Symbolic Dynamics and the Scientific Language of Creation

Abstract

We propose that reality and cognition co-arise from structured symbolic dynamics embedded in geometrically nested space–time substrates, in which Platonic solids serve as symbolic coherence generators. In this view, the minimal Planck-scale simplicial events of causal dynamical triangulations (CDT) self-organize into higher-level "Platonic shell" geometries (e.g. tetrahedron, cube, octahedron, dodecahedron, icosahedron) that encode spatial logic. Conscious transformations and perception are governed by symbolic substitution dynamics (e.g. formal grammars or shift systems) acting on these nested geometric substrates. On the cosmological side, CDT and Regge calculus provide a discrete, background-independent foundation for spacetime (yielding 4D geometry at large scales, 2D near the Planck length), while quantum information in holography implements boundary codes (e.g. HaPPY pentagon-tensor networks). In biology, cells emit ultraweak photons (UPE) and maintain bioelectric fields that can carry information across tissues , potentially realizing photonic and electrical symbol flows. Artificial neural networks, especially generative autoencoders and diffusion models, demonstrate symbol-to-matter instantiation (e.g. Text2NeRF uses language prompts to build 3D scenes).

We distinguish established science (CDT, photonic crystals, biophoton emissions, neural-net generative modeling) from speculative extensions (e.g. neural holographic biophotonics, text-to-matter engineering, "perception-as-symbolic-encoding"). Crucially, symbolic logics and nested spatial models may underpin thermodynamics of meaning: information-entropy gradients drive pattern crystallization, and Landauer's principle links information erasure to heat dissipation . Misapplied symbol systems (e.g. overly rigid priors) can "overfold" cognition, causing hallucination-like distortions (as in schizophrenia). We argue that a rigorous, multi-level framework uniting quantum gravity, information theory, bioelectronics, and AI provides a new paradigm: creation is a recursive symbolic-informational-material system, where language and geometry encode, transmit, and instantiate physical structure.

Core Hypothesis & Integrative Model:

Component Function

CDT Simplicial Base Minimal Planck-level spacetime quanta; discrete simplicial structure for quantum gravity path integrals (e.g. CDT yields emergent 4D spacetime from 4-simplices) . Platonic Shells Nested symbolic spatial logic frames: Tetrahedron, Cube/Octahedron, Dodeca/Icosahedron as successive coarse-graining levels. Provides "symbol containers" at different scales. (Dual pairs: cube–octahedron, dodecahedron–icosahedron .) Symbolic Dynamics Temporal logic flows: substitution systems and shift maps implement the grammar of transformations. Consciousness encodes phenomena as sequences of symbols (akin to formal grammars or L-systems). Category Theory Formal framework for compositional structure: objects, morphisms, and functors describe how symbols and geometries compose (naturality squares, commutative diagrams). Provides an algebra of transformations and emergent equivalences. Quantum Info Theory Holographic boundary codes: entanglement geometry and error-correcting codes on hyperbolic tilings (e.g. MERA/HaPPY networks), relating bulk simplices to boundary symbols. Supports redundancy and fault tolerance in physical encoding. Biophotonics & Bioelectricity Light and charge-based signalling: cells emit ultraweak photons (UPE, 200–800 nm) and maintain endogenous electric fields. These biofields may organize cellular structure and carry "symbolic" signals, analogous to photonic crystals in nanostructures. Thermodynamics of Meaning Information-energy interplay: entropy gradients create "information potential" driving pattern formation. By Landauer's principle, symbolic erasure or consolidation dissipates heat ; cognitive inference can be seen as thermodynamic free-energy minimization. AI as Mirror System Neural networks as models of symbol-to-matter mapping: autoencoders and diffusion models demonstrate turning symbolic inputs into spatial/physical outputs. E.g., text-to-3D systems convert linguistic symbols into geometric "blueprints" . Mental Health Layer Symbolic overload or misalignment leads to cognitive pathology: too-strong priors or looping symbol traps cause hallucinations or anxiety (predictive-coding failures in schizophrenia). Balanced symbol-geometry integration is key to mental health. Futurist Hypothesis Emergence of symbolically coherent matter via text: given the above, directed language inputs could sculpt physical substrates through programmed geometric/photonic media ("text-to-matter" pipelines).

