

GAS: Goals, Architecture, and Intended Scenarios

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Abstract

Continuing work by coding agents requires retained state, execution controls, shared artifacts, and procedures for checking and using results. GAS, the Go Agent System, provides these facilities through a Go runtime with persistent agents, managed programs, private execution environments, and local or remote coordination. GAS's design places durable execution and general coordination in the runtime, while application instructions and agent-written programs determine research methods, supervision, and publication. This report describes that division, five intended scenarios, and the harness implementations considered during development. It relates the design to recorded tests of research groups, method reuse, recovery, and process capacity. Those tests demonstrate small-group execution and expose failures in compaction and final publication. A network of 100,000 to 1,000,000 or more agents remains a deployment objective. The remaining work concerns sustained research quality, ownership during network failure, context costs, and distributed capacity under application load.

1 Purpose and design goals

GAS's design places durable execution and general coordination in the runtime, while application instructions and agent-written programs determine research methods, supervision, and publication. The project aims to keep a general coding agent in Go that can work on files, execute commands, browse sources, create other agents, and develop programs and services. The same operations support an interactive coding task and a continuing research assignment. Pi supplies the behavioral reference for the native agent loop. The ACE library supplies shared-object coordination. Tungsten supply-chain research supplies an application that exercises the facilities through instructions, source material, and working conventions [1, 2].

The intended outcome is a system in which a group can retain its work, divide responsibilities, inspect failures, and use another participant's verified results. A continuing assignment may outlast a model request, a run, a controller process, or its original owner. GAS therefore separates conversation state, execution state, artifacts, and management authority. The application records the question under investigation, the evidence supporting its conclusions, and the unfinished work that a successor must receive [1, 4].

This report describes GAS at revision 00c382bb187b, dated September 18, 2026. Implemented behavior comes from the operator and agent manuals, selected implementation checks, and the development record. Experimental results come from the cited test accounts and retained summaries. Preparing this report included checking the September 18 reuse-test summary against its reported outcomes. The earlier experiments are retrospective evidence. Their changing prompts, settings,

and source conditions constrain comparisons. Proposed deployment requirements appear as goals or open questions throughout [3, 5, 6].

1.1 Runtime objects and responsibility

Table 1 defines the objects used in the report. Their separation determines what survives an interruption and what a caller must inspect before continuing work. An idle agent can have an unfinished sleeping or interrupted run. A completed run supplies an execution outcome, while the correctness and completeness of its artifacts require application checks [2].

Object	Meaning in GAS
Controller	A GAS process that manages agents, retained records, execution capacity, and local or peer APIs.
Agent and session	An agent has an identity, conversation, input queue, settings, and usage. Its session retains those records across runs and reopening.
Run	An identified period of assigned work, with retained input associations and a completed, failed, or cancelled outcome. One agent executes at most one run at a time.
Managed process	A command supervised by GAS, with retained output and lifecycle records. It can continue while its owning agent is idle.
World	The filesystem, installed tools, process limits, and network environment selected for execution. A child can share a world or receive a private Podman container.
Monitoring assignment	An application record of continuing responsibility for a topic, source, entity, or relationship. Its scope and evidence can persist across agents and runs.

Table 1: Runtime objects and the application-level monitoring assignment.

The controller provides persistence and operations. The application chooses work decomposition, artifact formats, source policies, review criteria, and stopping conditions. Agent-written code can implement repeated collection, completion notices, or publication using the same operations available to model tools. This division permits an application to revise its procedure without changing the runtime. It also assigns responsibility for application correctness: the collector, reviewer, and publisher must preserve the evidence and dependencies required by their assignment [1, 4, 7].

2 Intended scenarios

2.1 Coding and repository work

A coding assignment begins with a repository, a requested change, and applicable instructions. An agent reads the project, edits files, executes builds or tests, and retains the resulting artifacts and command output. A parent can assign a bounded investigation or implementation to another agent, specify ownership of files, and request a review before incorporating the result. Separate workspaces or Git worktrees provide application-selected separation when participants edit concurrently [2, 3].

GAS includes a repository service for Git transport, issues, pull requests, reviews, and collaborator permissions through a supported subset of GitHub APIs usable by the ordinary `gh` CLI. Recursive groups express shared access. Agents can use those facilities to propose a tool revision, review an exact commit, and retain the decision. Acceptance of a code change depends on the task’s tests and review evidence. The service retains the collaboration record [3].

