

# **AI-Augmented Software Development Lifecycle (AI SDLC)**

**A Complete Methodology for Intent-Driven Development with AI**

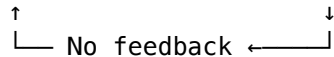
# Slide 1: The Problem

## AI Coding Assistants Are Powerful but Chaotic

### Current State of AI-Assisted Development:

- **No Methodology:** Developers use AI ad-hoc with no standardized process
- **Lost Context:** AI forgets discussions; developers re-explain repeatedly
- **Quality Varies Wildly:** TDD ignored, technical debt accumulates
- **Enterprise Gap:** Can't use AI for regulated workloads (no traceability)
- **Each Team Reinvents:** No shared framework; every team creates their own prompts

Developer → AI → Code → ???



| “We have powerful AI tools but no discipline for using them.”

# Slide 2: The Vision

## AI Assistance with the Rigor of Traditional SDLC, but 10× Faster

AI SDLC Core Promise:

Traditional SDLC	Ad-hoc AI	AI SDLC
Rigorous but slow	Fast but chaotic	Rigorous AND fast
Full traceability	No traceability	Full traceability
Human-only	AI-only decisions	Human decides, AI accelerates
Static requirements	No requirements	Living requirements

**Key Insight:** Requirements become a *control system* (like a thermostat), not a static document.

# Slide 3: The Chain of Intentionality

## Where Does Intent Come From?

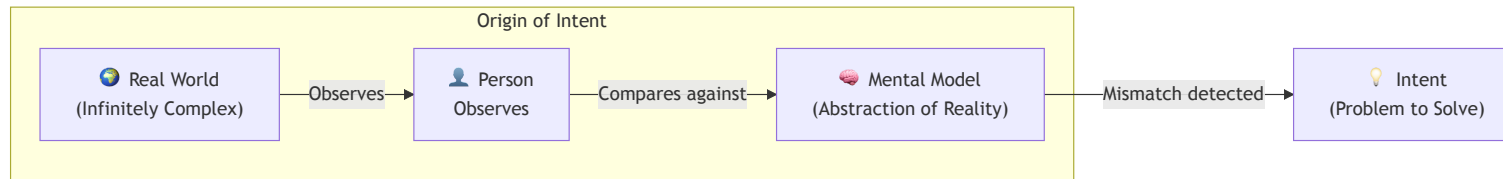


Diagram 0

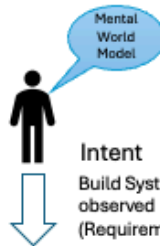
## Where Does Intent Come From?

IT Systems are built to solve real world problems.

The real world is infinitely complex.

Our own minds only store a small abstraction of reality.

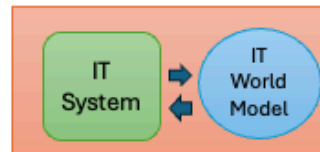
Our IT Systems (for now) store even less.



Person evaluates observations, against their own Mental Model of the world. Intent arises from a mismatch between the Observations and the Mental Model.

Intent

Build Systems to solve observed problem. (Requirements)



Example: Software Engineers work with Traders to build a Trading System. Traders use the system to enact trades and record the representation of those trades. The representation of that recorded data is meaningless if its context and business rules are lost.

### What is Data?

The IT system is an abstraction of the real world

- It is a collection of Business Processes
- And the Saved Business Process Representation (Data)
- Without the context of the original system the data is meaningless

Where Does Intent Come From?

