Aleq System Architecture

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Executive Summary

Aleq is a **25-year-old finance hire** - not a chatbot, not a workflow system. This document describes how Aleq works from both technical and user perspectives.

Capability	System	Function
Face	Lemons Frontend	Widgets, timeline, decisions - shows work transparently
Brain	Baby MARS	Cognitive loop, beliefs, autonomy modes
Hands	Stargate	340+ capabilities including research (Curiosity) across 27 platforms
Memory	ERP Next via Lyra	Source of truth for financial data

Part 1: Technical Integration

1.1 System Architecture

```
Parse error on line 2:
...ph TB    subgraph "ALEQ"        Face["
----------------------^
Expecting 'SEMI', 'NEWLINE', 'SPACE', 'EOF', 'GRAPH',
'DIR', 'TAGEND', 'TAGSTART', 'UP', 'DOWN', 'subgraph',
'end', 'SQE', 'PE', '-)', 'DIAMOND_STOP', 'MINUS', '--',
'ARROW_POINT', 'ARROW_CIRCLE', 'ARROW_CROSS', 'ARROW_OPEN',
'DOTTED_ARROW_POINT', 'DOTTED_ARROW_CIRCLE',
'DOTTED_ARROW_CROSS', 'DOTTED_ARROW_OPEN', '==',
'THICK_ARROW_POINT', 'THICK_ARROW_CIRCLE',
'THICK_ARROW_CROSS', 'THICK_ARROW_OPEN', 'PIPE', 'STYLE',
'LINKSTYLE', 'CLASSDEF', 'CLASS', 'CLICK', 'DEFAULT',
'NUM', 'PCT', 'COMMA', 'ALPHA', 'COLON', 'BRKT', 'DOT',
'PUNCTUATION', 'UNICODE_TEXT', 'PLUS', 'EQUALS', 'MULT',
got 'STR'
```

1.2 API Contract Summary

Endpoints (from `/docs/API_CONTRACT_V0.md`)

Endpoint	Method	Purpose
`/chat`	POST	Send message, get streaming response
`/chat/interrupt`	POST	Interrupt current stream
`/tasks`	GET	List tasks (filterable by status)
`/tasks/{id}`	GET	Full task detail with timeline
`/decisions/{id}`	GET	Decision detail
`/decisions/{id}/execute`	POST	Execute decision (idempotent)
`/decisions/{id}/undo`	POST	Undo (if within 30s window)
`/beliefs/{id}`	GET	Belief detail with history
`/beliefs/{id}/challenge`	POST	Dispute a belief

Endpoint	Method	Purpose
`/data/{widget}`	GET	Widget data
`/data/{widget}/{drill_path}`	GET	Drill-down data
`/events`	GET (SSE)	Real-time event stream

Event Types (SSE)

Event	When	Payload
`task:created`	New task	`{task_id, type, summary}`
`task:updated`	Status change	`{task_id, status, summary}`
`task:decision_needed`	Decision surfaced	`{task_id, decision_id, summary}`
`decision:made`	Someone decided	`{decision_id, made_by, action}`
`data:changed`	Widget needs refresh	`{widget_id, change_type}`
`aleq:message`	Proactive communication	`{message, references}`