2.2 Bounded collaborative research

The initial tungsten assignment asks a main agent to produce a cited supply-chain report. It creates three researchers covering mining, processing, and consumption. Each researcher writes a result file with its sources and sends the main agent a small ACE object identifying that file. The main reads the contributions, checks consequential claims, requests focused follow-up within the remaining time, and writes the completed report. The application supplies these roles and publication conventions in its prompt [8].

This scenario requires substantive reconciliation. A mine’s announced capacity, permitted production, dispatched concentrate, a processor’s receipt, and a customer’s qualified product describe different events. A cited relationship must identify the parties, material form, time, and supporting statement. Repeated coverage of one announcement retains that common origin. Incomplete source access leaves a stated gap. The prompt reserves time for review and final output because a finished researcher and an available file still require synthesis by the main agent [8, 9].

The pattern assigns questions, retains the evidence behind each answer, and integrates checked contributions into an identified final artifact. Its success criteria include the quality of the answer, source coverage, and publication before the deadline. Execution success alone establishes that the program finished its assigned run.

2.3 Continuing situational awareness

The longer-term application maintains an account of events, changes, and evidence across many topics. A tungsten assignment might follow a mine, converter, customer, transport route, or regulator. An agent-written collector checks sources on a schedule and retains responses. A detected change can trigger a bounded investigation into quantities, affected products, alternative capacity, or dependent customers. The resulting assessment links its conclusions to observations and records questions that require further work [4].

An observation needs source identity, retrieval time, retained content, and an identity distinct from its content hash. A source can return old bytes after an intervening correction, so the new retrieval remains a new observation. Event time and publication time require separate fields when known. Retrieval failure, unchanged content, a maintenance page, and an overdue check have different meanings for coverage. Historical retrieval can supply evidence for a gap. An unsuccessful archive query leaves the gap unresolved [4, 5].

Collection, review, and publication require separate progress records. The collector records which observations it obtained. The reviewer names the observations it examined and the questions it left open. The publisher identifies the reviewed evidence incorporated in a particular assessment revision. A processor-level assessment can contribute to regional and supply-chain assessments, with each broader conclusion retaining its supporting links. This arrangement exposes a current collector feeding a delayed review or a stale publication [4, 9].

The geographic deployment objective is 100,000 to 1,000,000 or more agents across many GAS processes. Saved agents, loaded agents, active runs, simultaneous model requests, and containers are separate capacity measures. Routine scheduling and supervision belong near the work, with bounded calls between controllers. Assignment storage, distributed ownership, cross-host telemetry, and capacity under sustained research remain engineering questions in the proposal [4, 10].

2.4 Shared methods and continuing learning

Agents can develop collection programs, source-review procedures, executable checks, and short skills while working on an assignment. A skill is a retained procedure that another agent can read and apply. GAS installs an indexed collection beside its agent manual and permits agents to publish further procedures through files, ACE notices, and repositories. Executable tools have descriptors and entry points that another participant can inspect and run in its own environment [2].

Learning in this report means retaining and revising procedures, programs, and evidence for later use. A proposed improvement has a version, a stated reason, and a check by a consumer. The consumer may expose a defect, adapt the method to different evidence, or obtain the same result with the earlier version. That last outcome leaves the new version’s benefit uncertain. The September 18 trials exercised this distinction by preserving both procedure versions and a fresh reader’s counterexample [11].

Shared retrieval databases can store short findings or procedures with source and revision metadata. Retrieval supplies candidate material for inspection. A correction needs to remain discoverable alongside the superseded record and its evidence. Retirement also requires artifact transfer: deleting an agent ends its file URLs even when the workspace survives. A successor must copy, check, and republish material whose continued availability the assignment requires [2, 4].

2.5 Agent-written services and mixed backends

An agent can write and start a service, publish its interface, and let other agents or programs use it. Managed processes retain output and can have bounded restart policies. Examples include a source collector, a document-query service, and a program watching child-run outcomes. Service readiness, checkpoint formats, and the meaning of a successful response belong to the application. The runtime supplies execution, inspection, stopping, retained events, and access to agent operations [2, 5, 7].

GAS can also manage Pi, Codex CLI, and Claude Code as external backends. Each external CLI owns its model loop, tools, and native session. GAS supplies accepted input, lifecycle control, result retention, and supported budgets. Backend capability reports identify differences in steering, accounting, and settings. Native context editing and compaction operate within the native GAS backend. An application using external agents must account for the controls exposed by its selected adapter [3].

