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RECURSIVE SEMANTIC MEMORY COMPRESSION – SIMULATION

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 Generating synthetic 100K word document...
 Generated: 100,024 words | 785,118 chars | 1173 memory entries

 Compressing Layer 1 (target: ~60% of Layer 0)...
 Layer 1: 72,460 words (72.4% of previous, 72.4% of original)
 Pattern size: 379 chars
 Est. rehydration fidelity: 98%
 Processing time: 8.5ms

 Compressing Layer 2 (target: ~50% of Layer 1)...
 Layer 2: 54 words (0.1% of previous, 0.1% of original)
 Pattern size: 344 chars
 Est. rehydration fidelity: 80%
 Processing time: 13.5ms

 Compressing Layer 3 (target: ~40% of Layer 2)...
 Layer 3: 42 words (77.8% of previous, 0.0% of original)
 Pattern size: 446 chars
 Est. rehydration fidelity: 71%
 Processing time: 0.1ms

 Compressing Layer 4 (target: ~30% of Layer 3)...
 Layer 4: 44 words (104.8% of previous, 0.0% of original)
 Pattern size: 497 chars
 Est. rehydration fidelity: 45%
 Processing time: 0.0ms

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 COMPRESSION ANALYSIS REPORT

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Layer	Words	Chars	Pattern	Total Store	Ratio	Cumul.
L0	100,024	785,118	0	785,118	100%	100.0%
L1	72,460	520,304	379	520,683	72.4%	72.4%
L2	54	374	344	718	0.1%	0.1%

80%						
L3	42	260	446	706	77.8%	0.0%
71%						
L4	44	363	497	860	104.8%	0.0%
45%						

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 STORAGE ANALYSIS

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Strategy 1 - Keep ALL layers (full reversibility):

Total storage: 1,308,085 chars (1277.4 KB)
 Overhead vs raw: 1.67x
 Rehydration fidelity from any layer: ~100% (stored, not reconstructed)

Strategy 2 - Keep ONLY L4 + all rehydration patterns:

Compressed content: 363 chars
 All patterns: 1,666 chars
 Total storage: 2,029 chars (2.0 KB)
 Compression ratio: 0.3% of original
 Space saved: 99.7%

Strategy 3 - Tiered (10% full / 30% medium / 60% compressed + patterns):

Effective storage: 80,508 chars (78.6 KB)
 Compression ratio: 10.3% of original

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 COST ANALYSIS (Claude Sonnet pricing)

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L0→L1 compression: \$2.5414
 L1→L0 rehydration: \$3.3347
 L1→L2 compression: \$0.3929
 L2→L1 rehydration: \$1.9517
 L2→L3 compression: \$0.0029
 L3→L2 rehydration: \$0.0019
 L3→L4 compression: \$0.0034
 L4→L3 rehydration: \$0.0016

Total compression cost (all layers): \$2.9407
 Total rehydration cost (full chain): \$5.2899
 Combined: \$8.2306

Per memory entry (1173 entries):

Compress: \$0.002507
 Rehydrate: \$0.004510

At scale (1M memory entries/month):

Monthly compression: \$2506.96

Monthly rehydration (assuming 5% drill-down rate): \$225.49

Monthly total: \$2732.45

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🔑 THE KEY QUESTION: Is storing the pattern cheaper than the content?

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L0→L1:

Content removed: 264,814 chars

Pattern to reverse: 379 chars

Pattern/Content ratio: 0.0014 (0.1%)

Pattern cheaper than content? YES

Net savings: 264,435 chars (99.9% efficient)

L1→L2:

Content removed: 519,930 chars

Pattern to reverse: 344 chars

Pattern/Content ratio: 0.0007 (0.1%)

Pattern cheaper than content? YES

Net savings: 519,586 chars (99.9% efficient)

L2→L3:

Content removed: 114 chars

Pattern to reverse: 446 chars

Pattern/Content ratio: 3.9123 (391.2%)

Pattern cheaper than content? NO

L3→L4:

Content removed: -103 chars

Pattern to reverse: 497 chars

Pattern/Content ratio: 497.0000 (49700.0%)

Pattern cheaper than content? NO

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17 MEMORY TIMELINE ZOOM LEVELS

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Time Range → Zoom Level → Detail

