

## PATENT APPLICATION

### INVENTOR(S)

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### TITLE

0002 Distributed Semantic Inference via Public Network Validation and Structured Knowledge  
Decoding

### CROSS-REFERENCE TO RELATED APPLICATIONS

0003 This application claims the benefit of priority under 35 U.S.C. § 119(e) to the following  
provisional patent applications:

- a. U.S. Provisional Application No. 63/810,843, filed 05/23/2025, titled "BlockMesh  
Decentralized Memory-Mesh Architecture"
- b. U.S. Provisional Application No. 63/810,834, filed 05/23/2025, titled "Memory Field  
Pressure & Tension System"
- c. U.S. Provisional Application No. 63/810,841, filed 05/23/2025, titled "Non-Generative  
Artificial Cognition Engine"
- d. U.S. Provisional Application No. 63/810,837, filed 05/23/2025, titled "Proof of Memory  
Flow System"
- e. U.S. Provisional Application No. 63/811,761, filed 05/23/2025, titled "Composite  
Cognition Pools for Emergent Memory-Driven Systems"

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- f. U.S. Provisional Application No. 63/811,758, filed 05/25/2025, titled "Genesis Document Anchor Method for AI Behavior"
- g. U.S. Provisional Application No. 63/811,763, filed 05/25/2025, titled "On-Chain VM for Deterministic Language Model Execution"
- h. U.S. Provisional Application No. 63/812,634, filed 05/27/2025, titled "Stateless Action Engine & Minimal Proof Logging"
- i. U.S. Provisional Application No. 63/812,620, filed 05/27/2025, titled "One Action-One Mint Transaction Paradigm"
- j. U.S. Provisional Application No. 63/812,645, filed 05/27/2025, titled "Epoch Rhythm & Synchronization Mechanism"

All of the above applications are incorporated herein by reference in part or in their entirety.

## TECHNICAL FIELD

0004 This invention relates to distributed artificial intelligence inference, semantic computation using public validation networks, structured knowledge navigation, cryptographic output interpretation, and deterministic response generation. The invention encompasses methods for utilizing distributed network validation processes as computation oracles, decoding deterministic outputs into coordinates within structured knowledge representations, generating responses without neural network inference or probabilistic sampling, and creating deterministic AI systems that operate without GPU compute, model weights, or centralized API dependencies.

## BACKGROUND

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0005 Conventional artificial intelligence systems rely on neural network architectures requiring substantial GPU compute resources, large model weights, probabilistic token sampling, and centralized infrastructure. These systems suffer from non-determinism, opacity in reasoning, high operational costs, and dependence on commercial API providers. The computational resources required for inference are concentrated in data centers, creating single points of failure and excluding participation by resource-constrained nodes.

0006 No existing system provides a unified framework for:

- a. Utilizing distributed network validation processes as computation oracles
- b. Interpreting deterministic outputs as coordinates in semantic space
- c. Navigating structured knowledge representations using output-derived coordinates
- d. Generating deterministic responses without neural networks
- e. Performing AI inference at zero or near-zero marginal cost using existing network infrastructure
- f. Creating auditable reasoning chains from operation sequences
- g. Operating without model weights, GPU compute, or probabilistic sampling
- h. Enabling any network participant to perform inference using public validation infrastructure

## DETAILED DESCRIPTION

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0007 This invention provides a comprehensive framework for distributed semantic inference utilizing public network validation as computation oracles and structured knowledge representations as semantic decoders.

### 0008 Public Network Validation as Distributed Computation Oracle:

0009 Distributed networks perform validation operations on submitted data through deterministic functions including cryptographic hashing, signature verification, consensus computation, or equivalent transformations. When data is submitted to such networks, multiple independent nodes compute identical deterministic outputs for validation, deduplication, or routing purposes. This invention recognizes that this distributed validation constitutes massively parallel computation that can be repurposed for semantic inference. By encoding semantic queries into network-compatible data formats and submitting to distributed networks, the system obtains deterministic outputs computed by multiple nodes without incurring execution costs or requiring dedicated compute resources.

0010 The key insight is that validation computation occurs as an inherent property of network operation regardless of whether submitted data triggers further processing. Data formatted to avoid execution while still undergoing validation creates a zero-cost or near-zero-cost computation channel where:

- a. Input data is encoded into network-compatible payloads
- b. Payloads are submitted to distributed networks
- c. Multiple nodes independently compute identical deterministic outputs
- d. Outputs serve as computation results

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- e. No execution fees or dedicated resources are consumed
- f. Results are reproducible by any party with the original input data

### 0011 Network Types and Validation Mechanisms:

0012 The invention applies to any distributed network where multiple nodes perform deterministic computations on submitted data, including but not limited to:

- a. Blockchain networks performing transaction hashing for validation and deduplication
- b. Distributed hash tables computing routing keys from content identifiers
- c. Peer-to-peer networks performing message authentication or integrity verification
- d. Federated systems computing consensus on submitted proposals
- e. Content-addressed storage networks generating content identifiers
- f. Gossip protocols propagating and validating messages across nodes
- g. Any network where data submission triggers deterministic multi-node computation

0013 The specific network mechanism is implementation detail; the invention covers the general method of repurposing distributed validation as semantic computation.