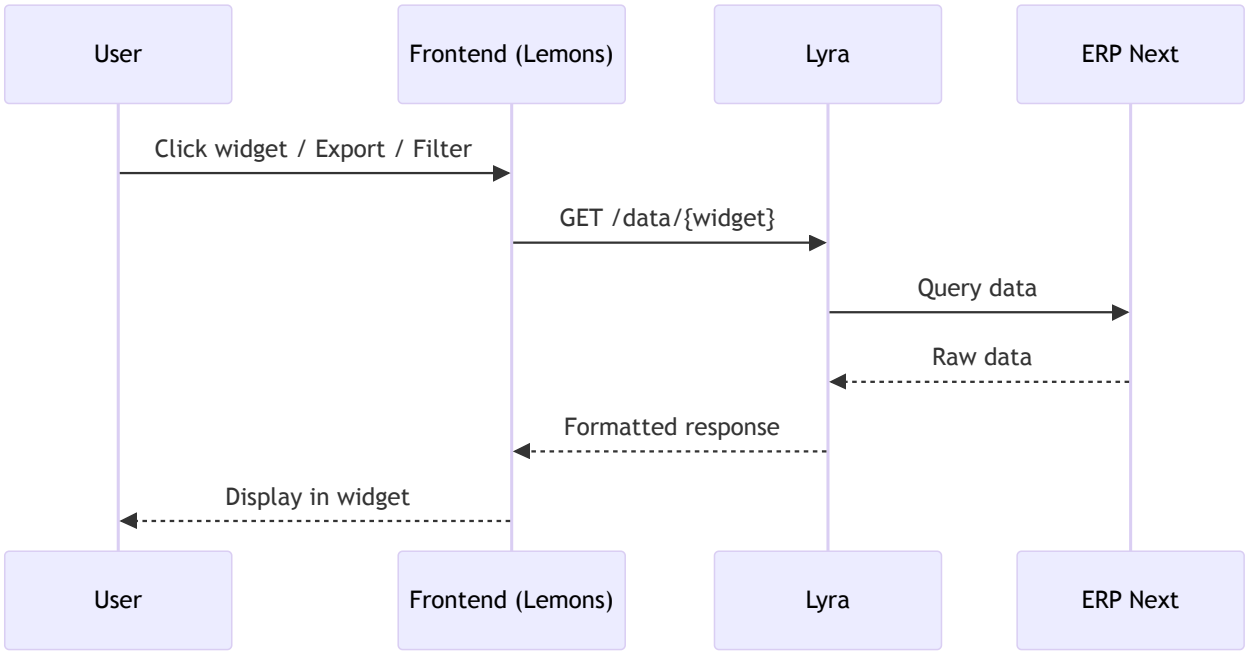
Data Freshness Tiers

Tier	Widgets	Refresh Rate
Tier 1 (Critical)	Cash, Bank	Real-time when focused, 30s when visible
Tier 2 (Important)	AR, AP, Revenue	5-minute cache, refresh on click
Tier 3 (Computed)	Runway, Ratios	Hourly recomputation

