

# Research Proposal in Computational Social Sciences

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## 1. Why computer?

Attribution analysis is a cornerstone of social science research. However, due to the human brain's limited capacity to process data, traditional sociology focuses on macro-level attributions, often leading to unresolved controversies. This limitation stems from our constrained ability to comprehend the objective world.

Social science, like any science, seeks falsifiable truths. Today, big data has enabled more precise attribution analysis and gave rise to the interdisciplinary field of computational social science.

## 2. Algorithmic abstraction of social systems

I propose that social systems function as object-oriented memory algorithms, while the collective system of all societies operates as a parallel distributed algorithm. Social institutions serve as the framework and code implementation, determining algorithmic complexity and robustness. The objective conditions of society act as input, societal development as output, and human behavior as feedback—an iterative process driven by big data. Since feedback is not strictly deterministic, predicting and adapting to it is a necessary function of the system.

From this perspective, social systems can be optimized and reconstructed. Effective algorithmic design requires precise input analysis, as misinterpretation leads to inevitable failure. However, premature evaluation of a system's success can be equally misleading, as initial outputs do not fully reflect long-term viability.

Social systems are finite and continuously evolving. Once established, they become objective structures with inherent social costs for modification. A system reflects the ideology of its time, maintaining relative stability until unpredictable feedback surpasses its original design, leading to constraints on productivity or even social crises. For example, an education system designed to rapidly train specialists may struggle to adapt to interdisciplinary needs, limiting societal progress. Worse, failure to recognize systemic flaws can lead to national decline.

Ultimately, every social system has a lifecycle. As inputs change, new algorithms emerge, reinforcing the principle that no system remains optimal indefinitely.

## 3. Big Data-Driven Evaluation

My algorithmic abstraction of social institutions relies on big data science and technology. Only with advanced big data capabilities can the complexities of society be accurately interpreted as input and output. However, when analyzing social systems within specific domains, the difficulty is significantly reduced. Big data bridges macro-level abstraction with micro-level concreteness, enhancing cognitive ability and enabling more precise institutional analysis.

Even in a stable social system, institutional design remains flexible, with room for refinement. A key step in optimizing social efficiency is using big data to evaluate

institutional effectiveness. Traditional sociological methods—such as qualitative analysis—are often limited by one-sided perspectives, redundant conclusions, and a lack of micro-level validation. These limitations stem from the complexity of causal interactions in social systems, where outcomes result from the superposition of multiple factors. Identifying true inputs and outputs is particularly challenging, making big data science essential for overcoming these constraints.

#### **4. Causal Modeling of Social Systems**

I proposed a four-dimensional spatiotemporal causal graph model to analyze social systems. Each entity is represented as a discrete node with a quantified influence (weight), and causal relationships are captured through directed edges with associated strengths. Over time, these interactions evolve dynamically, forming a structured framework for understanding complex societal changes.

To apply this model, we should leverage big data-driven causal tracing. For instance, in evaluating an education system, we track individuals' trajectories over time—examining factors like income, career paths, and social mobility—to assess long-term impacts. Traditional methods often fail to capture the full causal structure due to their reliance on limited perspectives. Instead, this approach systematically hypothesizes causal links, searches for relevant data, and refines relationships iteratively. By constructing and comparing multiple causal graphs, we identify the most robust explanations and ensure causal accuracy, rather than drawing misleading correlations. Additionally, correlation discovery is employed to uncover hidden patterns within vast datasets. This method, akin to discovering unexpected market trends like the "beer and diapers" phenomenon, provides insights that may not emerge through hypothesis-driven approaches alone. The combination of causal inference and pattern recognition enables a comprehensive evaluation of social systems.

Implementing these methodologies enhances policy optimization and institutional efficiency. By quantifying systemic impacts, decision-making becomes more data-driven and adaptive. Moreover, this research contributes to democratic processes by providing objective, verifiable insights that mitigate ideological conflicts. Rather than relying on subjective interpretations, stakeholders can engage in evidence-based discussions, fostering mutual understanding and reducing societal friction.