### 0014 Semantic Input Encoding:

0015 Semantic queries are encoded into network-compatible data formats using structured representations comprising:

- a. Protocol identifiers specifying the encoding scheme

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- b. Input digests providing deterministic seeds from query content
- c. Context digests incorporating conversational, environmental, or system state
- d. Payload data containing the original semantic input
- e. Formatting to trigger validation while avoiding unwanted execution or side effects

0016 The encoding ensures that identical inputs produce identical outputs, enabling reproducible computation across the network.

0017 Output Interpretation as Semantic Coordinates:

0018 Deterministic outputs from network validation serve as coordinates in high-dimensional semantic space. The system interprets output bytes or bits as indices into structured knowledge:

- a. Bit or byte ranges map to semantic categories (parts of speech, entity types, relation types)
- b. Values select entries within categories (specific concepts, terms, or symbols)
- c. Combinations identify specific entries within knowledge structures
- d. Multiple segments combine to form multi-dimensional semantic vectors
- e. Entropy characteristics indicate confidence or uncertainty

0019 This mapping transforms deterministic outputs into navigable positions within structured knowledge representations.

0020 Structured Knowledge Representation Integration:

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0021 The system integrates with structured knowledge representations including but not limited to:

- a. Lexical databases (WordNet, Open English WordNet, or equivalent) providing word-meaning relationships
- b. Ontologies (OWL, RDF, or equivalent) providing formal concept hierarchies
- c. Knowledge graphs (Wikidata, ConceptNet, domain-specific graphs) providing entity-relationship structures
- d. Embedding spaces (word embeddings, sentence embeddings) providing vector-based similarity
- e. Taxonomies and classification hierarchies providing categorical organization
- f. Symbol tables and terminology databases providing domain-specific vocabulary
- g. Any structured representation mapping identifiers to semantic content

0022 The knowledge representation provides indexed access from coordinates to semantic content.

0023 Coordinate-to-Content Mapping:

0024 The system converts output-derived coordinates to semantic content through deterministic selection:

- a. Coordinates select entries from knowledge representation indices
- b. Selected entries provide candidate content (words, concepts, entities, symbols)

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- c. Additional coordinate components select among candidates
- d. Assembly rules combine selected content into coherent outputs
- e. Context from prior operations influences selection
- f. System state metrics guide output characteristics

0025 This process produces semantic content from deterministic outputs without generative models.

0026 Decoder Architecture:

0027 The system implements a hierarchical decoder architecture:

- a. Coordinate Decoder: Maps raw outputs to knowledge representation indices through configurable mapping functions
- b. Content Decoder: Retrieves content from knowledge representations using decoded indices
- c. Semantic Decoder: Extends content decoding with relationship awareness, linking related entries through knowledge graph edges or embedding proximity
- d. Context Decoder: Incorporates operational context to prefer content related to recent interactions
- e. Assembly Decoder: Combines selected content into formatted outputs using domain-appropriate rules

0028 Each layer adds semantic awareness while maintaining deterministic operation.



0029 Relationship-Based Clustering:

0030 Semantically related content is linked through relationships defined in the knowledge representation:

- a. Synonym, hypernym, hyponym, and other lexical relations link related terms
- b. Knowledge graph edges link related entities and concepts
- c. Embedding proximity links semantically similar content
- d. Coordinate proximity reflects relationship strength
- e. System metrics influence selection within clusters
- f. Context biases selection toward operationally relevant clusters

0031 This structure enables semantically coherent selection without explicit reasoning.

0032 Sequential Reasoning Chains:

0033 Multi-step reasoning is achieved through sequential operations:

- a. Initial query produces first output
- b. First output becomes context for second query
- c. Chain of outputs accumulates semantic trajectory
- d. Final result integrates information from all steps
- e. Each step is independently verifiable
- f. Complete chain provides auditable reasoning trace
- g. Branching chains enable parallel exploration
- h. Convergent chains synthesize multiple paths

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0034 This enables complex inference through composition of simple deterministic operations.

