

Implementing and Analyzing Settlers of Catan as a Digital Artifact: Computational Recreation and Procedural System Analysis

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Abstract

Settlers of Catan translates economic scarcity, spatial expansion, chance, and negotiation into a compact ruleset that supports varied social play (Teuber, 1995). Discussion of its strategic depth, however, often treats properties such as balance, emergence, or negotiation as self-evident features of the finished game. This paper asks a more specific methodological question: how can rebuilding a tabletop game as executable software support humanities analysis? It presents a full Java recreation of Catan and treats implementation not as neutral digitization, but as a form of procedural close reading. In this approach, every rule must be made explicit enough to execute, every spatial relation must be represented as data, and every legal action must be stated as a testable condition. The practice therefore aligns with critical making, in which material production supports conceptual inquiry (Ratto, 2011), and with software studies that examines computational processes beneath an interface (Wardrip-Fruin, 2009).

The study uses a practice-based case study of the recreation’s design and implementation. The official rules and the behavior of physical components were translated into state representations, adjacency relations, action validators, and turn transitions. Development decisions and failures were retained as analytical evidence. An initial rectangular-grid model, for example, made edge cases proliferate because the board’s playable positions are hex tiles, intersections, and edges rather than cells in a single grid. Replacing it

with ring-based indexing and a dual-graph representation made the topology explicit: one graph records relations among hexes, another records intersections and edges, and mappings connect resource-producing tiles to eligible buildings. The resulting model supports direct queries about legal settlement spacing, road continuity, production neighborhoods, port access, and scalable board generation. This is not only an engineering improvement. It shows that Catan’s spatial meaning is distributed across several linked structures and cannot be adequately described by the visible tile layout alone.

Rule enforcement provides a second analytical layer. Build costs, component limits, turn phases, resource production, robber effects, and victory conditions are centralized rather than dispersed across interface code. Each proposed action is checked against the same game state and set of constraints. This turns rules that players may handle tacitly at the table into inspectable invariants, while also exposing adaptation choices. A standard distribution of resources and number tokens can be distinguished from a general board-generation algorithm; mandatory placement constraints can be distinguished from interface conventions; and implemented mechanics can be distinguished from deferred or simplified ones. In particular, open-ended player trading proved much harder to formalize than deterministic building rules. That asymmetry is itself a finding: the aspects most central to Catan’s social identity are not necessarily those most readily captured by a

stable computational model.

The executable artifact also separates interacting sources of strategic value. Dice probabilities determine expected resource flows; settlement locations couple players to overlapping production neighborhoods; roads constrain future reach; ports alter exchange ratios; and opponents change the value of a resource through their positions and willingness to trade. In physical play these factors are experienced together. In software they can be instrumented independently and recombined in controlled variants. The present contribution is therefore not an empirical claim that one configuration is optimally balanced, nor merely another playable Catan clone. It is a traceable model that makes hypotheses about scarcity, expansion, and rule variation available for future simulation and comparison.

This emphasis on formal systems engages, but does not simply adopt, procedural rhetoric's account of rules as expressive structures (Bogost, 2007). Sicart's critique warns that proceduralist analysis can reduce players to activators of meanings already contained in rules, neglecting appropriation, negotiation, and play as expression (Sicart, 2011). The recreation confirms that limitation. Code can reveal the opportunity structure within which negotiation occurs, but it cannot by itself explain why a player offers a generous trade, honors an informal promise, targets a rival, or collectively modifies a rule. Accordingly, procedural close reading is proposed here as one layer of analysis rather than a total account of play. Its proper objects are encoded constraints, affordances, state transitions, and implementation choices; player interpretation and situated social practice require observation and other human-centered methods.

The project contributes (1) an executable, testable representation of Catan's spatial and rule systems; (2) a documented method for using implementation decisions and failures as evidence; and (3) a bounded account of what computational recreation can and cannot disclose. By

pairing formal reconstruction with explicit attention to what escapes formalization, it offers a reproducible basis for comparing rule variants and digital adaptations without collapsing a socially negotiated game into code alone.

Keywords: computational recreation; critical making; procedural analysis; board games; game studies; software studies; hex-grid topology

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