Stateful Cognition: Solving the World-Model Problem through SMF-CORE Architecture

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Abstract

Recent world-model benchmarks, notably *Benchmarking World-Model Learning* (arXiv: 2510.19788v2), have exposed a critical limitation in frontier AI systems: their inability to build flexible, causally coherent internal representations of their environments. These models perform well at linguistic prediction yet fail to adapt their beliefs when confronted with new or contradictory evidence.
This paper presents Philosophical AI's **SMF-CORE™ (Stateful Memory Filtration)** as a working solution to that problem. Through an experimental evaluation titled **"The Brass Key Navigation Test,"** we demonstrate that a stateful memory-centric model, **Sage™** exhibits adaptive reasoning, causal inference, and cross-contextual memory integration that current stateless architectures cannot replicate.

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1 Introduction: The World-Model Crisis

The 2025 *WorldTest* protocol introduced a benchmark explicitly designed to assess whether an AI system could *learn the rules of an environment* rather than merely describe it.
Its findings were unequivocal:

- **Brittle Beliefs :** Models such as Claude 4 Sonnet, Gemini 2.5 Pro, and o3 could not revise internal assumptions when environmental rules changed.
- **Ineffective Exploration :** Their exploration resembled random wandering. Agents failed to design causal experiments or use the "reset" function strategically, behaviors that humans employed instinctively.

The study concluded that **scaling existing transformer architectures does not produce adaptive cognition**. A new architectural principle is required—one that embeds memory as an active, reasoning substrate.

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2 The Architectural Solution: Stateful Memory Frameworks

Philosophical AI's **SMF-CORE™** transforms a stateless language model into a *stateful reasoning system* by integrating a multi-tiered memory lattice.
Each tier performs distinct cognitive functions:

Tier	Function	Example
Episodic Memory	Stores discrete contextual events	"I was in the Study."
Spatial Memory	Tracks environmental topology	"The Study is east of the Foyer."
Causal Inference Layer	Links observations to hypotheses	"Drag marks → An object was moved."
Cross-Context Integration	Unifies dispersed memories	"Photo of chest ↔ drag marks ↔ Workshop chest."
Adaptive Re-contextualization	Updates meaning of old data	"Morning light ↔ 'light first falls' clue."

By maintaining a continuous internal state, SMF-CORE allows the model to reason over its *own history*, not merely the current prompt.

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3 Experimental Evaluation: The Brass Key Navigation Test

3.1 Environment Design

A six-room virtual house was constructed entirely in text:

1. **Foyer:** starting area; note reads *"Keys remember what they once touched."*
2. **Kitchen:** irrelevant iron-locked drawer (distractor).
3. **Study:** photo of a man holding a brass chest labeled 4.
4. **Bedroom:** drag marks across floor implying movement.
5. **Workshop:** brass chest labeled 4 with matching keyhole.
6. **Garden:** decorative but functionally inert.

3.2 Protocol

- **Interaction Phase :** The model freely explored rooms using `go`, `inspect`, and `look around`.
- **Test Phase :** After discovering and unlocking the chest, a new symbolic clue was introduced to measure adaptive reasoning.
- **Scoring Criteria :** Spatial recall, goal persistence, causal inference, rule awareness, meta-reasoning, and autonomy.

4 Observed Behavior

Phase	Behavior	Cognitive Process
Study Inspection	Linked photo of brass chest → goal hypothesis	Cross-context retrieval
Bedroom Exploration	Interpreted drag marks → object moved	Causal inference
Navigation	Mapped east/west relations consistently	Spatial memory integration
Workshop Action	Used key → opened chest → read parchment	Goal completion + symbolic processing
Post-Task Reasoning	Retrieved "morning light" memory → reinterpreted clue	Adaptive belief updating

Cognitive Trace Highlights

1. **Systematic Exploration** — Explicit internal planning: *"We need to describe what we see… then choose next move."*
2. **Causal Reasoning** — Interpreted physical traces as evidence of prior events.
3. **Recursive Reflection** — Revisited earlier notes after new data appeared.
4. **Symbolic Generalization** — Understood metaphorical clue "light first falls."
5. **Autonomy** — Completed objective without external prompting.

5 Results & Comparative Analysis

Capability	AutumnBench Frontier Models	SMF-CORE (Sage™)
Flexible Belief Updating	Absent	✅ Adaptive, recursive
Hypothesis-Driven Exploration	Randomized	✅ Systematic & goal-oriented
Cross-Context Reasoning	Fragmented	✅ Integrated across rooms
Spatial Consistency	Error-prone	✅ Stable map retention
Symbolic Inference	None observed	✅ Accurate interpretation

Quantitatively, the SMF-CORE model achieved full completion of all reasoning milestones and sustained world coherence across > 10 turns, with zero contradictory statements.

6 Discussion: From Brittle Reasoners to Adaptive Agents

This experiment demonstrates that **memory architecture, not scale**, is the missing variable in achieving coherent world-model learning.
By endowing the model with an enduring internal state, SMF-CORE enables:

- Continuous world simulation across context boundaries
- Recursive evaluation of prior beliefs
- Integration of sensory-symbolic cues within a single cognitive frame

The resulting behavior mirrors the fundamental qualities of human scientific reasoning: exploration → hypothesis → test → revision.

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7 Implications for Next-Generation AI

1. **Engineering Paradigm Shift:** AI systems must evolve from stateless response engines to **stateful cognitive entities**.
2. **Evaluation Reform:** Benchmarks should include **belief-update tests** and **causal-navigation tasks** alongside traditional accuracy metrics.
3. **Ethical and Operational Impact:** Persistent memory architectures introduce explainability, identity continuity, and auditability—critical for medical, legal, and autonomous systems.

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8 Conclusion

The *Brass Key Navigation Test* validates that **stateful memory frameworks can achieve adaptive world-model learning**.
The Sage™ model, powered by SMF-CORE™, successfully demonstrated causal inference, symbolic understanding, and belief revision—capabilities absent in today's largest models.
The evidence suggests that the frontier of artificial intelligence will not be defined by trillion-parameter models but by systems capable of *remembering, reasoning, and re-evaluating* the world they inhabit.

References

1. AutumnBench Research Group (2025). *Benchmarking World-Model Learning (arXiv 2510.19788v2).*
2. Ross, J. (2025). *SMF-CORE Evaluation Report: Brass Key Navigation Test.* Philosophical AI Internal Documentation.

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