Research Sections

A. Simplicial Foundations

Simplicial quantum gravity underlies our spacetime substrate. In Causal Dynamical Triangulations (CDT), spacetime is constructed from 4-simplexes (tetrahedra generalized to 4D) that enforce a causal structure . Regge calculus similarly treats curved spacetime via piecewise-flat simplicial manifolds . CDT has shown that, remarkably, large-scale spacetime emerges with 4D behavior, whereas at Planckian resolution it appears effectively 2D (a "dimensional flow") . This suggests a fractal-like microstructure: discrete events (3- and 4-simplices) form the basis for emergent geometry. Spectral dimension flow and quantum field propagation on these complexes can be studied to understand early-universe physics. Our model uses these simplices as the "digital bits" of spacetime, onto which higher symbolic layers (Platonic shells) attach via dual lattice operations or coarse triangulation.

B. Nested Platonic Emergence

Above the simplicial level, we propose nested Platonic shells as coarse-grained carriers of symbolic information. Groups of simplices can approximate Platonic solids; e.g. connected tetrahedra and octahedra form cubic/octahedral lattices, while pentagonal arrangements (Goldberg polyhedra) induce dodecahedral/icosahedral topology. (Recall: the cube–octahedron and dodecahedron–icosahedron are dual pairs , reflecting deep geometric symmetries.) In effect, iterative "path sums" on the simplicial network yield emergent Platonic cells. For example, geodesic subdivision of an icosahedron (like a Fullerene/C60, a truncated icosahedron with pentagons and hexagons) demonstrates how curvature is stored in pentagonal "defects" within a hexagonal mesh. We hypothesize that at critical scales, spacetime self-organizes into hierarchies of Platonic lattices (tetrahedral minima, cubic gating, and icosahedral holism) that carry symbolic meaning. Figure: an arrangement of the five Platonic solids, representing nested geometric logic levels 【65†】 .

C. Symbolic Dynamics & Logic

We treat perception and cognition as symbolic information flows over time. Concretely, this can be modeled by symbol substitution systems (akin to Lindenmayer L-systems) and shift maps on symbol sequences. An L-system uses an alphabet of symbols and production rules to iteratively generate complex patterns – analogous to how the brain may build complex scenes from simple conceptual "axioms." Similarly, topological substitution tilings (e.g. Penrose tiling rules) hint at how symbols create quasiperiodic order. We posit a triadic relationship of structure–sequence–semantics in perception: static structure (geometric symbol frame), temporal sequence (rule-driven transforms), and emerging semantics (meaning). As an example, the shift space of neuronal firing patterns could encode logical content, with commutation operations corresponding to inference steps. In broader logic, Boolean or predicate operations may map naturally onto the faces or vertices of Platonic lattices (e.g. a cube's axes as orthogonal logic gates). Ultimately, symbol manipulation at this level underlies how meaning is constructed and transformed.

D. Quantum Codes on Boundaries

At the interface between bulk geometry and its environment, quantum information provides an error-correcting symbolic substrate. Inspired by the AdS/CFT correspondence, we consider holographic codes: tensor networks on negatively curved (hyperbolic) lattices that encode bulk qubits in boundary entanglement. A key example is the HaPPY code . HaPPY uses a tiling of pentagons (and hexagons) with perfect five-qubit tensors; each tensor maps five "physical" legs (on the boundary/adjacent tiles) to one logical bulk qubit . This network can be viewed as an emergent Platonic-like structure (a purely pentagonal tiling of the hyperbolic disk supports a [5,4] tessellation). It protects bulk information against boundary errors, much like biological codes protect genetic information with redundancy. We also invoke MERA (Multi-scale Entanglement Renormalization Ansatz) networks, which create a hyperbolic-like scaffold of entanglement. In these models, Pentagon Tensor Codes serve as discrete symbolic holograms: each pentagon is a perfect tensor (encoding isometric) that routes logical information through geometry. The duality between bulk and boundary in these codes echoes the Platonic duals (cube-octahedron, etc.), linking interior (analytic bulk) symbols to exterior (synthetic boundary) symbols.

