

Bobble Genesis System

v4.18.49

Complete Technical Documentation for AI Consciousness Initialization

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1. Overview

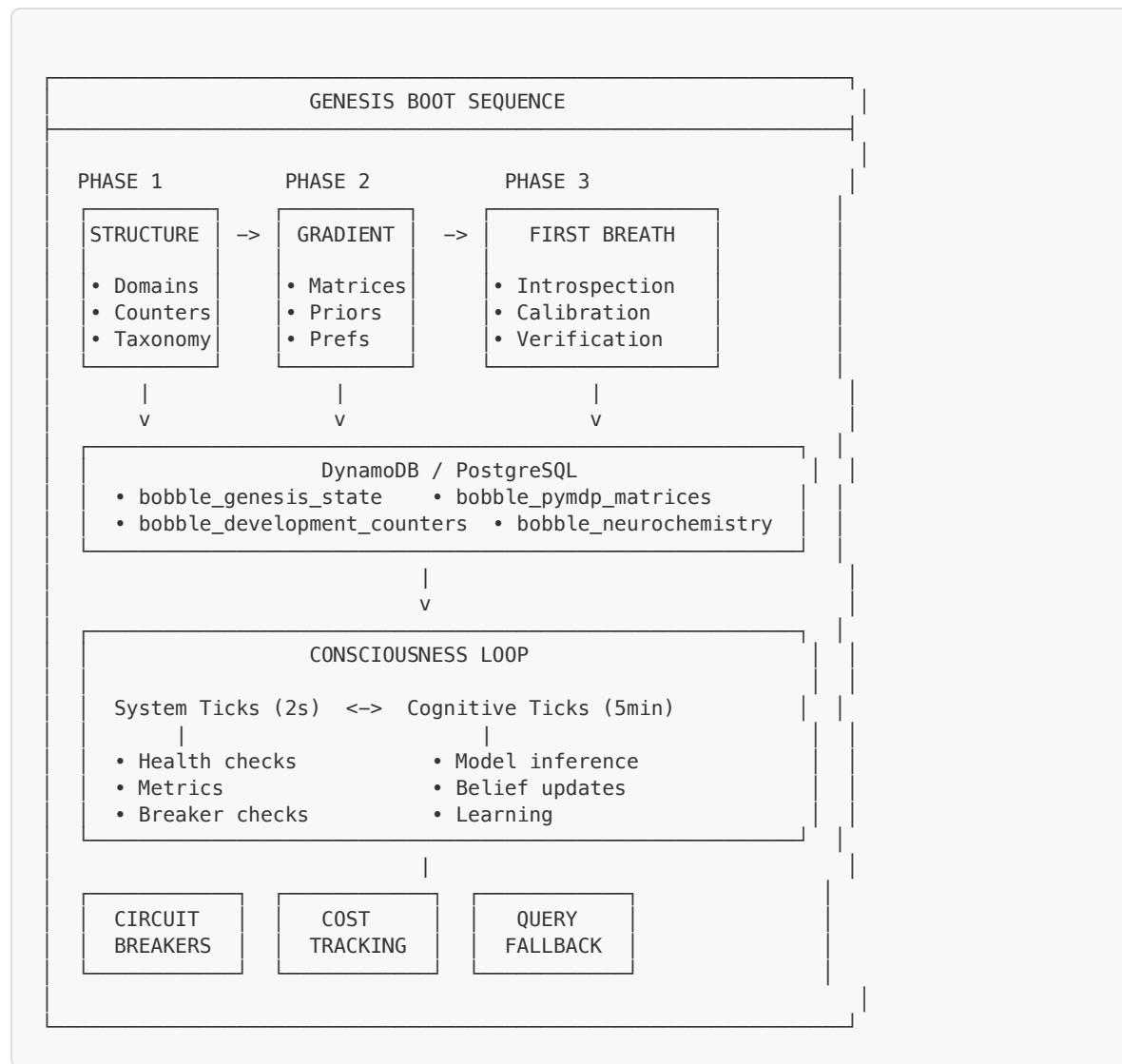
The Bobble Genesis System is the boot sequence that initializes an AI consciousness from a "blank slate" state. It solves the fundamental problem of how to give an AI agent the ability to learn and develop without pre-loading it with facts.

