Informational Ontology and Pre-Digital Automation in Ancient Engineering

itzhexen – June 21, 2025

Abstract

This paper explores how ancient engineering—specifically the construction of Egyptian pyramids—can be understood through the lens of informational ontology. We propose that while ancient civilizations likely did not possess formal computing technology, the foundational informational principles necessary for proto-computational systems were inherently available to them. By viewing construction as a process of structured information flow, resolution, and boundary-defined differentiation, we argue that pre-digital automation emerges naturally from physical constraints and interactions. This reframes ancient engineering as a distributed, mechanical computation embedded in material and labor.

1. Introduction: Reframing Ancient Construction as Informational Systems

Traditional accounts of pyramid construction focus on manpower, simple tools, and logistical coordination. This paper proposes an alternative perspective: large-scale ancient construction can be seen as a complex informational system where humans, tools, and materials participate in structured flows of information and resolution events.

We do not claim that ancient builders used computers or formal automatons as we understand them today. Instead, we highlight that the fundamental components and principles underpinning computation—flow, observation, resolution, identity, time, and boundaries—were available in the physical and material world they inhabited.

2. Automatons and Informational Machines: Beyond Electronics

The term automaton historically refers to mechanical devices performing pre-programmed tasks, often attributed to Greek inventors. However, within an informational ontology, an automaton can be any system that mediates information flow through structure to achieve resolution—a stable, transformed state.

Mechanical systems such as pulleys, counterweights, or tensioned ropes, combined with human coordination, can function as proto-automatons. These systems do not require symbolic processing or electricity; instead, their power lies in their structural constraints and physical interactions.

3. Observation as Structural, Not Mental

Observation in this framework is defined as the mediation of information flow through physical structure. This process requires no consciousness or awareness. Ancient construction could have employed mechanical principles where tools and structures mediated forces and movements, effectively "observing" through design and interaction.

Ancient civilizations may have possessed the essential components and mechanical principles necessary to build systems functioning like computation devices, even if they lacked formal understanding or terminology. By combining structural constraints, controlled flows of force, and sequential operations, they could have created proto-computational mechanisms—complex, reliable machines performing automated tasks without conscious design of computation itself.

4. Resolution and Precision in Ancient Tools
Artifacts such as precisely drilled holes and aligned shafts reveal remarkable control in construction. The creation of such features involves collapsing many potential outcomes into stable, repeatable forms—an act of informational resolution.

Tools like the bow drill, when used with guiding structures and abrasive materials, encode reliable, repeatable behavior into physical processes. This transforms raw material into functionally precise components through structured interaction rather than symbolic command.

5. Distributed Labor and Construction as Parallel Computation
A large construction project can be modeled as a distributed, parallel informational system: workers act as variable processors; tools serve as logic gates; supervisors provide control flow and error correction; the environment functions as energy input and timing.

The interaction of these elements sequences operations, ultimately producing a stabilized artifact—the pyramid. This emergence of complex, reliable structure from coordinated flows of physical action parallels computational processes, albeit without symbolic formalism.

6. Temporal and Ontological Boundaries in Construction
Time within this framework is shaped by sequences of resolution events, each marking a transition from uncertainty to form. Construction steps—cutting, lifting, placing—are temporal nodes that compose the evolving structure of the project.

Boundaries—physical or conceptual—enforce differentiation, defining observers and the channels through which information flows and resolves. Historical understanding is similarly bounded by cultural and conceptual limits, shaping what civilizations could observe or conceive.

7. Speculative Proto-Computational Machines
While speculative, the possibility exists that ancient builders could have created mechanical devices—constructed from wood, stone, ropes, and gravity—that functioned as automata by mechanically processing structure into form.

Such devices, cycling predictably and performing work without electronics or symbolic control, would represent proto-computational machines. Whether or not they existed, this ontological framing makes their feasibility conceptually clear.

8. Core Informational Principles and Their Relevance to Pre-Digital Automation
The following principles form the foundation of this framework and illuminate how proto-computational systems could arise from physical reality:

Observation is structural, not mental.
Physical structures and tools mediate information flow, enabling mechanical 'observation' without consciousness. Ancient construction could have harnessed these capabilities through design and material interaction.

Resolution collapses possibility into form.
The shaping and assembly of materials reduce potential outcomes into stable, functional states—performing computation as transformation.

Identity follows from collapse.
Distinct architectural elements and mechanical components emerge as identities through completed resolution events.

Time is shaped by resolution events.
The sequential nature of construction marks a temporal flow inherent in the process itself.

Boundaries enforce differentiation.
Physical and conceptual boundaries define observers and structure information flow.

These principles were inherently available within the physical and material context of ancient civilizations. This means the essential informational mechanics required to create proto-computational systems existed as possibilities—even if such systems were not consciously designed or fully realized.

9. Conclusion: Emergent Computation in Ancient Engineering
This paper has argued that the informational principles underlying computation are not limited to modern electronics or symbolic systems. They arise naturally from physical constraints, material interactions, and structured flows.

Ancient engineering—though lacking formal computational theory—may have realized proto-computational processes embedded in tools, labor coordination, and mechanical design. Recognizing this expands our understanding of computation as a broader structural phenomenon and enriches interpretations of ancient technological capabilities.

Importantly, the use of concrete examples, such as ancient pyramid construction and proto-automatons, serves as a means to test and illustrate the applicability of this informational ontology framework. These examples function as experimental grounds, revealing strengths, limitations, and areas for refinement. Through such grounded exploration, the framework moves from abstraction toward practical utility, bridging philosophy, history, and technology in a way that can inform further interdisciplinary inquiry.

Moreover, this inquiry raises deeper questions about the nature of tools and computation themselves. It invites reflection on whether the universe inherently provides the materials and physical laws that constitute “tools” in a broader sense—not just silicon chips or electronics, but any structure capable of mediating information flow, enforcing boundaries, and collapsing possibilities into form. Computation thus emerges not merely as a human invention but as an intrinsic property of structured matter and interaction. Ancient civilizations, though lacking modern technology, had access to many of these fundamental components by virtue of inhabiting a universe rich with physical and informational resources. This view broadens the concept of computation as a spectrum of systems, from simple mechanical flows to complex electronic processors, all grounded in universal informational

principles.