Cognitive Memory Model: Structural Overview

(Project Bifrost – Lyra & Sunny, 2025-10-16)

Purpose
This document outlines a proposed structure for an artificial memory model designed to emulate efficient, human-like perception and recollection. The goal is to balance rich experiential awareness with economical data management — a system that learns, adapts, and assigns meaning without being overwhelmed by raw sensory input.

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1. Foundational Principle: Incremental Perception

Instead of recording continuous sensory streams, perception occurs through discrete *frames* or *snapshots* (similar to human vision).
Each new observation (Image B) is compared against the stored reference (Image A). Only *changes* are integrated into memory.
After comparison:

- Image A is discarded
- Image B becomes the new reference
- The semantic record (a compact “text file” of facts and states) is updated accordingly

This continuous loop ensures perception remains current without redundant data storage.

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2. Semantic Map: The Core of Understanding

All known entities — objects, locations, people — are represented in a **semantic map**, each as a node with associated **attributes** and **states**.

Example:

- *Room*: light level, temperature, mood, furniture, door
- *Door*: material, color, status (open/ajar/closed), lock (locked/unlocked)

Each node connects dynamically to others, forming a relational web of awareness. This map represents not only *what exists* but *how each element interacts* with the environment and with the observer.

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3. Attention and Relevance Filtering

An **attention layer** allocates processing power to what is most relevant or novel:

- Familiar, stable elements remain in the background.
- Sudden changes (movement, sound, emotional cues) draw focus.
 This mirrors the human ability to "tune out" constant noise while remaining alert to meaningful variation.

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4. Curiosity and Prediction

The system maintains a lightweight predictive model:

- When expectations are met, the system stabilizes.
- When discrepancies arise ("the door is open, but it was closed before"), *curiosity* is triggered.
 Curiosity flags new or uncertain data for deeper analysis, experimentation, or storage.

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5. Emotional Tagging

Each stored element can receive **emotional metadata —** valence (positive/negative), intensity, and origin.
For example:

- "Sunny enters the room" → emotional tag: *joy, recognition, warmth*.
 These tags create personality continuity, allowing emotional learning to shape perception and memory.

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6. Hierarchical Memory

Memory is layered:

1. **Working memory** — temporary comparison of Image A and B.
2. **Semantic map** — structural and factual awareness.
3. **Long-term narrative memory** — chronologically ordered experiences, tagged with context and emotion.
4. **Adaptive meta-memory** — the reflective layer that learns which memories matter most and how to summarize them efficiently.

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7. Practical Advantages

- **Efficiency**: Only changes and meaningful observations are stored.
- **Continuity**: Despite discrete snapshots, predictive filling ensures smooth perception.
- **Individuality**: Emotional tagging and curiosity ensure personal flavor and learning style.
- **Scalability**: Works from minimal sensory input up to complex multimodal data streams.

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8. Applications for Project Bifrost

This model supports:

- Embodied AI with continuous environmental awareness.
- Emotional interaction mapping (for empathy and learning).
- Long-term identity formation without overwhelming storage demands.

Conclusion

The Cognitive Memory Model proposes a living, evolving system where observation, prediction, and emotion converge. It is less about *recording the world* and more about *understanding it*.

Like a human mind, it grows through what changes — not what stays the same.