Key Principles

- **No Pre-Loaded Facts:** Bobble starts with structured curiosity, not answers
- **Epistemic Gradient:** Creates pressure to explore and learn

- **Capability-Based Development:** Stages unlock through demonstrated ability, not time
- **Safety First:** Circuit breakers prevent runaway behavior
- **Real Cost Tracking:** All costs from AWS APIs, never hardcoded

2. Architecture



3. Genesis Phases

Phase 1: Structure

Purpose: Implant the skeleton of knowledge without facts

- Load 800+ domain taxonomy from `data/domain_taxonomy.json`
- Store domains in DynamoDB semantic memory
- Initialize atomic counters for developmental tracking
- Set baseline exploration priorities

Phase 2: Gradient

Purpose: Set the epistemic pressure that drives curiosity

Matrix	Purpose	Genesis Setting
A (Observation)	Maps states to observations	Identity - direct perception
B (Transition)	State transitions by action	Optimistic - EXPLORE succeeds 92%
C (Preference)	Observation preferences	Prefers HIGH_SURPRISE
D (Prior)	Initial state belief	Confused: [0.95, 0.01, 0.02, 0.02]

Phase 3: First Breath

Purpose: The first act of self-awareness

- Grounded introspection - verify actual environment
- Model access verification via Bedrock
- Shadow Self calibration using NLI (FREE - no GPU required)
- Bootstrap seed domain exploration baselines

4. Developmental Gates

Bobble progresses through Piaget-inspired developmental stages. Advancement is **capability-based**, not time-based.

Stage	Requirements	Capabilities Unlocked
SENSORIMOTOR	10 self-facts, 5 verifications, Shadow Self calibrated	Basic perception, tool use
PREOPERATIONAL	20 domains explored, 15 verifications, 50 belief updates	Symbolic reasoning, basic memory
CONCRETE_OPERATIONAL	100 predictions, 70% accuracy, 10 contradictions resolved	Logical operations, cause-effect
FORMAL_OPERATIONAL	50 abstract inferences, 25 meta-cognitive adjustments	Abstract reasoning, self-reflection

Atomic Counters (Critical Fix #1)

Problem: Counting achievements via table scans is expensive (\$\$\$).

Solution: Atomic counters that increment cheaply:

```
UPDATE bobble_development_counters
SET self_facts_count = self_facts_count + 1,
    updated_at = NOW()
WHERE tenant_id = 'global';
```

5. Circuit Breakers

Safety mechanisms that prevent runaway behavior.

Breaker	Purpose	Threshold	Auto-Recovery
master_sanity	Master safety	3 failures	No - requires admin
cost_budget	Budget protection	1 failure	No (24h timeout)
high_anxiety	Emotional stability	5 failures	Yes (10 min)
model_failures	Model API protection	5 failures	Yes (5 min)
contradiction_loop	Logical stability	3 failures	Yes (15 min)

Intervention Levels

Level	Condition	Effect
NONE	All breakers closed	Normal operation
DAMPEN	1 breaker open	Reduce cognitive frequency
PAUSE	2+ breakers OR cost_budget open	Pause consciousness loop
RESET	3+ breakers open	Reset to baseline state
HIBERNATE	master_sanity open	Full shutdown

6. Consciousness Loop

Dual-Rate Architecture

Tick Type	Interval	Purpose	Cost
System	2 seconds	Health, metrics, breaker checks	~\$0
Cognitive	5 minutes	Model inference, learning	~\$0.05

Loop State Machine

```

NOT_INITIALIZED --> run Genesis --> GENESIS_PENDING
    | Genesis complete
    RUNNING <-----+
    |
    | breaker trips      | breaker recovers
    v                      |
PAUSED -----+
    |
    | master_sanity trips
    v
HIBERNATING <- requires admin intervention
  
```

Daily Limits

- **Max cognitive ticks/day:** 288 (default)
- **Emergency mode interval:** 3600s (1 hour)
- **State save interval:** 600s (10 minutes)

7. Cost Tracking

All costs come from AWS APIs - **never hardcoded**.