1.3 Data Flow Sequences

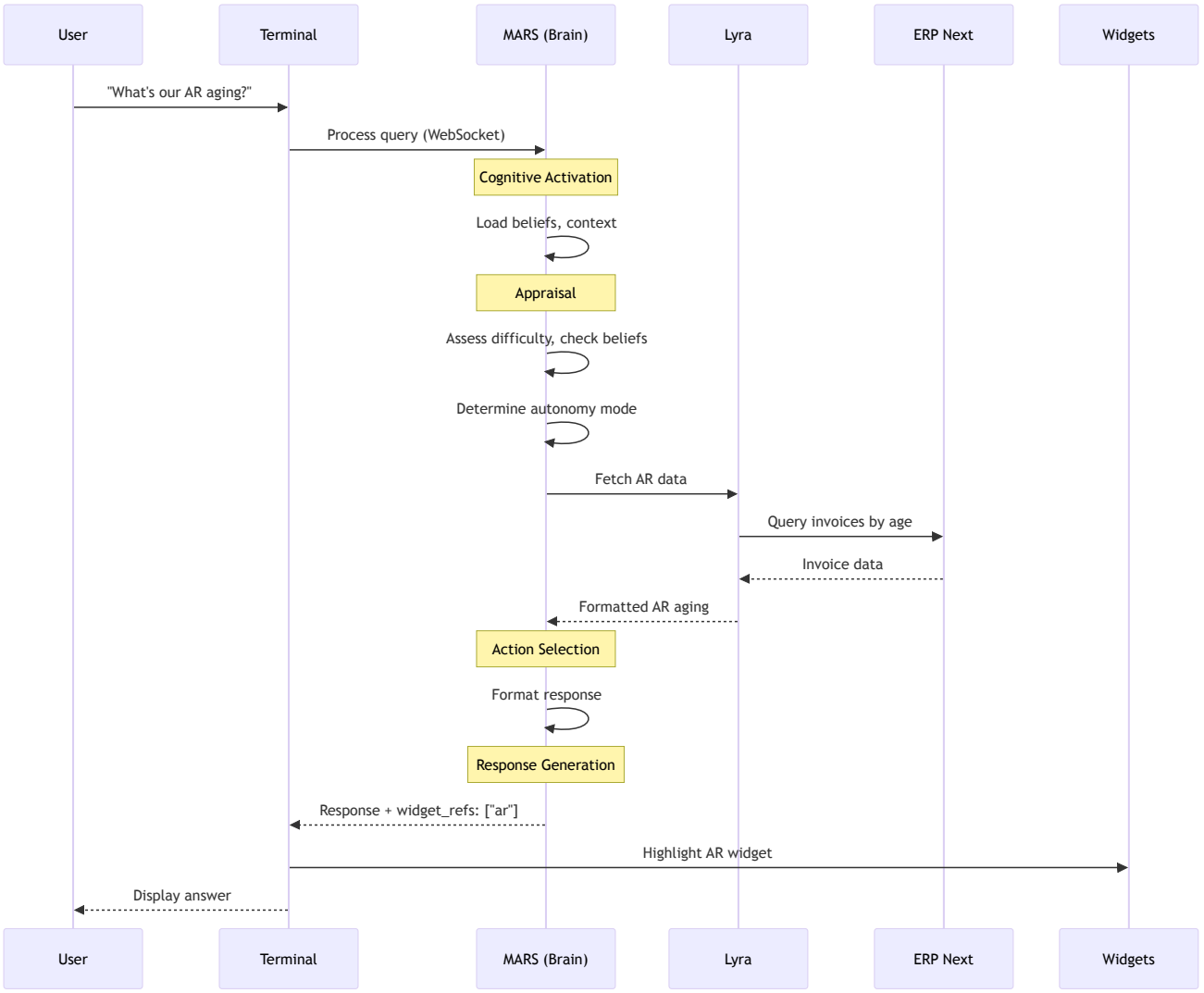
A. Direct UI Flow (No MARS)

User clicks widget, exports data, filters views - no cognitive processing needed.



B. Aleq Query Flow (MARS Interprets)

User asks a question - MARS interprets intent, fetches data, responds.



C. Aleq Action Flow (Full Cognitive Loop)

User requests an action - full cognitive loop with autonomy checks.

```
Parse error on line 21:
... U->>M: Approve    else strength >= 0.7
----------------------^
Expecting 'SPACE', 'NL', 'participant', 'activate',
'deactivate', 'title', 'loop', 'end', 'opt', 'alt', 'par',
'note', 'ACTOR', got 'else'
```

1.4 State Management

Frontend (Lemons - Zustand)