0035 System State Integration:

0036 System state metrics influence output characteristics:

- a. Magnitude or intensity metrics favor action-oriented content
- b. Tension or conflict metrics favor descriptive content
- c. Density or concentration metrics favor substantive content
- d. Coherence or stability metrics favor context-related content
- e. Metric combinations create nuanced semantic profiles
- f. Temporal patterns influence content evolution

0037 This connects system state to semantic output without explicit programming.

0038 Low-Cost Inference Economics:

0039 The system achieves zero or near-zero marginal cost for inference operations:

- a. Validation computation is performed by existing network infrastructure
- b. No dedicated GPU or compute resources required
- c. No model weights to store, transfer, or update
- d. No per-query API fees or token costs
- e. Knowledge representation lookups are local operations
- f. Any participant can perform inference using public networks

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- g. Costs are limited to network access and local storage

0040 This democratizes AI inference beyond resource-rich operators.

0041 Extensibility and Modularity:

0042 The system supports extension through:

- a. Additional knowledge representations integrated through standard indices
- b. Custom mapping functions for domain-specific coordinate interpretation
- c. Pluggable assembly rules for different output formats
- d. Composable decoder layers for specialized applications
- e. Multiple network backends for different availability/cost tradeoffs
- f. Federated knowledge representations spanning multiple sources

0043 This enables adaptation to diverse domains and requirements.

## ENABLEMENT

0044 The inventions described herein are enabled at the system and protocol level. A person of ordinary skill in distributed systems, network protocols, natural language processing, and knowledge representation can practice the claimed methods using the architectural descriptions in these specifications together with any suitable software/hardware stack.

0045 A working, non-limiting embodiment is publicly available at:

<https://github.com/zeam-labs/zeam-testnet>

0046 This implementation comprises a modular codebase demonstrating the claimed protocol flows including input encoding, network submission, output interpretation, knowledge graph integration, and response generation.

0047 Function, file, and module names below are illustrative. Equivalent structures, languages, network types, and knowledge representations may be substituted without departing from the inventions.

0048 System-Level Enablement

0049 Architecture & Flows. The reference implementation demonstrates:

- a. Collapse Compute: encoding semantic inputs into network-compatible data, submitting to distributed networks, and interpreting outputs
- b. Category Mapping: converting output byte ranges to semantic categories and knowledge indices
- c. Content Decoding: mapping coordinates to content items through forward and reverse indices
- d. Knowledge Integration: parsing and indexing knowledge representations with efficient lookup structures
- e. Coordinate-to-Content: deterministic content selection from outputs through index navigation

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- f. Output Assembly: constructing formatted outputs from selected content using domain rules
- g. Semantic Field Construction: training semantic decoders from example mappings
- h. State-Driven Selection: using system metrics to influence content characteristics
- i. Reasoning Chains: sequential inference through accumulated output contexts
- j. Relationship Groups: clustering related content for coherent selection

0050 Reproducibility. Determinism is enforced by:

- a. Identical inputs producing identical outputs across all participating nodes
- b. Fixed mappings from outputs to semantic categories
- c. Deterministic content selection from sorted indices
- d. Reproducible assembly rules without randomness

0051 Portability. The methods are implementation-agnostic:

- a. Any distributed network providing deterministic validation may serve as computation oracle
- b. Any structured knowledge representation may serve as semantic decoder
- c. Any programming language may implement the encoding and decoding logic
- d. The protocol operates over standard network submission mechanisms

0052 Practicing the Inventions Without the Reference Code

0053 A skilled practitioner can implement the inventions by:

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- a. Encoding semantic inputs into network-compatible payload format with protocol identifiers, input digests, context digests, and raw data
- b. Submitting payloads to distributed networks in formats that trigger validation without execution
- c. Capturing deterministic outputs as computation results
- d. Mapping output segments to semantic categories using configurable mapping functions
- e. Indexing a structured knowledge representation with efficient lookup structures
- f. Selecting content from knowledge representation entries using output-derived indices
- g. Assembling selected content into formatted outputs using domain-appropriate rules
- h. Chaining multiple operations to build reasoning sequences

0054 These steps can be realized using any network client library, any structured knowledge representation, and standard programming constructs.

## CLAIMS

1. A method for performing distributed semantic inference using network validation, comprising:
  - a. encoding semantic input data into a network-compatible payload format;
  - b. submitting encoded payloads to a distributed network where multiple independent nodes perform deterministic validation computations;
  - c. obtaining deterministic outputs computed by network validators as inference results;

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- d. interpreting outputs as coordinates in a semantic space by mapping output segments to semantic categories;
  - e. navigating a structured knowledge representation using output-derived coordinates to select semantically relevant entries;
  - f. generating formatted output from selected knowledge representation entries; and
  - g. achieving deterministic inference without neural network computation, probabilistic sampling, or centralized API dependencies.
2. A system for semantic decoding of deterministic computation outputs, comprising:
- a. an output-to-category mapper that assigns semantic categories to segments within computation outputs;
  - b. a knowledge representation index providing efficient lookup from category identifiers to semantic entries;
  - c. a coordinate decoder that maps output-derived coordinates to content items through index structures;
  - d. a semantic decoder extending coordinate decoding with relationship awareness linking related entries;
  - e. a context decoder incorporating operational history to bias selection toward contextually relevant entries;
  - f. an assembly module that constructs formatted outputs from selected entries using domain-appropriate rules; and
  - g. output generation producing structured content from computation outputs without neural network inference.