#### **5. Optimizing Social Systems: Balancing Efficiency and Equity**

A social system is a structured mechanism through which a governing body directs societal operations. Fundamentally, it reflects the interests of the ruling class, yet its overarching purpose remains the same across nations: maximizing resource utilization to enhance national strength and global standing. The core challenge lies in designing a system that effectively gives everyone access to equitable development.

The effectiveness of a social system is quantifiable. Different institutional frameworks yield varying degrees of success depending on historical and environmental contexts. The necessity of assessing institutional outcomes is based on measurable performance rather than ideological assumptions.

Social systems, once established, shape economic structures and distribute benefits among societal groups. Their evolution follows a dynamic interplay between

production relations and economic forces. Institutional inertia, often reinforced by vested interests, creates resistance to change, whereas dissatisfaction with current status often generates momentum for reform. Stability arises when conservative forces dominate, but when the drive for change outweighs resistance, systemic transformation occurs. Historical patterns reveal that clinging to outdated structures inevitably leads to stagnation, necessitating continuous institutional adaptation.

The design and implementation of an efficient social system resemble engineering and physics problems—requiring rigorous analysis of objective laws and flexible adaptation to real-world conditions. Reforms operate on two fronts: reducing inefficiencies (e.g., streamlining bureaucracy) and improving governance effectiveness (e.g., macroeconomic regulation). Achieving this balance demands an in-depth understanding of societal challenges, as human cognitive limitations constrain our ability to navigate complex social dynamics.

The trade-off between efficiency and equity is central to social system optimization. While disparities drive ambition and economic dynamism, unchecked inequality hinders productivity and social cohesion. The tension between capitalism and socialism, or even policy debates such as lockdown measures during a pandemic, often boil down to balancing these competing imperatives. The success of a system hinges on its ability to manage contradictions pragmatically, recognizing that qualitative debates are often inconclusive without robust quantitative analysis.

Ultimately, improving social systems requires empirical evaluation. Public opinion, though valuable, is often fragmented and reactionary. Effective governance depends on systematically gathering and analyzing data—tracking economic performance, policy impacts, and societal trends—to refine decision-making processes. Only through such an evidence-based approach can we enhance institutional efficiency, minimize systemic costs, and foster sustainable social progress.

## **6. Big Data Governance: Efficiency, Oversight, and Decision-Making**

Big data governance encompasses three key dimensions: service, oversight, and research.

First, big data services facilitate digital governance, streamlining administrative processes, enhancing governmental efficiency, and modernizing governance systems. Second, big data oversight strengthens regulatory mechanisms and social monitoring, reducing corruption and crime by ensuring greater transparency. Third, big data research enhances decision-making by uncovering causal relationships, minimizing errors, and optimizing resource allocation through quantitative analysis.

Unlike traditional governance methods, big data governance is characterized by efficiency, precision, and scalability. Computer-assisted decision-making reduces bureaucratic inefficiencies, lowers costs, and reallocates human resources to higher-value tasks. However, the effectiveness of such systems depends on the accuracy of algorithms—flawed models can lead to resource misallocation and unintended consequences. While traditional governance also utilizes data, the scale and analytical power of big data transform governance fundamentally, allowing for limitless data processing and deeper insights.

Robust oversight is essential to mitigate risks associated with big data governance.

Institutions, including regulatory bodies, are susceptible to corruption, making technological safeguards necessary. Blockchain and other immutable data storage mechanisms enhance transparency by preventing unauthorized alterations. Comprehensive social surveillance, though controversial, plays a role in public safety by identifying criminal activities and addressing societal issues efficiently.

Big data governance also revolutionizes research methodologies by shifting from qualitative speculation to quantitative analysis. Traditional dialectics often highlight complexity without offering solutions, whereas big data enables objective, data-driven insights. Conventional causal inference relies on empirical induction, which is inherently uncertain and prone to error accumulation. By leveraging full-scale data analysis rather than selective sampling, decision-makers can extract meaningful patterns from vast datasets, reducing reliance on flawed top-down causality assumptions. This bottom-up approach provides a more accurate reflection of societal dynamics, enabling more effective policymaking.

Ultimately, big data governance transforms decision-making by minimizing uncertainty and improving predictive accuracy. By integrating large-scale data analytics, policymakers can achieve a more precise understanding of societal trends and governance challenges, ushering in a new era of political and administrative efficiency.