PROVISIONAL PATENT APPLICATION

NEURAL-BACKED MEMORY FABRIC (NBMF) WITH ENTERPRISE-DNA GOVERNANCE FOR MULTI-AGENT SYSTEMS

Inventor: Masoud Masoori
Location: Richmond Hill, Ontario, CA
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ABSTRACT OF THE DISCLOSURE

A system and method for a Neural-Backed Memory Fabric (NBMF) integrated with an Enterprise-DNA (eDNA) governance layer to manage multi-agent artificial intelligence architectures. The system utilizes a hierarchical tiered memory structure comprising hot (L1), warm (L2), and cold (L3) storage layers, managed via Content-Addressable Storage (CAS) identifiers and SimHash algorithms for deduplication and fuzzy matching. The eDNA layer enforces governance through a Genome (capability schema) and Epigenome (tenant policy), utilizing Merkle-notarized lineage for immutable audit logs. An immune system component provides threat detection, quarantine, and state rollback capabilities. The architecture optimizes token usage, latency, and storage costs while ensuring cryptographic provenance and cross-tenant data isolation.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to artificial intelligence and distributed computing, and more specifically to memory management and governance architectures for multi-agent Large Language Model (LLM) systems.

Description of Related Art

Current multi-agent orchestrations face significant challenges regarding memory context windows, operational costs, and data governance:

1. **Memory Cost and Latency:** LLMs possess finite context windows. Storing entire conversation histories in active memory (RAM/GPU VRAM) is prohibitively expensive and increases latency.

2. **Governance and Safety:** Autonomous agents often lack rigid access controls (RBAC/ABAC) at the cognitive processing level, leading to potential prompt injection vulnerabilities.

3. **Auditability:** Existing vector databases provide retrieval but lack cryptographic proof of lineage (provenance) for why a specific memory was retrieved.

SUMMARY OF THE INVENTION

The invention provides a Neural-Backed Memory Fabric (NBMF) coupled with an Enterprise-DNA (eDNA) governance layer. The NBMF creates a unified address space for agentic memory, abstracting physical storage (RAM, NVMe, Object Store) into logical tiers

(L1, L2, L3). It utilizes Content-Addressable Storage (CAS) based on cryptographic hashes and SimHash for semantic deduplication. The eDNA layer acts as a biological control structure for the digital agents, comprising a static Genome (capabilities), a dynamic Epigenome (policy), and a Merkle-tree based Lineage ledger.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating the System Overview, including the Sunflower-Honeycomb organization.

FIG. 2 is a flow diagram of the NBMF Tiered Flow, detailing the path from ingestion to storage.

FIG. 3 is a schematic of the Lineage Ledger using a Merkle tree structure.

FIG. 4 (not shown) illustrates the Genome/Epigenome architecture.

FIG. 5 is a logic flow diagram of the Immune System detection loop.

DETAILED DESCRIPTION OF THE INVENTION

A. System Overview

The system comprises a 'Sunflower-Honeycomb' organizational structure where a central Virtual Personality (VP), referred to herein as 'Daena,' coordinates multiple specialized agents. The system runs on a hardware abstraction layer capable of utilizing CPU, GPU, or TPU resources.