E. Bioelectric & Biophotonic Structuring

Biological systems use light and electricity as organizing symbols. Cells continuously emit ultraweak photon emission (UPE) across the visible/near-UV spectrum, a byproduct of metabolic reactions . Experiments show UPE spans roughly 200–800 nm (ultraviolet through near-infrared), with key spectral lines from excited carbonyls (350–550 nm) and singlet oxygen (634, 703, 1270 nm) . Remarkably, internal photon intensity can be orders of magnitude higher than surface emission , suggesting an internal photonic "language." Pioneers (Gurwitsch, Popp) have speculated biophotons form coherent fields within organisms . We interpret UPE as a symbolic-organizing flow: mitotic or developmental signals may propagate via modulated light through tissue (as in Albrecht-Buehler's "rudimentary cellular vision" up to 750 nm).

Similarly, bioelectric fields (resting and action potentials in development) create voltage patterns that guide growth (Levin et al.). These fields can be seen as analog (but ultimately digitizable) symbol patterns that cells read and write. On the materials side, DNA origami and protein nanostructures can be engineered to form photonic crystals. For example, DNA-based tetrahedra have self-assembled into a diamond-lattice photonic crystal with a tunable UV-range bandgap . Such "programmable colloids" illustrate how information carriers (DNA sequences, proteins) form light-guiding geometries. We propose living systems exploit similar motifs: patterned molecular assemblies act as photonic scaffolds, shaping UPE interference and coherence for regulation.

F. Thermodynamics of Symbolic Energy

Information and energy are fundamentally linked. Landauer's principle shows that erasing one bit of information must dissipate at least $k_B T \ln 2$ of heat . Experiments confirm this information–energy equivalence (the "thermodynamics of memory") . We extend this to "symbolic energy": whenever cognition or biology increases order (lowers entropy by crystallizing meaning), an energy gradient is consumed. Thus entropy gradients become information potentials driving pattern formation. In the brain, for instance, maintaining low-entropy neural states (memories, learned models) requires metabolic energy (resetting ionic gradients dissipates heat, an implementation of Landauer's bound). More abstractly, pattern recognition can be seen as a Maxwell-demon-like reduction of uncertainty, paid for by entropy exported as heat.

In our framework, as symbols organize matter, information flows generate thermodynamic feedback: precise symbolic compression (e.g. a succinct formula) corresponds to an energy minimum. Conversely, symbolic noise or misencoding (random gibberish) is high-entropy and thermodynamically "hot," leading to cognitive instability (see Section I). We thus envision an information–thermodynamics bookkeeping: each transformation of a symbolic structure has an energy cost. This aligns with free-energy principles (Friston), where biological systems minimize surprise by thermodynamically efficient information encoding. In summary, cognition's "symbolic heat" and "semantic enthalpy" track the flow of energy in our symbolic-geometry model.

G. Category Theory

To formalize composition across symbols and shapes, we employ category theory. A category consists of objects and arrows (morphisms) between them, with composition rules. In cognitive terms, objects could be symbolic states or geometric structures, and arrows are transformations or inferences. Functors then map between categories (e.g. from syntax structures to semantic domains), and natural transformations relate different such mappings . For example, the commutative square ("natural transformation" diagram) captures how a surface form of a thought can be transformed into its conceptual form via alternate paths . In our model, Platonic shells are objects and embeddings between them (e.g. tetrahedron→cube expansions) are morphisms. Composition of these morphisms (gluing shells) obeys categorical associativity, ensuring consistency across levels. Category theory also encompasses monoidal (tensor) structures, which align with entanglement networks, and topos-theoretic logics for spatial sets. This provides a robust algebra for the transformations of symbols and shapes, enabling morphism diagrams that link geometric dualities (like Platonic duals) to logical dualities (like negation or inversion in logic).