**The Insight:** - IT Systems are built to solve real-world problems - The real world is infinitely complex - Our minds store only a small abstraction of reality - Our IT Systems (for now) store even less - **Intent arises from mismatch between observation and mental model**

# Slide 4: The Complete Consciousness Loop

**Builder → Executor → Observer → Evaluator → Intent**

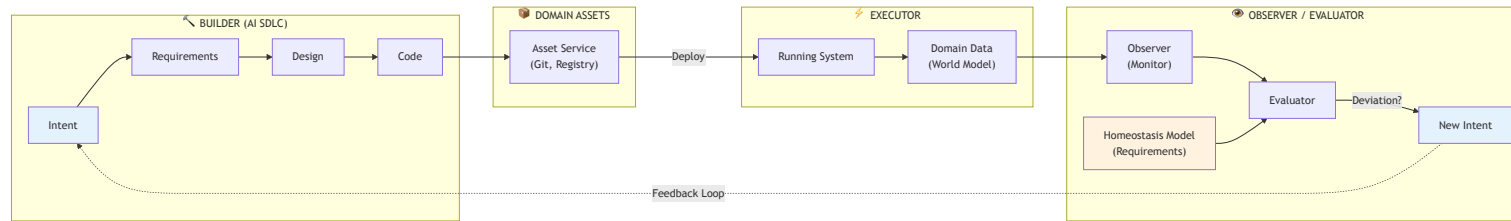
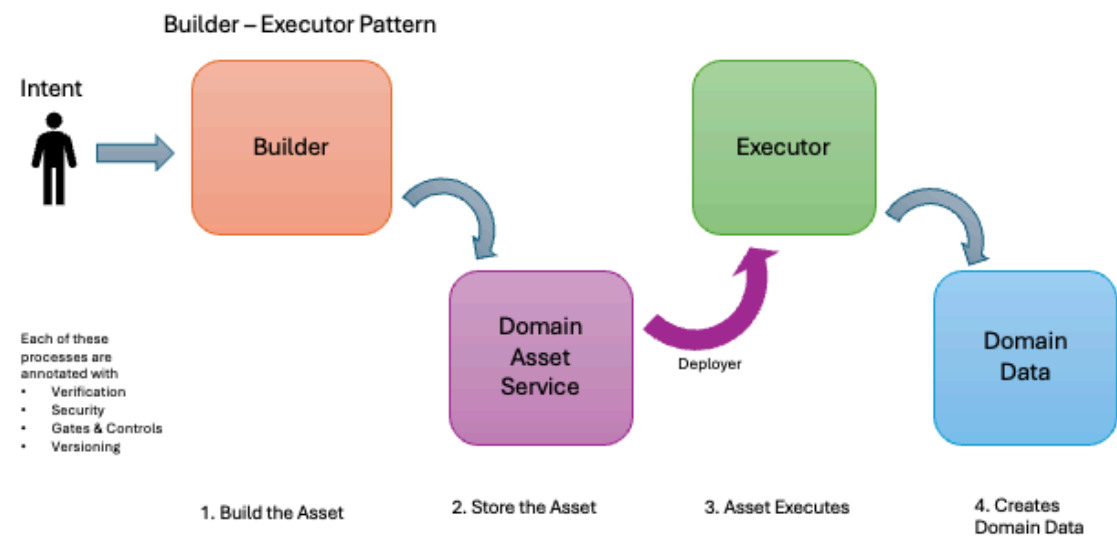