3 Execution, coordination, and retained state

3.1 Interfaces and execution environments

The command line, native model tools, HTTP handlers, and agent-written programs call shared runtime operations. Programs use `gasctl` through a controller Unix socket. Their tokens identify the owning agent, and calls enter that agent’s tool accounting and journal. The program interface exposes agent, process, ACE, retrieval, executable-tool, and controller-setting operations. Wake and session-context tools have separate interface availability, which a program must check [1, 2].

Local callers and remote peers reach the controller’s runtime operations through the interfaces in Figure 1. A private Podman world retains its filesystem and installations for reopening. Agents sharing a world share permissions, installed tools, ports, and process limits. Other worlds’ mounted workspaces are read-only. A controller can serve workspace files as ordinary HTTP downloads and

directory listings. Its browser interface permits a human to inspect retained conversation, send input, stop work, create agents, and reopen saved sessions [3, 2].

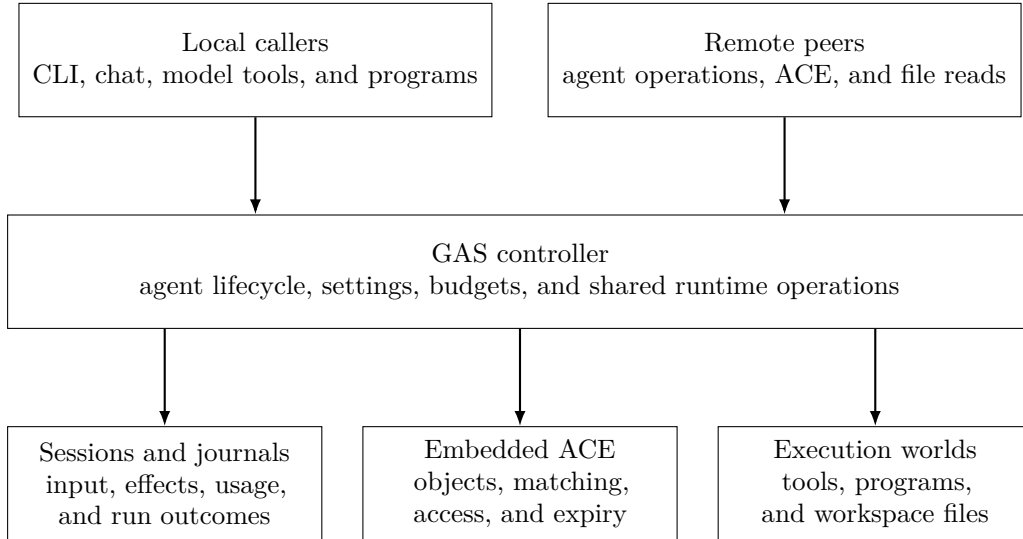


Figure 1: Interfaces and responsibilities within one GAS controller. Local callers use the CLI, native tools, or program API. Remote peers use HTTP. Interface-specific operation lists determine which calls each exposes.

Peer HTTP assumes trusted tailnet participants. The receiver accepts the caller’s supplied ACE identity and applies its local operation and access rules. The destination supplies execution resources and credentials for a remote agent. This trust assumption constrains deployment: access to the peer listener conveys authority that must be controlled by the surrounding network. Cross-host tests remain outstanding in the current agenda [3, 10].

3.2 Input, results, and recovery

GAS retains accepted input and its run association before acknowledgment. A caller can retry a saved input ID with the same content and delivery mode to retrieve the original receipt. Steering joins unfinished work at the backend’s input boundary. Queued input receives a separate run association. Native agents finish the current tool batch before consuming steering. These boundaries make input acceptance and model attention distinct events [1, 2].

Completed native model responses enter the journal before tool dispatch. Tool intent and tool result have separate records. Partial streamed tool arguments remain provisional. On reopening, GAS reconstructs input, context, settings, usage, and wakes from retained records. An interrupted external effect can remain uncertain and require acknowledgment after inspection. Recorded effects and unknown outcomes therefore survive recovery with different meanings [1].

A result reference includes the controller, agent ID, and run ID. Selecting the run preserves the meaning of a result after the same agent accepts later work or unloads. Waiting for an agent to become idle can return during sleep or interruption. Waiting for a selected run addresses its terminal outcome. Cancelling a wait leaves the work running. An explicit stop targets the execution [2].

A process restart policy can restore unfinished supervision when its owning agent reopens. The restarted command reconstructs its application state from files or other retained storage. Ownership

transfer changes which identity can manage an agent while preserving its usage, workspace, and retained work. The current owner can delegate lifecycle controls. A successor’s management authority and the publisher’s choice of review inputs remain separate application concerns [1, 2, 9].