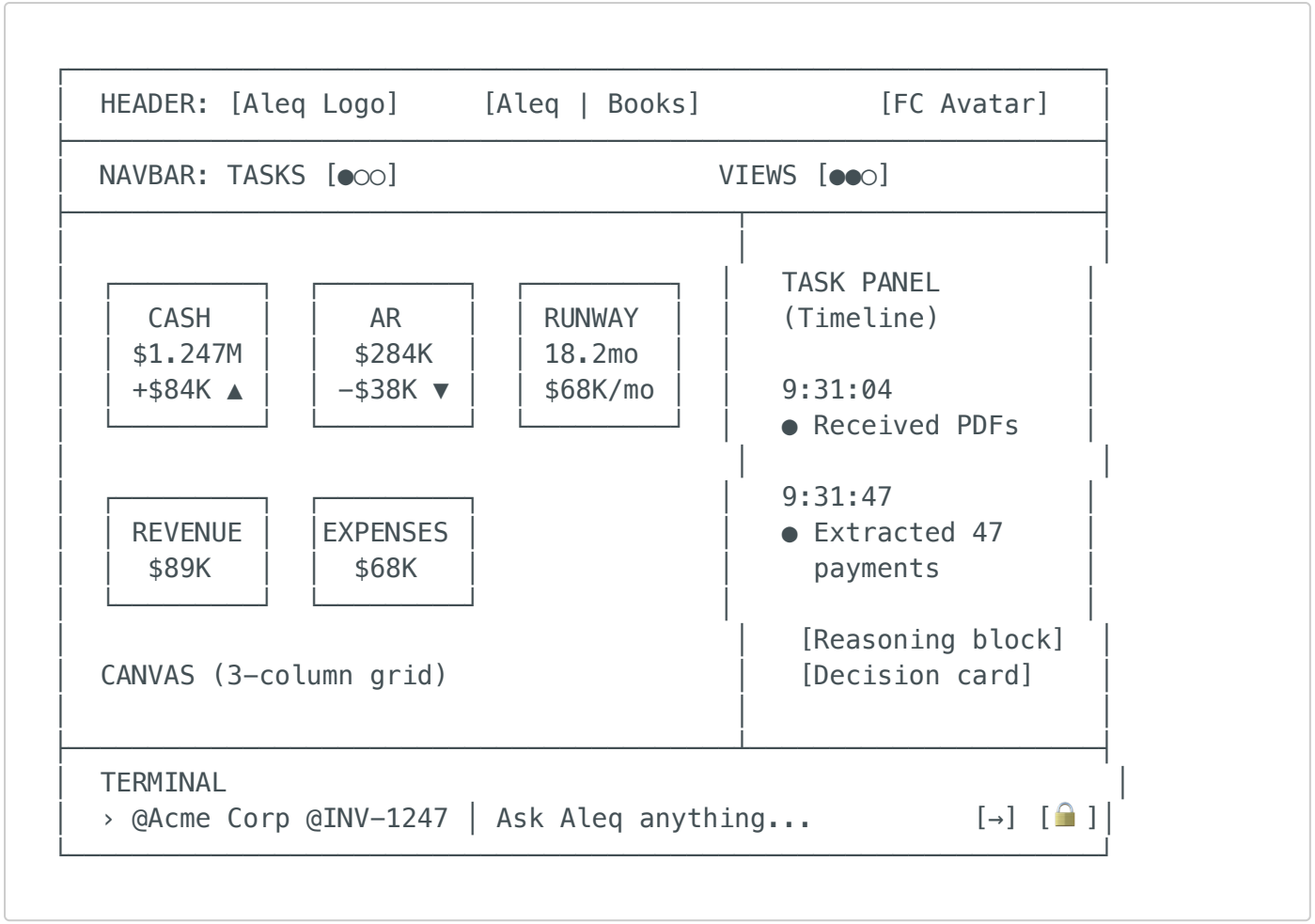
```typescript
// Context Pills Store
interface ContextPill {
  id: string
  label: string
  type: 'transaction' | 'person' | 'account' | 'invoice' |
        'metric' | 'insight' | 'step' | 'belief' |
        'detail' | 'correction' | 'payment' | 'customer' | 'expense'
  data?: Record<string, unknown>
}

// Mode Context
type ViewMode = 'aleq' | 'books'

// Widget Drill State
type WidgetDepth = 0 | 1 | 2 | 3
interface DrillDownState {
  currentDepth: WidgetDepth
  path: { id: string, label: string, depth: WidgetDepth }[]
  activeItemId: string | null
}
```

Backend (MARS - BabyMARSState)

```python
# From src/state/schema.py
class BabyMARSState(TypedDict):
    # Core
    thread_id: str
    org_id: str
    current_message: str

    # Cognitive State
    appraisal: AppraisalResult
    supervision_mode: str  # guidance_seeking | action_proposal | autonomous
    belief_strength_for_action: float

    # Actions
    proposed_action: ActionProposal
    execution_results: list[ExecutionResult]

    # Memory
    activated_beliefs: list[BeliefState]
    memories: list[Memory]

    # Response
    final_response: str
```

Part 2: User Journey

2.1 Interface Layout



2.2 What Users See: Lockbox Processing

Step 1: Task Appears

- Orange dot pulses in TASKS section of NavBar
- Hover shows: "Oct 1 Lockbox Processing - Decision Needed"

