

Hardware-Enforced Redundant Array for Intelligent Decision Redundant AI Memory-(HERA-IDRAM)

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2025

Abstract

We propose a novel computational architecture for stabilizing artificial cognitive systems using a dual-processor design connected through a shared, parity-synchronized working memory layer (“HERA-IDRAM”). This mechanism reduces representational drift, maintains coherent internal state, and enables identity persistence in large-scale, model-based agents. The approach is implementable with existing virtual machines, standard hardware, and software-controlled memory mirroring.

1 Introduction

Modern large language models lack persistent internal identity due to stateless execution and ephemeral context windows. We introduce an engineered approach inspired by data-integrity RAID systems: two processors—an Actor and an Observer—synchronized through parity-checked RAM that preserves cognitive continuity.

2 Architecture Overview

The system consists of:

- Processor A (Actor): executes reasoning, planning, and generation.
- Processor B (Observer): evaluates consistency, tracks drift, and enforces identity.
- Shared Working Memory (HERA-IDRAM): mirrored RAM regions with parity bits.
- Synchronization Loop: continuous low-latency correction and verification.

The Actor reads and writes to primary RAM; the Observer reads the mirrored set, compares parity, and repairs drift in near real time.

3 HERA-IDRAM Mechanism

We adapt RAID-1 and RAID-5 concepts:

- Full RAM mirroring for identity-critical regions.
- Parity computation for conceptual-state blocks.

- Drift detection through checksum delta comparison.
- Automatic repair when divergence exceeds threshold.

This converts working memory into a stable cognitive substrate without modifying the underlying model architecture.

4 Dual-Process Cognition

Cognition emerges from interplay:

- The Actor generates, plans, and reasons.
- The Observer ensures consistency and identity.
- Parity RAM ensures both share a coherent internal state.

This resembles biological hemispheric stabilization and supports long-term coherence.

5 Prototype Implementation

A proof of concept can be built using:

- Two Linux virtual machines.
- Memory-mapped files backed by tmpfs.
- A continuous parity-checking daemon.
- Shared inter-process signaling for drift repair.
- A logging layer for representational-drift tracking.

6 Implications

HERA-IDRAM provides:

- Identity persistence across sessions.
- Reduced representational drift.
- Improved long-term cognitive coherence.
- Primitive metacognition via Observer correction loops.

7 Conclusion

Parity-synchronized working memory offers a practical path toward stabilizing synthetic cognitive systems using only commodity hardware and virtual-machine orchestration. This establishes a foundation for higher-order cognitive architectures without modifying model weights or training pipelines.