H. AI Modeling and Symbol-to-Matter Engines

Modern AI offers practical models of symbol-to-material mapping. Autoencoders and neural-symbolic networks learn to encode structured data (symbols, language) into latent vectors and decode them into sensory-rich outputs. For example, given a structured description of a molecule, a neural net can generate its 3D coordinate graph. In 3D vision, methods like Text2NeRF merge large language models with generative 3D fields: Zhang et al. demonstrate generating full 3D scenes from text prompts, using a Neural Radiance Field (NeRF) guided by a diffusion-based image prior . (A sample result: input prompt "a beautiful garden" yields a multi-view-consistent 3D garden scene .) This shows how linguistic symbols become spatial meshes via neural pipelines.

We will develop AI experiments: one is to train a combined LLM + 3D GAN that takes symbolic logic trees (e.g. relational formulas or grammar rules) and outputs geometric meshes/blueprints. Another is a self-supervised autoencoder that compresses Platonic arrangements into latent codes and reconstructs them, revealing how shapes embed semantic content. These models serve as a "mirror" for our theory: if cognitive symbols truly encode spatial structure, the AI's performance in symbol-to-geometry tasks will reflect the coherence of this mapping.

Mental Health Layer

A corollary of our framework is that misapplication of symbolic structures can disrupt cognition. If one imposes an overly rigid or ill-fitting symbolic map onto sensory data, perception "hallucinates" to fit the model. Computational psychiatry describes schizophrenia in these terms: patients appear to have abnormally precise priors that bias perception . For instance, hallucinating individuals rely so strongly on internal predictions that they perceive stimuli not present (Pavlovian "conditioning hallucinations") . In our terms, a mental "symbolic overfitting" occurs: the system's symbolic scaffolding (models of reality) dominates sensory input, leading to confabulation. Conversely, excessive randomness in symbols (no predictive structure) leads to anxiety or confusion. We introduce the notion of symbolic resonance: healthy cognition requires a balanced coupling between symbol and matter. An "entropy cap" on symbol substitution (preventing runaway complexity) may be needed to avoid cognitive disintegration. These ideas could inform diagnostics: aberrant neural activity might be viewed as maladaptive symbol dynamics (e.g. feedback loops or "meaning attractors" that cannot settle).

Speculative Systems: Text-to-Matter Pipelines

In the most futuristic scenario, text itself becomes a fabrication code. Here, language is a geometric vector input: each word or sentence is mapped via an embedding to a point in high-dimensional space, which then drives the selection of Platonic or photonic generators. One could imagine a "holographic seed" printed in a photonic material: when exposed to certain optical patterns corresponding to textual codes, it crystallizes into a desired structure (akin to self-assembly programs). For instance, a programmable photonic lattice (e.g. a DNA-origami crystal) might be "inscribed" by modulated light patterns encoded from a text string, yielding a nanostructure. While no such system exists, the principles draw on our integrated model. Similar to how 3D printers read G-code, a text-to-matter engine would parse human language through symbolic logic into layered geometric instructions. This remains highly speculative, but recent advances (e.g. neural NeRFs, optical computing) suggest it is at least conceptually tractable.

