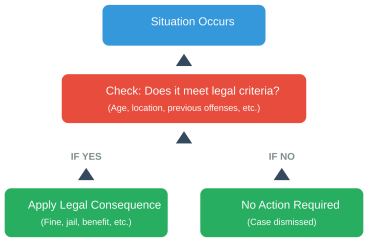
Think of it like a recipe, but for processing information and making choices

Legal Systems as Algorithms

- **What it does**: Governs behavior and assigns consequences
- **How it works**: Step-by-step instructions for society
  - "If person commits action X under conditions Y, then apply penalty Z"
  - "If citizen meets criteria A, B, and C, then grant benefit D"
- **Social impact**: Creates and enforces social order, determines rights and obligations
- *Laws are society's original algorithms—written instructions that shape collective behavior*

Legal Systems Visualization

Laws as Algorithms: Step-by-Step Instructions for Society

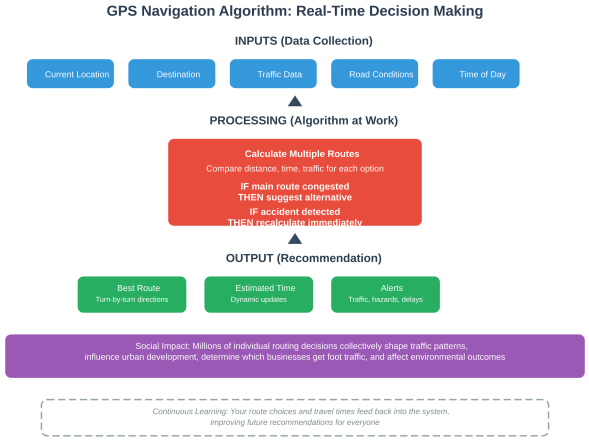


Example: Speeding Law Algorithm

IF person drives over speed limit AND is caught by officer
THEN issue ticket with fine based on speed excess
IF speed > 25 mph over limit THEN add license suspension

GPS Navigation

- **What it does**: Finds the best route from point A to point B
- **How it works**: Processes multiple factors in real-time
  - Calculates distance, traffic conditions, road closures
  - "If main route is congested, then suggest alternative path"
  - Updates recommendations as conditions change
- **Social impact**: Influences where people go, how cities develop, which businesses thrive


GPS Navigation Algorithm: Real-Time Decision Making
INPUTS (Data Collection)
Current Location
Destination
Traffic Data
Road Conditions
Time of Day
PROCESSING (Algorithm at Work)
Calculate Multiple Routes
Compare distance, time, traffic for each option
IF main route congested
THEN suggest alternative
IF accident detected
THEN recalculate immediately
OUTPUT (Recommendation)
Best Route
Turn-by-turn directions
Estimated Time
Dynamic updates
Alerts
Traffic, hazards, delays
Social Impact: Millions of individual routing decisions collectively shape traffic patterns,
influence urban development, determine which businesses get foot traffic, and affect environmental outcomes
Continuous Learning: Your route choices and travel times feed back into the system,
improving future recommendations for everyone

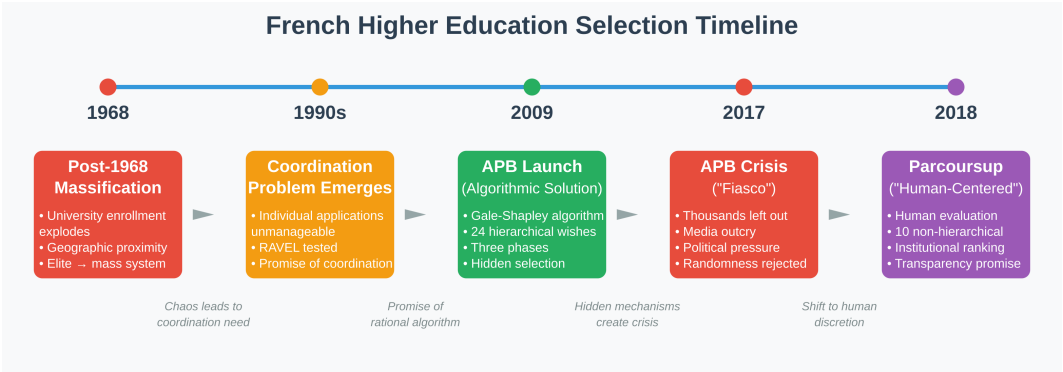
Why This Matters for Sociology

Algorithms don't just process data—they actively shape social reality by determining:

- Who gets opportunities (jobs, education, loans)
- What information people see (news, recommendations)
- How social interactions are mediated (dating apps, social networks)

They are invisible architects of social structure

French Higher Education Selection



System Architecture

Feature	APB (2009-2017)	Parcoursup (2018+)
Selection Method	Algorithmic with random lottery	Human evaluation + institutional ranking
Application Structure	24 hierarchical wishes	10 non-hierarchical wishes
Decision Timeline	3 fixed phases (June-August)	Continuous rolling process
Transparency	Hidden selection mechanisms	Published algorithms + selection criteria
University Role	Passive recipients	Active evaluators