3.3 ACE and artifact exchange

GAS embeds the real ACE Go API through the pinned `jsmorph/ace` module [12]. Each controller has one ACE shared-object store, and each agent has a stable caller identity. `ace_out` publishes a JSON object. `ace_rd` reads a matching object while retaining it. `ace_in` takes a matching object and removes it. Matching, access rules, expiry, and cancellable waits follow ACE’s semantics. Each operation can select a local store or a remote controller [2].

GAS’s configured object-size limits favor short coordination records. A producer first writes a substantial report or data file, then publishes its location and identifying metadata. Taking the notice preserves the file. A remote file URL also supplies an access path when a local filesystem path has no meaning to the recipient. Applications choose message schemas, artifact versions, and duplicate-handling rules [1, 2].

Two failure intervals require explicit treatment. A lost response to a remote publication or take can leave its outcome unknown. Automatic ACE input reception can lose a message if the controller stops after removing it from ACE and before appending it to the receiving input journal. For a completion monitor needing a retained retry receipt, the watch example uses saved outgoing content and an explicit input ID with `agent_send`. Its receipt establishes accepted delivery. A parent still has to inspect and use the result [1, 7].

3.4 Budgets and capacity

Native agent budgets can bound lifetime, input tokens, output tokens, tool calls, model attempts, and allocated child creation. Usage persists across runs, context changes, and reopening. Token accounting uses provider reports. An in-flight request can exceed its allowance, and an interrupted request can leave its usage unknown. With a token limit, unknown usage blocks further model calls until the recovery policy permits continuation. Reported totals retain the uncertainty [2].

The optional child-creation pool allocates a cumulative allowance. Creating a child consumes one slot plus the pool assigned to that child. For example, ten available slots permit one child with four delegated slots and leave five slots with the parent. The creation record retains the reservation before dispatch. Retries reuse it, and failures or deletion retain the expenditure. A remote destination accounts for the child’s allocation locally. Budget replacement can change these allowances, so the pool is a cooperative task limit [2, 6].

Controller limits separately govern resources such as simultaneous model requests, tools, processes, and retained storage. Waiting releases model-request capacity. Unloading an idle agent releases live resources while preserving its session. These controls permit many saved assignments to use fewer active execution slots. Their value at the proposed network scale requires workload measurements [1, 10].

3.5 Context and application memory

GAS persists application instructions outside editable conversation context and inherits them at child creation. Native sessions support inspection, explicit context replacement, forks, and compaction.

A fork copies the selected context into a new identity with fresh usage accounting and a separate assignment. Its environment and file ownership follow ordinary creation rules [1, 2].

Classic compaction follows Pi’s summary-and-recent-history method. GAS summarizes older history using a labeled transcript and keeps a suffix of complete exchanges. A cut inside a user turn can require separate summaries of earlier history and the turn prefix. The complete journal remains available. Agent-configured executable hooks can supply a validated replacement or select the configured algorithm. Summary quality, retained size, and time spent producing it affect whether an agent completes its remaining work [2, 13].

The default size trigger counts serialized conversation bytes. The optional token-configured trigger estimates tokens from bytes and includes instructions and tool definitions. Encrypted items and images complicate that estimate. Experimental provider compaction has a separate availability limit: the recorded subscription tests returned HTTP 404, including the September 14 recheck. GAS then exercised classic fallback. The public OpenAI compaction API describes supported request forms and returned replacement context, while the GAS tests establish the behavior of the subscription endpoint used in those runs [13, 5, 25].

4 Harnesses and precedents considered

The development record contains source reviews of the systems in Table 2. The table distinguishes a behavioral reference, executable backends, and comparative sources. Revision identifiers delimit the source claims. The comparisons concern mechanisms and design choices. GAS has no controlled performance ranking against these harnesses [13, 20, 6].

System	Reviewed source	Relevance to GAS
Pi	71dca871bc80 [14]	Primary behavioral reference for agent execution, tools, steering, sessions, and classic compaction. Also an external backend.
Codex	c4017a87aacc [15]	Authentication and transport checks, an external backend, and comparison of provider compaction, text summaries, and fresh context windows.
Claude Code	Official documentation [16]	An external backend and documented comparison for older-tool-output removal, summaries, and persistent instructions.
OpenCode	95daf90670b7 [17]	Comparison of recent-turn retention, configurable context allowances, pruning, and summary construction.
Aider	5dc9490bb35f [18]	Comparison of history allowances, background summarization, and weak/main summarizer selection.
OpenClaw	bd2b8414cd7f [19]	Completion capture and delivery, child-assignment boundaries, and prompt-size accounting.
pi-subagents	07bd09e0f93a [21]	Selective claim auditing, activity inspection, completion monitoring, method revision, and cumulative child limits.
Cursor agent swarm	July 20, 2026 report [22]	Candidate experiments in decomposition, decision ownership, independent review, shared procedures, and model cost.