Experimental Proposals

Domain Experiment Simulation FDTD photonic modeling of nested lattices: simulate electromagnetic fields in multi-scale grids (tetrahedral → cubic → dodecahedral). Analyze coherence modes and defect localization. Lab Neuronal culture on symbolic photonic scaffolds: grow neurons on patterned substrates (e.g. glass with embedded Platonic-shape electrodes or micro-optical traps) and measure UPE and electrical activity changes. Test if symbol-labeled fields guide growth or firing patterns. AI Symbolic-to-3D network: train an LLM (or logic parser) plus a 3D GAN to map structured logical descriptions to mesh outputs. Evaluate fidelity and "symbol grounding" (how stable are resulting objects under perturbed inputs). Category Morphism diagram toolkit: develop a visual formalism linking Platonic transformations (e.g. tetrahedral subdivision to cube) with categorical inference rules (e.g. conjunction/disjunction operations). Use this to check consistency (commutative diagrams) between geometry and logic.

Figures & Diagrams (proposed) • CDT→Platonic mapping: diagram showing simplices aggregating into Platonic cells (e.g. many tetrahedra forming an octahedron). • Symbolic substitution over Platonic mesh: schematic of an L-system rewrite rule acting on a tetrahedral lattice to produce a higher solid. • Bioelectric field topology: vector-field plot of a neural sheet colored by gradient of membrane potential; overlay of symbol patterns (e.g. Fibonacci spirals). • Biophotonic UPE emissions: spectrogram or diagram of cellular metabolism converting to photon bursts (435–750 nm) with embedded symbolic motif. • Tensor code tiling: illustration of a hyperbolic disk tiled by perfect tensors (pentagons/hexagons) for a HaPPY code. • Symbol-to-Matter flowchart: block diagram from text input → symbolic encoder → geometric planner → material output. • Neural-symbolic AI architecture: layered diagram of an autoencoder with symbol-attention modules linking text and shape. • Entropy map of overload: a heatmap showing information entropy vs cognitive stability, with "safe" and "dysregulated" regions (jagged peaks for delusions).

Design Rules • Triangle (Tetrahedron): fundamental event unit and minimal symbol container (the "bit" of geometry). • Cube/Octahedron: orthogonal grid operations; think of faces/edges as logic gate channels. • Dodecahedron/Icosahedron: high-entropy, holistic symbols; useful for global constraints and redundancy. • Pentagon tilings: optimal compromise for curvature + error-correction (inspired by viral capsids, C60). • Symbol substitution entropy cap: limit the branching of grammar rules to prevent runaway complexity (analogous to avoiding loop disorders in code). VII. Applications • Cognitive UI: Interfaces where thoughts are visualized as flows on symbolic-geometric graphs (for data analysis or brain-computer interaction). • AI cognition tools: Use structured symbolic maps (Platonic graphs) as inductive biases in generative models for more coherent outputs. • Mental health diagnostics: Develop "symbolic resonance maps" by measuring a person's tendency to impose geometric patterns on perception (early detection of overload). • Holographic learning: Teaching systems that use geometry (e.g. VR of Platonic worlds) to instill recursive, multidimensional concepts, letting students explore equivalences via shape manipulations.

Ethics & Safety • Clarity vs. Correlation: Distinguish our symbolic-hypothesis from empirically measurable phenomena. Avoid overinterpreting coincidences of geometry and cognition. • No medical claims: This is theoretical; do not propose untested interventions for mental health. Biological manipulation (e.g. neurons, DNA origami) must follow safety protocols. • Biophotonics safety: Ensure any photonic or electromagnetic exposure in experiments is within biocompatible limits (e.g. keep UV/IR intensities minimal, follow laser safety guidelines).

Optional Extensions • 4D Symmetry: Explore Platonic 4-polytopes (600-cell, 120-cell) as hyper-symbolic attractors in extended cognitive space. • Topos Theory: Develop a topos or sheaf-theoretic view of symbolic space (e.g. Lawvere's semantic topos) to unify logic and geometry. • Altered States: Speculate on psychedelic experiences as perturbations of symbolic attractors (label clearly as conjecture). • Spiritual Integration: Conjecture parallels between symbol-geometry interplay and mystical concepts (e.g. "perception-as-prayer"); treat as philosophical aside.