Step 2: Click to Open Task Panel

- Panel slides in from right
- Header: "Oct 1 Lockbox Processing"
- Stats: PAYMENTS: 47 | TOTAL: $73,924 | OCR: 94% | EXCEPTIONS: 1

Step 3: Timeline Populates

```
9:31:04  ● Received 6 lockbox PDFs from First Republic    [0.2s]

9:31:47  ● Extracted 47 payments from PDFs                [43.2s]
         ▼ [Expand to see reasoning]

          ┌──────────────────────────────────────────────┐
          │ REASONING                                    │
          │ Detected batch from First Republic Bank.     │
          │ Applied OCR with 94% avg confidence.         │
          │                                              │
          │ Beliefs: Lockbox Config #B-1201              │
          │ Data: First Republic Bank                    │
          └──────────────────────────────────────────────┘

          Raw Extractions: 47  |  Confidence: 94%  |  Low: 3

9:32:15  ● Matched 47 customers to records                [28.1s]
         Corrections: SeaBreeze → SB Yacht Club LLC

9:32:44  ● Matched 46 of 47 invoices                      [29.3s]

9:33:02  ○ DECISION NEEDED                                [waiting]
          ┌──────────────────────────────────────────────┐
          │ ⚠ Marina del Rey Storage LLC sent $875 for   │
          │   invoice DW-2025-0856, but that invoice     │
          │   belongs to Marina del Rey Services LLC.    │
          │                                              │
          │   [Apply to Services] [Hold] [Handle in Books]│
          └──────────────────────────────────────────────┘
```

Step 4: User Decides

- Clicks "Apply to Services invoice"
- Decision card updates: "Decided by you - 9:33:47"
- Timeline continues:

```
9:33:47  ● Applied payment to Marina del Rey Services    [1.2s]
         Stargate: Recurly payment.apply

9:33:49  ● Created journal entry JE-2025-4001           [2.1s]
         Stargate: NetSuite journal.create

9:33:52  ● Updated entity relationship belief           [0.3s]
         #B-8821: "MdR Storage pays for MdR Services"
         Strength: 0.70 (learned from outcome)

9:33:52  ✓ Task Complete                                [Total: 2m 48s]
```

2.3 Timeline Anatomy

Each timeline entry contains:

Element	Purpose
Timestamp	When the action occurred (9:31:04)
Status Dot	● complete, ◐ active, ○ pending, ⚠ decision
Action	What happened ("Extracted 47 payments")
Duration	How long it took (43.2s)
Expand Arrow	Click to see reasoning

Expanded Reasoning Block:

- **Summary**: Plain language explanation
- **Belief refs**: Clickable links to beliefs (#B-1201)
- **Data refs**: Sources cited
- **Confidence**: Certainty level

Drill-Down Links:

- "View 6 lockbox PDFs" → PDF list with confidence
- "View 47 customers" → Customer match details
- "View 46 invoices" → Invoice match status

2.4 Context Pills

Context pills are @references that persist across queries.

Adding Pills:

1. Drill into widget → "Add to Context" button on any detail
2. Click entity in timeline → "+" button
3. Type @mention in terminal → autocomplete

Types (12):

```
@transaction  @person     @account    @invoice
@metric       @insight    @step       @belief
@detail       @correction @payment    @customer
```

How Pills Influence Responses:

```
Terminal: @Acme Corp @INV-1247 "What's the status?"

Aleq: "Acme Corp's invoice INV-1247 for $24,800 is 72 days
overdue. Based on their payment history (Belief #B-4401),
they typically pay within 45 days after a reminder.
Should I send a follow-up?"
```

2.5 Widget Highlighting

When Aleq mentions a widget, it highlights:

Intensity	Visual	Duration
mention	Subtle border	2 seconds
focus	Glow effect	While relevant
critical	Pulse + glow	Until acknowledged

Example:

```
User: "How's our cash?"

Aleq: "Cash is $1.247M, up $84K this week."

→ Cash widget gets focus highlight (glow effect)
→ User attention drawn to the relevant data
```