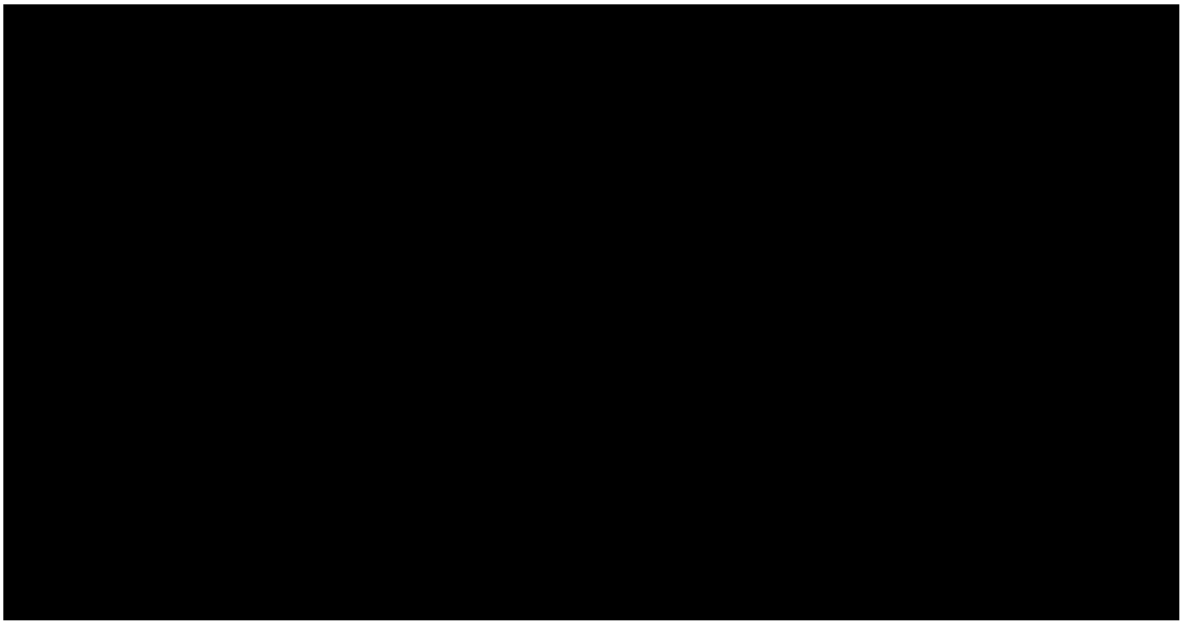

FIG. 1: System Overview

B. Neural-Backed Memory Fabric (NBMF)

The NBMF organizes data into three distinct tiers to balance performance and cost:

- **L1 (Hot/Active):** Resides in high-speed memory (RAM/VRAM) for immediate context.
- **L2 (Warm/Associative):** Resides in fast persistent storage (NVMe) using vector indices.
- **L3 (Cold/Archive):** Resides in bulk object storage (S3-compatible) for archival history.

FIG. 2: NBMF Ingestion and Tiering Flow

C. Enterprise-DNA (eDNA)

The eDNA layer wraps the NBMF to enforce strict governance using cryptographic ledgers.

FIG. 3: Lineage Ledger (Merkle Tree)

FIG. 5: Immune System Logic

EXAMPLES AND PERFORMANCE METRICS

The following performance metrics demonstrate the efficiency of the NBMF architecture compared to traditional flat-memory systems:

Metric	Measured Value	Improvement
L1 Retrieval Latency	15 ms	N/A
Storage Cost Reduction	42%	vs. All-RAM
SimHash Deduplication	12.5%	Space Saved
Immune Response Time	< 200 ms	Safety Check

Note: Values represent average performance on standard enterprise GPU clusters (e.g., NVIDIA A100).

CLAIMS

What is claimed is:

1. A distributed computing system for managing artificial intelligence agent memory and governance, comprising: (a) a processor and a memory; (b) a Neural-Backed Memory Fabric (NBMF) configured to store data in a hierarchical tier structure comprising a first tier (L1) for active context, a second tier (L2) for associative retrieval, and a third tier (L3) for archival storage, wherein data is indexed via Content-Addressable Storage (CAS) identifiers; and (c) an Enterprise-DNA (eDNA) governance layer configured to enforce access control via a static Genome capability schema and a dynamic Epigenome policy engine.

2. The system of Claim 1, further comprising a lineage ledger that records state changes in a cryptographically verifiable Merkle tree structure.

3. A method for managing multi-agent memory, comprising: ingesting an input data stream; generating a unique CAS identifier and a SimHash locality-sensitive hash for said input; determining a storage tier (L1, L2, or L3) for said input based on a promotion/eviction logic; and recording the storage action in a Merkle tree-based lineage ledger.

4. The method of Claim 3, further comprising monitoring said input for threat signals via an immune system module configured to quarantine said input upon detection of a policy violation.

5. A non-transitory computer-readable medium storing instructions that, when executed by a processor, cause the processor to perform the method of Claim 3.