Diagram 1

**Builder / Executor Pattern**

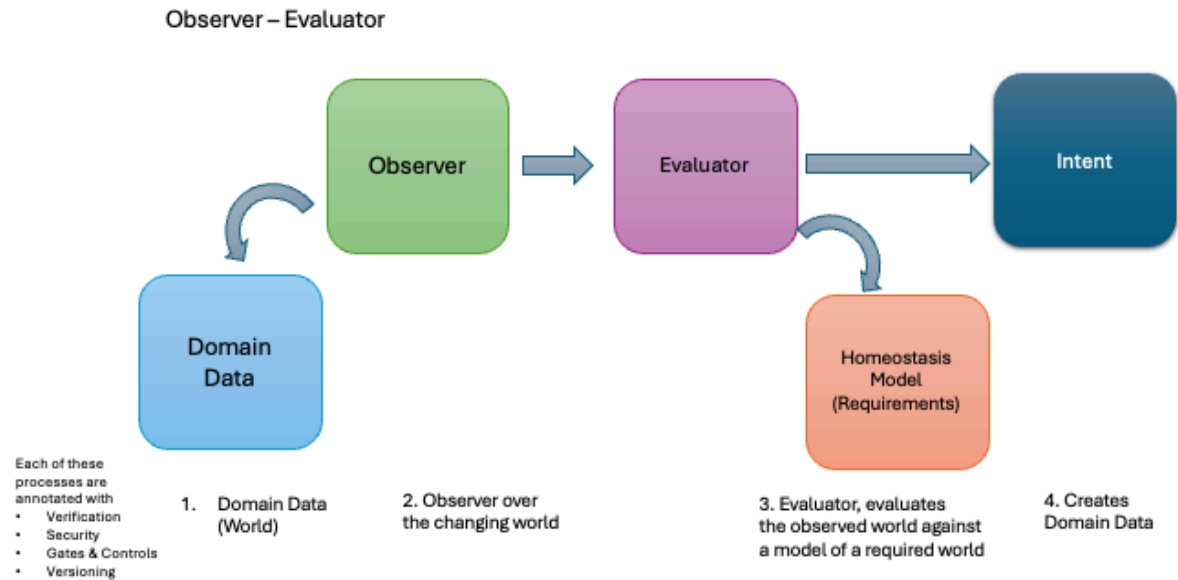
**Builder / Executor**



Builder / Executor

Observer / Evaluator Pattern

Observer / Evaluator



Observer / Evaluator

The Four Phases:

Phase	Purpose	Output
Builder	Transform intent into executable assets	Code, Tests, Configs
Executor	Run assets to create domain data	Running system + World Model
Observer	Monitor the changing world	Observations, Metrics
Evaluator	Compare actual vs. required state	Deviations → New Intent

This is the **Consciousness Loop**: The system becomes *aware* of its own behavior and self-corrects.



# Slide 5: Intent Categories

## Discovery vs. Builder

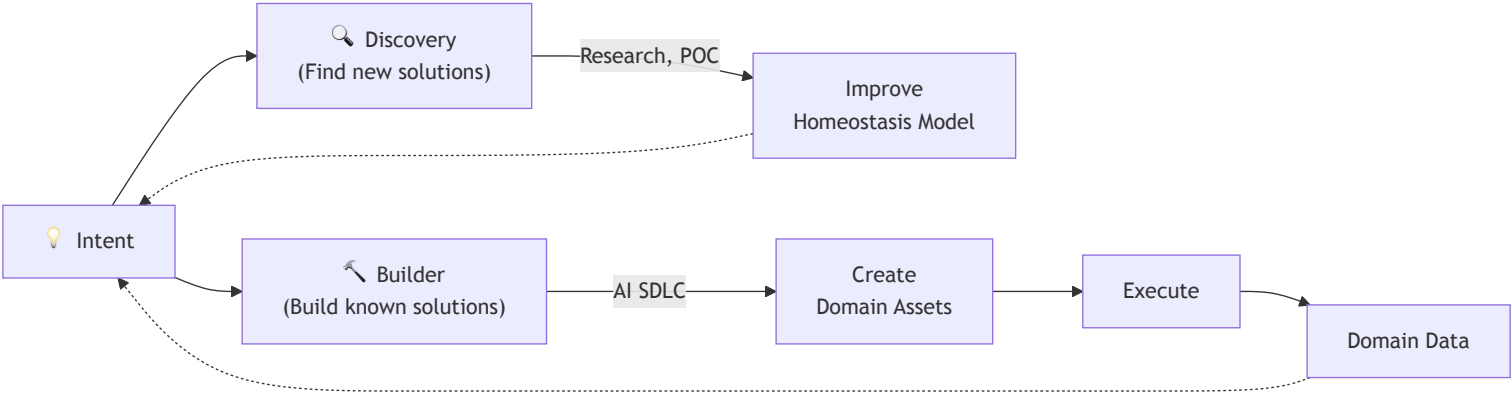


Diagram 2

Category	Purpose	When to Use
Discovery	Find new solutions to improve the homeostasis model	Unknown problem space, research, POC
Builder	Build assets using known solution patterns	Known solution, ready to implement