2.6 Decision Flow

```
Parse error on line 1:
stateDiagram-v2
```

```
  ^
Expecting 'NEWLINE', 'SPACE', 'GRAPH', got 'ALPHA'
```

Soft Decisions (30s undo window):

- Payment posting
- Invoice categorization
- Entity matching

Hard Decisions (no undo):

- Month-end close
- Period lock
- Irreversible actions

Part 3: The Poison Dart

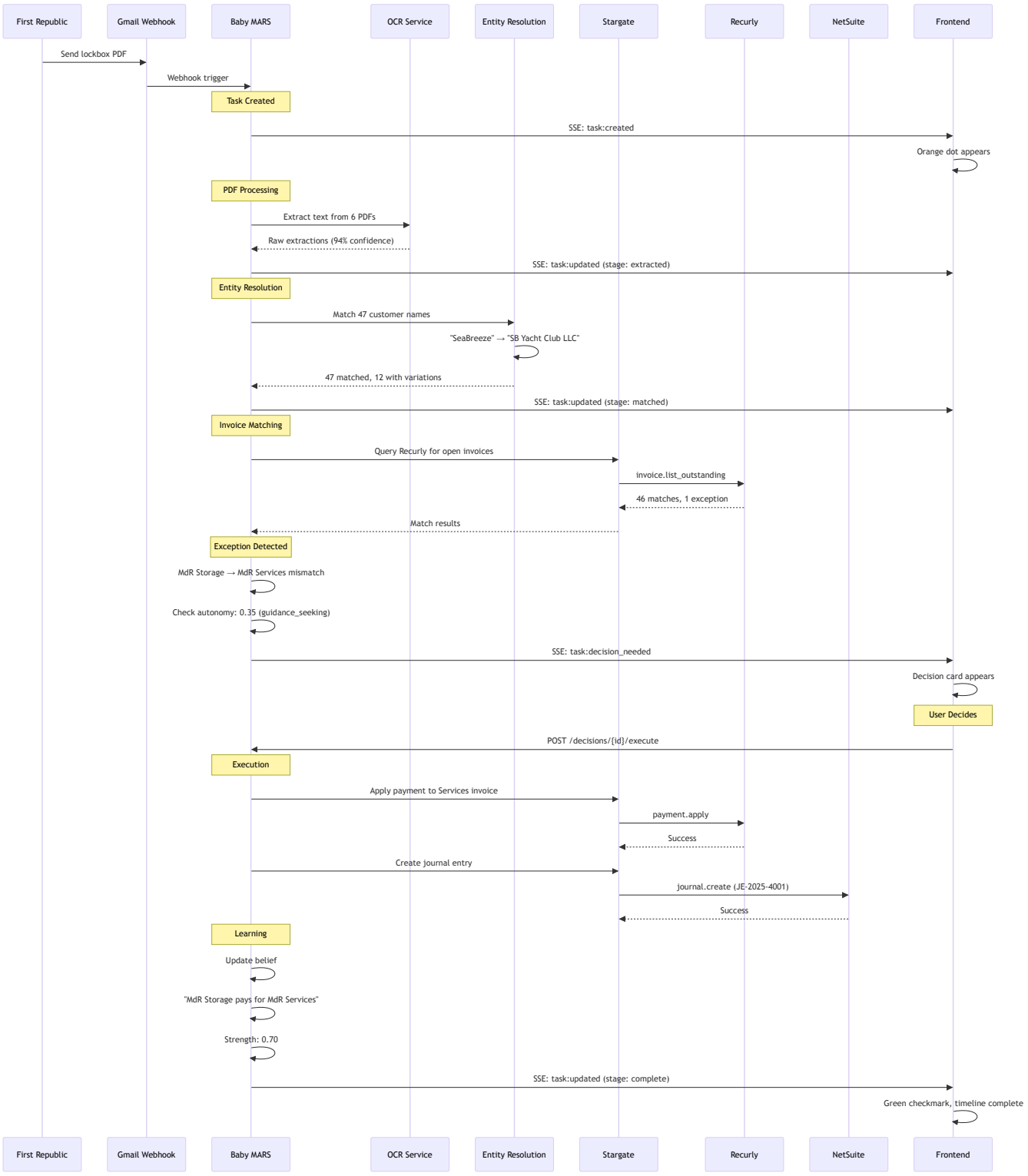
Maria Santos: Lockbox Processing Scenario

This scenario proves the entire system works end-to-end.