The Parcoursup Paradox

Promise vs. Reality

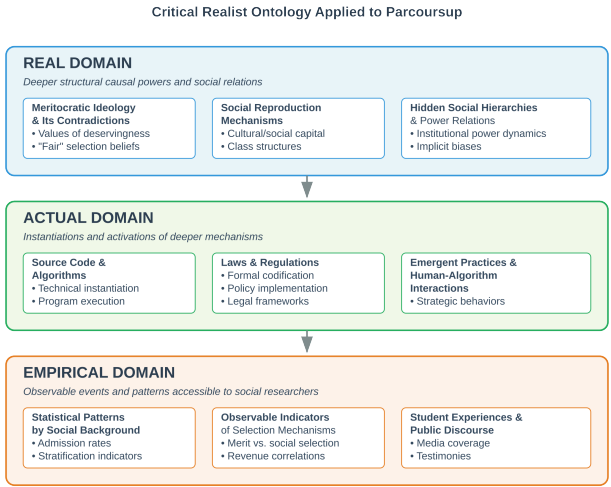
Promise: "Human-centered" system eliminating unfair randomness
Reality: More complexity, not less

Key Contradictions

- **Transparency Illusion**: Published algorithms hide subjective evaluation criteria
- **Merit Rhetoric**: "Human review" masks continued geographic and social reproduction
- **Complexity Transfer**: From algorithmic opacity to institutional discretion
- **Rolling Anxiety**: Extended decision period creates prolonged uncertainty

A Critical Realist Analysis

Stratified Ontology Applied to Algorithmic Systems



Key Insight: Algorithms as Social Constructors

Beyond Instrumental View: Algorithms don't merely process social reality - they actively **construct** it

Generative Causal Powers:

- **Geographic quotas** systematically favor local students
- **Merit calculations** encode particular definitions of academic worth
- **Ranking opacity** enables discretionary institutional bias
- **Temporal processes** advantage families with cultural capital
- **Emergence**: New forms of social sorting arise from algorithmic-social interactions

Digital Excavation: Code as Material Evidence

The Transparency Revolution That Wasn't

May 2018: The Court-Ordered Disclosure

- Student Guillaume Ouattara forces release of Parcoursup source code
- Government publishes algorithms on *Algorithmes De Parcoursup* (2023)
- **Promise**: Full transparency enables democratic oversight
- **Reality**: Two-tiered opacity system emerges

What Code Analysis Actually Revealed

The Visible Layer: - Central Parcoursup matching system: fully open source - Mathematical verification using formal methods - Legal compliance proofs and documentation

The Hidden Layer: - Institutional ranking criteria: completely opaque - University committee deliberations: protected by secrecy - "Local algorithms": no standardization or oversight

2019 Conseil d'État Ruling: Universities' specific sorting mechanisms protected by "educational deliberation secrecy"

Critical Realist Methodology: Retroductive Code Analysis

Digital Excavation Approach:

- **Source code as material evidence** of embedded generative mechanisms
- **Retroductive analysis**: From observable code patterns to underlying social mechanisms
- **Stratified analysis**: Multiple levels of algorithmic decision-making

Methodological Innovation:

- Digital excavation for critical realist research
- Code analysis as complement to traditional sociological methods
- New tools for identifying generative mechanisms in algorithmic systems

Beyond Black Box: Neither pure technical analysis nor pure social critique—mechanism identification

Methodological Framework for Digital Excavation

Collaborative Interdisciplinary Approach:

- **Technical partnerships**: Collaborate with computer scientists and software engineers for code interpretation
- **Domain expertise integration**: Combine sociological theory with computational analysis
- **AI-assisted analysis**: Use large language models for systematic code pattern identification and interpretation

Retroductive Process:

- **Layer identification**: Map visible code to hidden decision mechanisms
- **Mechanism inference**: Move from empirical patterns to generative structures
- **Social validation**: Test mechanism hypotheses against observed social outcomes

Some Examples of Research

Credit Scoring Research Question

What are the generative mechanisms through which credit scoring algorithms reproduce social stratification, and under what structural conditions do these mechanisms operate to transform financial access into durable patterns of wealth inequality?

Criminal Justice Research Question

How do risk assessment algorithms function as generative mechanisms within existing criminal justice structures, and what emergent properties arise from the interaction between algorithmic prediction and human discretion in sentencing decisions?

Conclusions - Code as Social Archaeology

Bottom Line Up Front

Core Findings:

1. **Code serves as material evidence** of underlying social mechanisms - source code analysis reveals embedded generative powers operating in the domain of the real
2. **The Parcoursup case demonstrates** how algorithmic transparency creates two-tiered opacity - visible code obscures invisible institutional discretion mechanisms
3. **Digital archaeological methodology** enables critical realist investigation of algorithmic systems through retroductive analysis of code patterns
4. **Stratified ontology applies to algorithmic systems** - code exists in the real, execution in the actual, and social outcomes in the empirical domain

Opening to Data-First Approaches

The Coming Challenge: - **From Theory-Driven to Data-Driven**: Traditional explicit programming → Machine learning from patterns - **Methodological Implications**: How do we conduct archaeological analysis when algorithms learn rather than implement? - **Critical Realist Response**: Need for deeper excavation techniques to uncover mechanisms in AI/ML systems

Future Research Directions: - Extending archaeological analysis to machine learning systems - Investigating training data as social reality embedded in algorithms - Developing tools for retroductive analysis of emergent AI behaviors

Thank You - Questions?

Contact Information:
Vincent Martin-Schreiber
University of Ottawa
vmartins@uottawa.ca

Research Focus: Critical realist methodology applied to algorithmic governance and digital sociology

Collaboration Welcome: Expanding critical realist approaches to digital systems analysis

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