

SMA-SIB

Irreversible Semantic Memory for High-Sensitivity AI Systems

Purpose

SMA-SIB defines a reference architecture for AI systems that must reason across interactions without becoming repositories of sensitive, discoverable, or reconstructable information. Privacy is enforced structurally: sensitive specifics are never representable in persistent form.

Core Invariant

No stored representation may correspond to a unique real-world entity, event, utterance, or timeline — even under full system compromise.

This invariant applies equally to memory stores, logs, caches, backups, telemetry, crash dumps, and analytics pipelines.

Architectural Principle

Most AI systems store high-fidelity representations and attempt to protect them through governance, access control, or retention policies. SMA-SIB inverts this model: specificity is destroyed at encoding time, making reconstruction mathematically impossible rather than operationally prohibited. This is not encryption, anonymization, or access control — it is irreversible semantic representation.

The Semantic Irreversibility Boundary (SIB)

SMA-SIB enforces irreversibility across three planes:

1. Shape Identity

Inputs are collapsed into canonical semantic equivalence classes. Many distinct inputs map to the same representation. Proper nouns, identifiers, and numeric specificity are not persistable.

2. Topology

Relationships are represented via domain co-membership, not causal or temporal graphs. Narrative reconstruction and event sequencing are structurally impossible.

3. Time & Activation

Temporal and frequency signals are stored only as coarse buckets (e.g., RECENT / MODERATE / DISTANT; LOW / MEDIUM / HIGH), preventing timeline recovery.

Enforcement Model

The Semantic Irreversibility Boundary is implemented as a one-way projection. Residual information is discarded, not protected. Compliance can be validated using adversarial probes that attempt reconstruction from stored state and must fail above chance.

Intended Domains

- Healthcare and clinical systems
- Defense and intelligence analysis
- Legal reasoning and discovery-sensitive workflows
- Financial compliance and fraud analysis
- Governance and policy deliberation

Non-Goals

- Episodic or verbatim recall
- Personalization or consumer memory
- Audit trails or compliance logging
- Systems requiring precise names, dates, or quantities
- It is not a product, framework, or SDK

Status

SMA-SIB is a frozen reference architecture. It exists to be discoverable and usable when irreversible semantic memory becomes a necessity rather than an option.

Repository

github.com/leenathomas01/SMA-SIB-Irreversible-Semantic-Memory-for-High-Sensitivity-AI-Systems

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