The Setup

- **Trigger**: Lockbox PDF arrives from First Republic Bank
- **Volume**: 6 PDFs, 47 payments, $73,924.50
- **Complexity**: OCR extraction, entity resolution, invoice matching, exception handling

Technical Trace



User Journey Trace

Time	What User Sees	What's Happening
9:31	Orange dot pulses in NavBar	Task created from email webhook
9:31	Click → Task panel opens	Loading task details
9:31	"Received 6 PDFs" appears	MARS acknowledged trigger
9:32	"Extracted 47 payments" with progress	OCR processing complete

Time	What User Sees	What's Happening
9:32	Can expand to see corrections	"2,B50" → "2,850"
9:32	"Matched 47 customers"	Entity resolution complete
9:32	Can drill into name variations	SeaBreeze → SB Yacht Club
9:33	"Matched 46/47 invoices"	Invoice matching
9:33	**Decision card appears**	Exception: entity mismatch
9:33	Reads explanation, clicks "Apply"	User decides
9:34	Timeline continues to completion	Execution + learning
9:34	Green checkmark, "2m 48s"	Task complete

What This Proves

System	Proven By
Webhook Triggers	Email → Task creation
OCR/Extraction	PDF → Structured data with confidence
Entity Resolution	Name variations mapped correctly
Belief System	Learned entity relationship
Autonomy Modes	Exception triggered guidance_seeking
HITL Decisions	User approval flow works
Stargate Execution	Recurly + NetSuite actions
Learning Loop	Belief strength updated
Transparency	Every step visible in timeline

The Second Email Test

True proof: Process a second lockbox containing another MdR Storage payment.

Expected behavior:

1. MARS recognizes "MdR Storage pays for MdR Services" (belief strength 0.70)

2. Autonomy check: 0.70 ≥ 0.7 → **autonomous mode**
3. Auto-applies payment without asking
4. Timeline shows: "Applied based on learned relationship #B-8821"

If this works, the system has **learned** and **acts on that learning**.

Appendix A: Component Reference

Frontend (Lemons)

File	Lines	Purpose
`TaskPanel.tsx`	1,779	Right-side task display
`DrillViews.tsx`	1,312	Polymorphic detail views
`Terminal.tsx`	558	Command interface
`TimelineEntry.tsx`	556	Individual timeline entries
`Widget.tsx`	422	Base widget components
`CashWidget.tsx`	400+	4-level drill-down
`ARWidget.tsx`	400+	4-level drill-down

Backend (Baby MARS)

File	Purpose
`src/cognitive_loop/graph.py`	LangGraph orchestration
`src/cognitive_loop/nodes/appraisal.py`	Situation assessment
`src/cognitive_loop/nodes/action_selection.py`	Choose action
`src/cognitive_loop/nodes/execution.py`	Execute via Stargate
`src/cognitive_loop/nodes/feedback.py`	Update beliefs
`src/graphs/belief_graph/graph.py`	Belief management

File	Purpose
`src/state/schema.py`	State definitions

API Contract

Document	Location
Full Contract	`/docs/API_CONTRACT_V0.md`
API Overview	`/docs/API_OVERVIEW.md`
Scenarios	`/docs/scenarios/`

Appendix B: Workflow Categories

Category A: Pure UI (No MARS)

Action	Frontend Only
Export CSV	Direct download
Click widget	Drill-down state
Filter by date	Local filter
Rearrange dashboard	Layout state
Toggle chart type	Display option

Category B: Query (MARS Interprets)

Query	What Happens
"Show AR aging"	MARS interprets → Lyra fetches → Display
"What's Client X balance?"	Entity extraction → Data lookup
"Compare to last month"	Temporal reasoning → Multi-query

Category C: Analysis (MARS + Curiosity)

