Agency, Autonomy, and Freewill in Polynomial Time

Abstract

This note explores the philosophical implications of the fact that the Network Optimization Calculus (NOC) objective can be solved in polynomial time. We examine how this tractability informs the notions of *agency*, *autonomy*, and *freewill* within relational systems.

1 Agency

Agency refers to the capacity of an individual node to act within a system. Because the NOC optimization problem lies in the complexity class P, any node—or the system as a whole—can efficiently compute an optimal assignment of relationships. Thus, agents are not paralyzed by intractability; they possess the capability to act decisively within a feasible time frame. In this sense, *agency is empowered by tractability.*

2 Autonomy

Autonomy is the system's ability to self-determine its evolution. Since the global optimization can be carried out in polynomial time, the system is capable of continuously recalculating and adapting without reliance on heuristic or exponential computation. This renders autonomy practical: the system can evolve toward optimal configurations in real time, demonstrating a form of *continuous self-determination.*

3 Freewill

At first glance, polynomial solvability might appear to threaten freewill: if the optimal outcome is always computable, where is the room for choice? The answer lies in the superposition state N, which introduces probabilistic transitions between cohesion (C) and disjunction (D). Even within a tractable optimization landscape, outcomes remain probabilistically open. Thus, freewill is not grounded in computational hardness (NP), but in the *structural indeterminacy* of the system itself. Freedom is preserved through the possibility of reversal and stochastic transition, ensuring that the system is never locked into a deterministic trajectory.

4 Conclusion

The fact that NOC lies in P reframes the philosophical landscape:

- **Agency** is feasible action within solvable constraints.
- **Autonomy** is systemic self-determination empowered by tractability.
- **Freewill** is the structured possibility for divergence, preserved not by intractability but by probabilistic openness.

In short, tractability enables effective action and systemic autonomy, while probabilistic superposition safeguards the essence of free choice.