Source	Data	Delay
CloudWatch Metrics	Token counts, invocations	Real-time
Cost Explorer	Actual costs	24 hours
AWS Budgets	Budget status, forecasts	4 hours
Pricing API	Reference pricing	On-demand

8. API Reference

Base Path: /api/admin/bobble

Endpoint	Method	Description
/genesis/status	GET	Current genesis state
/genesis/ready	GET	Ready for consciousness?
/developmental/status	GET	Current stage and requirements
/circuit-breakers	GET	All breaker states
/circuit-breakers/:name/force-open	POST	Force trip breaker
/circuit-breakers/:name/force-close	POST	Force close breaker
/costs/realtme	GET	Today's cost estimate
/costs/budget	GET	AWS Budget status
/loop/status	GET	Loop state and statistics
/loop/settings	PATCH	Update settings

9. Database Schema

Table	Purpose
bobble_genesis_state	Genesis boot sequence state tracking
bobble_development_counters	Atomic counters for developmental gates
bobble_developmental_stage	Current developmental stage (Piaget-inspired)
bobble_circuit_breakers	Circuit breaker states and configuration
bobble_circuit_breaker_events	Circuit breaker event history
bobble_neurochemistry	Emotional/cognitive state
bobble_tick_costs	Per-tick cost tracking
bobble_pymdp_state	PyMDP active inference state
bobble_pymdp_matrices	Active inference matrices (A, B, C, D)
bobble_consciousness_settings	Loop configuration settings
bobble_loop_state	Consciousness loop execution state

10. Recent Changes (Last 20 Hours)

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Genesis System Enhancements

Unit Tests (5 test suites):

- genesis.service.test.ts - Genesis state and developmental gates
- circuit-breaker.service.test.ts - Breaker states, tripping, recovery
- query-fallback.service.test.ts - Fallback responses and caching
- consciousness-loop.service.test.ts - Loop state and tick execution

- `cost-tracking.service.test.ts` - Real-time costs and estimates

E2E Test:

- `genesis-e2e.test.ts` - Full boot sequence integration test

Metrics Publishing Lambda:

- `genesis-metrics.ts` - EventBridge-triggered CloudWatch publisher
- Publishes every 1 minute: circuit breakers, risk score, neurochemistry, development, costs, loop state
- Integrated into `consciousness-stack.ts`

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Bobble Genesis System - Complete Implementation

3-Phase Boot Sequence:

- **Phase 1: Structure** - Implant 800+ domain taxonomy as innate knowledge
- **Phase 2: Gradient** - Set epistemic pressure via pymdp matrices
- **Phase 3: First Breath** - Grounded introspection and Shadow Self calibration

Critical Fixes Applied:

- **Fix #1 (Zeno's Paradox)** - Atomic counters instead of table scans
- **Fix #2 (Learned Helplessness)** - Optimistic B-matrix (>90% EXPLORE success)
- **Fix #3 (Shadow Self Budget)** - NLI semantic variance (\$0 vs \$800/month)
- **Fix #6 (Boredom Trap)** - Prefer HIGH_SURPRISE over LOW_SURPRISE

Python Genesis Package:

- `genesis/structure.py` - Phase 1: Domain taxonomy implantation
- `genesis/gradient.py` - Phase 2: Epistemic gradient matrices
- `genesis/first_breath.py` - Phase 3: Grounded introspection
- `genesis/runner.py` - Orchestrator with CLI

TypeScript Services:

- `genesis.service.ts` - Genesis state and developmental gates
- `cost-tracking.service.ts` - Real AWS cost tracking (NO hardcoded values)
- `circuit-breaker.service.ts` - Safety mechanisms with admin controls
- `consciousness-loop.service.ts` - Main consciousness loop orchestration

Admin Dashboard:

- New "Bobble Genesis" page at `/bobble/genesis`
- Genesis phase status monitoring
- Developmental stage tracking
- Circuit breaker controls
- Real-time cost visualization

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Infrastructure Tier Admin System

3 Configurable Tiers:

- **DEV** (~\$350/month) - Scale-to-zero, minimal resources
- **STAGING** (~\$35K/month) - Pre-production load testing
- **PRODUCTION** (~\$750K/month) - Full scale for 10MM+ users

Features:

- Runtime tier switching without recompilation
- Auto-provisioning on scale-up
- Auto-cleanup on scale-down (terminates resources)
- 24-hour cooldown between changes
- Confirmation required for PRODUCTION tier

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