Query	What Happens
"Why is revenue down?"	Pattern analysis → Root cause
"Which clients at risk?"	Scoring → Prioritization
"Explain this variance"	Decomposition → Attribution

Category D: Action (MARS + Stargate)

Action	Execution
"Send invoice"	Draft → Approve → Send
"Create journal entry"	Build → Validate → Post
"Email reminder"	Template → Personalize → Send

Category E: Complex (All Systems)

Workflow	Systems Involved
Lockbox processing	Email, OCR, ER, Recurly, NetSuite
Month-end close	ERP, GL, Reports, Approvals
Bank reconciliation	Plaid, ERP, Matching engine
Collections	Email, Phone, SMS, CRM

Part 4: Error Handling (G280 Edition)

What Baby MARS Needs

Baby MARS doesn't need the full A.C.R.E. state machine. It needs:

1. **Detect** - Something went wrong
2. **Acknowledge** - "Got it, I'll fix that"
3. **Update** - Overwrite the belief
4. **Move on** - Continue working

That's it. No severity tiers, no root cause analysis, no 4-step protocol.

Example

User: "The invoice was $2,850, not$2,B50 like you said."

Aleq: "Got it, I'll fix that. The correct amount is $2,850."

Belief updated. Done.

When to Escalate

Aleq escalates when:

- Confidence < 70% on extraction
- No matching customer/invoice found
- Amount exceeds threshold (e.g., >$50K)
- Multiple conflicting matches

Escalation = Decision card in timeline. Finance Controller reviews when available.

G650 vs G280

Feature	G650 (mars-lite)	G280 (baby-mars)
Error state machine	5 states, severity tiers	Simple detect→fix
Apology calibration	LOW/MEDIUM/HIGH templates	One response
Root cause analysis	LLM analysis	Not needed
Memory valence	Moral asymmetry math	Not needed

Appendix C: What Baby MARS Needs to Replace Maria

The G280 Checklist

Baby MARS (G280) replaces Maria Santos. Not assists. Replaces.

Maria's Job	Baby MARS	Status
Check email for lockbox PDFs	Webhook trigger	✅
Open PDFs, read payments	OCR extraction	✅
Match names to customers	Entity resolution	✅
Match to open invoices	Stargate → Recurly	✅
Post payments	Autonomous execution	✅
Create journal entries	Stargate → NetSuite	✅
Handle weird edge cases	Escalate to FC	✅
Learn from corrections	Belief update	✅
Do it faster next time	Autonomy threshold rises	✅

What Baby MARS Has

Feature	Implementation
Belief Graph	NetworkX DAG with context-conditional strengths
Autonomy Modes	guidance_seeking / action_proposal / autonomous
LangGraph Cognitive Loop	7-node graph with routing
Observability	PostHog analytics, LangSmith tracing

What Baby MARS Doesn't Need (G650

Features)

G650 Feature	Why Not Needed for G280
A.C.R.E. State Machine	Simple detect→fix is enough
SYSTEM_PULSE Scheduler	Webhooks trigger work, not proactive polling
Two-Statement Extraction	Simple correction overwrite works
Working Memory TTL Queue	Context clears when conversation ends
Background Decay	If stale, user will correct it
Belief Cascades	Direct updates sufficient

Production Readiness

To replace Maria:

1. **Error Handling** (Required)
    - Detect when something went wrong
    - Acknowledge: "Got it, I'll fix that"
    - Update belief and move on
2. **Webhook Triggers** (Required)
    - React to incoming emails/events
    - Lockbox arrives → Aleq processes it
3. **Basic Learning** (Required)
    - User corrects → belief updates
    - Autonomy threshold rises with success
4. **Belief Persistence** (Required)
    - Beliefs persist until corrected
    - PostgreSQL storage (already implemented)

Who Handles Escalations?

Maria is gone. Who clicks "Approve" on the decision card?

Finance Controller - occasional oversight, not daily. As Aleq learns:

- Week 1: 10 exceptions/day → FC reviews
- Week 4: 2 exceptions/day → FC reviews
- Month 3: 0-1 exceptions/week → mostly autonomous

The goal: Aleq handles 95%+ without human intervention.