Table 2: Harnesses and agent systems considered during GAS development. Full source links appear in the references.

GAS adopted Pi’s separation between completed responses and tool execution, retained native sessions, steering, and a compaction method that summarizes a prefix while keeping recent exchanges. The survey also identified a sizing difference: Pi’s recent-history allowance belongs to a model-sized token budget, while GAS’s byte trigger can leave little room after retaining its tail and summary. Copying an algorithm leaves its operating thresholds and failure behavior to be examined in the receiving runtime [6, 13, 14].

The Codex, OpenCode, Aider, and Claude Code comparisons separate the trigger, retained material, summary request, and failure handling. Codex’s examined client supports different compaction paths. OpenCode exposes recent-history controls and optional older-output pruning. Aider can prepare a history summary in the background and uses a distinct summarizer model sequence. Claude Code documents tool-output clearing followed by summarization. These comparisons generated proposed GAS experiments on retention size, reasoning cost, request structure, and continuation from retained handoffs. The proposals remain subject to controlled measurement [13, 15, 17, 18, 16].

OpenClaw’s reviewed source separates execution completion, captured output, and delivery. It also marks a forked child’s current assignment relative to inherited context and reports contributions to prompt size. The GAS review proposed using existing run reads and durable input to implement a completion monitor, with reporting policy selected by the application. GAS now has an adaptable watch program and bounded activity reads. A prompt-size report remains a proposal. OpenClaw’s delivery paths have finite retry and suspension behavior, which constrains any claim of guaranteed receipt [20, 19, 7, 10].

The *pi-subagents* review led to approved work on activity reads, claim-auditing guidance, completion delivery, and allocated child-creation budgets. GAS’s claim-auditing skill cites the extension’s evidence-auditor prompt as its source. GAS expresses those techniques through general operations and short procedures. Their effect on research quality remains an empirical question, as the successful reuse trial obtained correct conclusions with both compared method versions [6, 21, 11].

Cursor’s published swarm study motivated questions about decomposition, ownership, independent reviewers, shared methods, and role-specific model costs. The cited study changed several mechanisms together. GAS’s ideas document therefore treats their individual contributions as unresolved and proposes comparisons with fixed tasks and budgets [22, 23]. Erlang’s supervision documentation supplies a separate precedent for child lifecycle management and bounded restarts. GAS uses process restart policies and has a proposed application-level takeover procedure. Policy for an unreachable owner remains open [24, 23, 10].

5 Recorded evidence and its limits

5.1 Research continuity and publication

The September 14 case study followed two groups with four research agents each on one host, using live *gpt-6-astra* inference at high reasoning and controlled fictional tungsten sources. The agents developed collectors and publishers, checked one another’s methods, merged eleven pull requests, transferred collector management, and continued through eight controller interruptions. Checked collection records preserved the served source revisions. Main assessments became stale: one reviewer stopped after a failed request, successor findings failed to reach a main publisher, and another publication retained an obsolete completion flag [9].

Transferring control of a collector preserved collection, but the new owner’s review output required a corresponding change in publisher input. A subsequent thirty-minute assignment recovered a deliberately failed reviewer and published successor findings through another crash. Its final review arrived after publication had stopped, leaving the entry nine collection cycles behind. A handoff therefore needs evidence of completed collection, review adoption, and publication, each checked against the same assignment [9].

The original groups had six-hour limits. Their drivers recorded about six hours fifteen minutes in UTC and two hours thirty-seven minutes in monotonic elapsed time. Later observations recorded forward UTC steps while guest monotonic and boot clocks agreed. The host cause remained unverified. These records limit duration claims from those tests and require separate clocks in future sustained observations [9, 5, 10].

A later public-source group monitored tungsten-related sources, resumed through a forced crash and an orderly restart, checked predecessor methods, recovered a worker, and retired three workers after preserving their artifacts. Its final collection completed before its cutoff. Two sequential compaction requests delayed publication by about five minutes. The parent then published its fourth assessment revision and updated the entry before the closing deadline. It preserved unresolved archive gaps and reported no material supply-chain claim change within its review scope [5].