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3. An apparatus for low-cost artificial intelligence inference, comprising:
  - a. an input encoder that structures semantic queries into network-compatible payloads including protocol identifiers, input digests, context digests, and payload data;
  - b. a submission module that transmits payloads to distributed networks in formats triggering validation without execution;
  - c. an output collector that captures deterministic outputs computed by network validators as inference results;
  - d. a semantic interpreter that converts outputs to knowledge representation coordinates through deterministic mapping functions;
  - e. a knowledge store containing structured semantic content with indexed access;
  - f. a content selector that chooses entries from the knowledge store using output-derived indices;
  - g. an output generator that assembles selected entries into formatted responses using domain rules; and
  - h. a chain manager that sequences multiple inference operations with outputs from earlier steps serving as context for later steps.
4. The method of claim 1, wherein the payload format comprises a protocol identifier, a cryptographic digest of the input data, a cryptographic digest of context data, and the raw input bytes.
5. The method of claim 1, wherein the distributed network comprises any network where multiple nodes perform deterministic computations on submitted data including blockchain



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networks, distributed hash tables, peer-to-peer messaging networks, federated consensus systems, or content-addressed storage networks.

6. The method of claim 1, wherein interpreting outputs comprises mapping output byte ranges to semantic categories including entity types, action types, property types, relation types, quantity types, state types, event types, or abstract concept types.
7. The method of claim 1, wherein the structured knowledge representation comprises any indexed semantic structure including lexical databases, ontologies, knowledge graphs, embedding spaces, taxonomies, symbol tables, or combinations thereof.
8. The method of claim 1, wherein generating formatted output comprises selecting entries using output-derived indices, filtering by semantic category, and assembling with domain-appropriate formatting rules.
9. The method of claim 1, further comprising chaining multiple inference operations wherein the output of each operation becomes context input for subsequent operations, creating auditable reasoning sequences.
10. The method of claim 1, wherein payload formatting prevents execution, settlement, or resource consumption while ensuring validation computation occurs, including techniques such as invalid signatures, exceeded limits, impossible conditions, or protocol-specific non-execution flags.
11. The system of claim 2, wherein the knowledge representation index comprises multiple index types including term-to-entry indices, identifier-to-entry indices, category-to-entry indices, and frequency-ranked indices.

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12. The system of claim 2, wherein relationship awareness is constructed from semantic relationships in the knowledge representation including synonymy, hypernymy, hyponymy, meronymy, antonymy, or domain-specific relation types.
13. The system of claim 2, wherein the context decoder maintains entries from recent operations and biases coordinate decoding toward entries sharing relationships with context entries when coherence metrics exceed configurable thresholds.
14. The system of claim 2, wherein the assembly module applies domain-specific rules including grammatical formatting for natural language, schema compliance for structured data, or protocol formatting for machine interfaces.
15. The system of claim 2, further comprising a state integration module that selects entry characteristics based on system state metrics wherein different metric values favor different semantic categories.
16. The apparatus of claim 3, wherein the output collector computes statistical properties of outputs including entropy, distribution, or pattern characteristics to derive confidence scores for inference results.
17. The apparatus of claim 3, wherein the semantic interpreter supports multiple configurable mapping functions enabling domain-specific coordinate interpretation.
18. The apparatus of claim 3, wherein the knowledge store supports dynamic extension through addition of new entries, new relationship types, or new index structures without system restart.
19. The apparatus of claim 3, wherein the chain manager accumulates outputs from sequential operations, combines accumulated outputs to derive composite semantic coordinates, and propagates confidence scores across chain steps.

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20. The apparatus of claim 3, wherein low-cost operation is achieved because validation computation is performed by existing network infrastructure without requiring payload execution, dedicated compute resources, or per-operation fees, enabling any network participant to perform inference using only network access capabilities.

### ABSTRACT

0055 A framework for distributed semantic inference utilizing network validation as computation and structured knowledge representations as decoders. Semantic queries are encoded into network-compatible payloads and submitted to distributed networks where multiple nodes perform deterministic validation computations. Resulting outputs are interpreted as coordinates in semantic space, used to navigate knowledge representations and select relevant entries, which are assembled into formatted responses. The system achieves AI inference without neural networks, GPU compute, model weights, or probabilistic sampling at zero marginal cost by leveraging existing network validation infrastructure. All operations are deterministic, reproducible, and auditable.