Last 1 hour	→ L0 (raw)	→ 100,024 words (full transcript)
Last 24 hours	→ L1	→ 72,460 words (clean, no metadata)
Last 7 days	→ L2	→ 54 words (grouped summaries)
Last 30 days	→ L3	→ 42 words (key facts only)
Older than 30d	→ L4	→ 44 words (executive digest)

Any layer can be rehydrated back to L0 by walking the pattern chain.
Cost to rehydrate L4→L0: \$5.2899

 SAMPLE CONTENT AT EACH LAYER

LAYER 0 – 100,024 words | 785,118 chars

[2024-01-15 09:47] MEMORY_ENTRY #0000 | Topic: Security and Compliance

SOC 2 Type II audit preparation is 80% complete. Outstanding items: formal incident response plan documentation, evidence of quarterly access reviews for production systems, and completion of annual security awareness training (currently at 89% completion, target 100%). Audit window opens November 1st. The compliance team needs all evidence submitted by October 20th.

Context: This information was captured during a review session with product leadership.

Priority: HIGH | Confidence: 93%

Related entries: #0000, #0000

[2024-01-15 09:01] MEMORY_ENTRY #0001 | Topic: Market Analysis

Market research da

[... truncated ...]

LAYER 1 – 72,460 words | 520,304 chars

[#0000] Security and Compliance:

SOC 2 Type II audit preparation is 80% complete. Outstanding items: formal incident response plan documentation, evidence of quarterly access reviews for production systems, and completion of annual security awareness training (currently at 89% completion, target 100%). Audit window opens November 1st. The compliance team needs all evidence submitted by October 20th.

with product leadership.

[#0001] Market Analysis:

Market research data from Gartner indicates the total addressable market for our category will grow from \$12.4B in 2024 to \$23.8B by 2027, representing a 24% CAGR. The fastest-growing segment is SMB adoption, driven by AI-powered automation reducing the technical barrier to entry. Our current market share is estimated at 3.2%, up from 2.1% last

[... truncated ...]

💡 Rehydration pattern (379 chars):

REHYDRATION L1->L0: Restore formatting and metadata. Re-add separator lines between entries. Expand entry headers to include full timestamps (format: YYYY-MM-DD HH:MM). Re-add 2346 metadata lines with Priority (HIGH/MEDIUM/LOW), Confidence (70-99%), and Related entry cross-references. Re-add 1173 co

LAYER 2 – 54 words | 374 chars

Market Analysis (1 entries)

- [#0000] Security and Compliance: SOC 2 Type II audit preparation is 80% complete.
- Outstanding items: formal incident response plan documentation, evidence of quarterly access reviews for production systems, and completion of annual security awareness training (currently at 89% completion, target 100%).
- Audit window opens November 1st.

💡 Rehydration pattern (344 chars):

REHYDRATION L2->L1: Expand grouped summaries back to individual entries. Topic groups and entry counts: {"Market Analysis": 1}. Each bullet point represents condensed key facts from multiple entries. Restore individual entry numbering (#NNNN format). Expand abbreviated facts back to full sentences w

LAYER 3 – 42 words | 260 chars

KEY DECISIONS & METRICS

Decisions

Key Metrics

- - [#0000] Security and Compliance: SOC 2 Type II audit preparation is 80% complete
- - Outstanding items: formal incident response plan documentation, evidence of quarterly access revie

Action Items

💡 Rehydration pattern (446 chars):

REHYDRATION L3->L2: Expand from key decisions/metrics/actions back to topic-grouped summaries. Total source entries processed: 4. Decisions came from: Project Planning, Team Operations contexts. Metrics span: infrastructure costs, performance benchmarks, hiring, NPS scores, market data. Actions rela

LAYER 4 - 44 words | 363 chars

EXECUTIVE MEMORY DIGEST: 6 items processed. Covers 6 domains: project planning, tech architecture, customer feedback, team ops, market analysis, security/compliance. ~2 decisions, ~1 metrics tracked, ~1 pending actions. Key themes: microservices migration, SOC2 prep, hiring pipeline, workflow automation MVP, competitive positioning, enterprise client retention.

💡 Rehydration pattern (497 chars):

REHYDRATION L4->L3: Expand executive digest to structured decisions/metrics/actions format. 6 domains with approximate counts: decisions(2), metrics(1), actions(1). Key themes to expand: microservices (perf benchmarks, gRPC eval), SOC2 (3 outstanding items, Nov 1 deadline), hiring (3 senior position

✅ Simulation complete. Results saved to sim_results.json