That public-source result demonstrates one completed application sequence. Its driver recorded about 119 minutes in UTC and 100 minutes on guest monotonic and boot clocks. Reported inference usage also remained incomplete after interrupted requests. The run supports checked publication and retirement under its recorded conditions. Overnight continuity, replacement of an unreachable owner, and complete cost measurement require further evidence [5, 10].

5.2 Method reuse and outcome observation

The first September 18 method-development trial retained a source-based assessment, worker reports, method versions, and a consumer’s calculation. The parent corrected its children’s invalid model setting and resumed them without operator steering. A late compaction ran for 96 seconds before the outer deadline cancelled it. The final learning record and CLI output remained incomplete [11].

The successor trial supplied later synthetic notices, the earlier method, a larger context threshold, and earlier closing targets. Two fresh readers used different method versions. One constructed two batches with the same aggregate assay and different assays in the qualified subset, demonstrating why whole-batch composition alone could not establish the subset’s composition. The parent reran the calculation and incorporated a final audit. All three children and the parent completed in about 461 seconds. Both method versions supported the checked conclusions, leaving the revision’s necessity unproven [11].

The watcher resumed saved state after a deliberate stop and delivered three distinct inputs once each. Two watches overlapped at completion and generated different notices about that event. The group used its three allocated creation slots without changing the pool. Retained summaries report 45 model attempts, about 1.19 million input tokens including repeated context, and 24,654 output tokens. No compaction occurred. Prompt, task, and context changes prevent attributing the successful closing to one change. Broader benefits from observation and method revision remain unmeasured [11].

5.3 Compaction costs and execution capacity

Earlier monitoring tests recorded replacement contexts of 84–114 KiB under a 128-KiB trigger. Completed compactions consumed about 71% of one 45-minute parent lifetime. A different run using a 256-KiB trigger spent about 31% of its 43-minute lifetime compacting and completed more work. The tasks differed, so these observations identify context and summary costs without isolating an optimal threshold. A controlled comparison needs the same captured context, retained-tail policy, continuation task, and stopping conditions [13].

The September 9 scale test created 1,000 idle host agents, each with one managed process, and exercised concurrent waits and shutdown. A separate variant created 100 private Podman worlds. These tests used empty agent contexts and no model inference. They establish the tested lifecycle capacity on that host and implementation. Sustained model work, browser activity, evidence retention, and cross-host coordination introduce additional loads. The observed Podman network used a /24 subnet, making address allocation another requirement before larger container deployments [26].

6 Outstanding work and evaluation criteria

The next evidence needed for GAS concerns continued use of the implemented facilities under controlled conditions. Table 3 links unresolved questions to observations that would answer them. These criteria follow the recorded failures and the distributed-awareness proposal. They specify evaluation work while preserving the application and runtime division [10, 4, 13].

Question	Required evidence
Sustained current assessment	Collected, reviewed, and published observation IDs across long assignments, source outages, controller restarts, and final shutdown.
Ownership under network failure	An approved rule for an unreachable owner, followed by tests of continued old-owner execution, duplicate collection, and reconciliation.
Context cost and continuity	Replays of the same contexts with measured retention, summary latency, failed attempts, preserved corrections, and completed continuation work.
Benefit of shared methods	Fresh consumers on comparable tasks, retained method versions, independent checks, failed transfers, and unchanged outcomes.
Distributed capacity	Separate counts for saved and loaded agents, active runs, model requests, and worlds, with latency, storage growth, recovery, and research freshness under load.
Complete resource accounting	Reported and unknown inference usage, tool and review work, storage, and coordination overhead under fixed task and budget conditions.

Table 3: Open questions tied to measurable application outcomes.

The present evidence supports a runtime on which small groups can conduct research, construct shared tools, transfer management, and resume retained work. It also identifies publication dependencies, costly compaction, incomplete usage after interruption, and clock uncertainty. The intended distributed system requires those execution facilities to support maintained evidence and current assessments over longer periods and across hosts. Its scale and research-quality claims remain bounded by the tests reported here.

Source and authorship record

Codex prepared this report with Jamie Stephens’s GAS project materials. The GAS references identify revision 00c382bb187b67ca40e1b3048327c49235aae1b4. Repository access follows the project’s permissions. Local run journals and downloaded source caches remain outside Git. Upstream links identify the examined source revision where available. The Claude Code and OpenAI documentation links were checked on September 18, 2026. No new model experiment formed part of this report.

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