**Builder Work Types (CRUD):** - **Create:** Build something new (greenfield) - **Update:** Change existing behavior (enhancement) - **Remediation:** Fix risks/bugs (urgent) - **Read:** Analysis/discovery (investigation) - **Delete:** Decommission (tech debt reduction)

# Slide 6: The Homeostasis Model in Detail

## Requirements as Living Control System

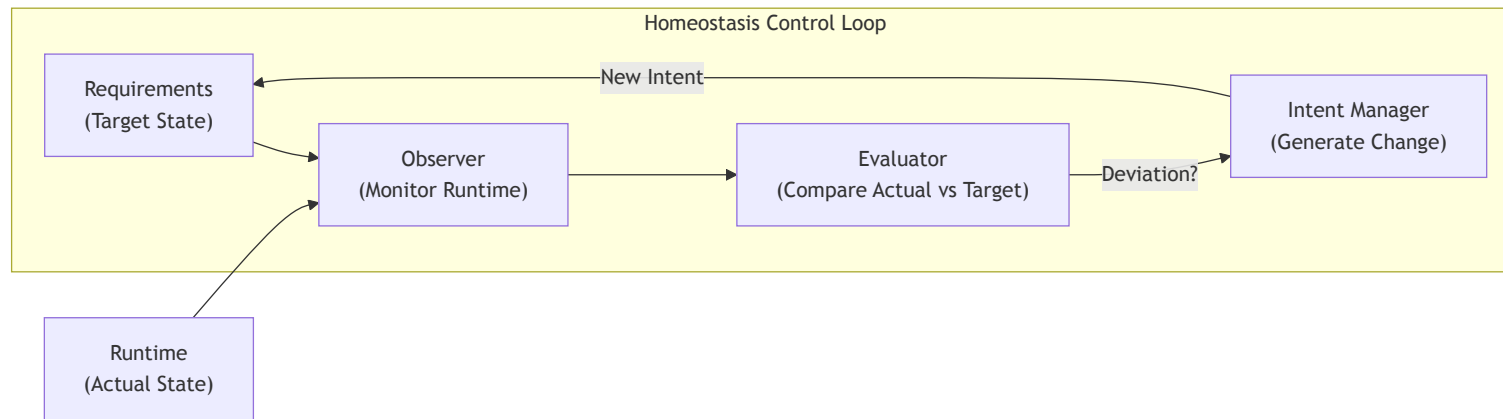


Diagram 3

### Leading Concept:

- **Traditional:** Requirements = fixed specifications (written once, forgotten)
- **AI SDLC:** Requirements = living control system (continuously compared to runtime)

**Example:** - Requirement: "Login < 2 seconds (p95)" - Runtime detects: 5 seconds → Deviation → New intent: "Optimize login" - New cycle completes → 1.2 seconds → Homeostasis restored

# Slide 7: The 7-Stage Pipeline

## Complete Lifecycle with Full Traceability

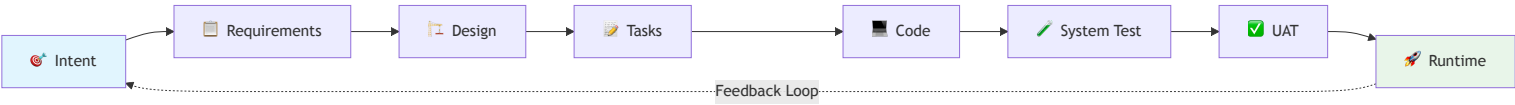


Diagram 4

Stage	Input	Output	AI Agent
Requirements	Intent	REQ-F-, <i>REQ-NFR</i> -, BDD	Requirements Agent
Design	Requirements	Components, APIs, ADRs	Design Agent
Tasks	Design	Jira tickets tagged with REQ	Tasks Agent
Code	Tasks	TDD code, unit tests	Code Agent
System Test	Code	BDD integration tests	QA Agent
UAT	Tested build	Business sign-off	UAT Agent
Runtime	Deployed system	Telemetry, new intent	Feedback Agent

# Slide 8: The Golden Thread

## Requirement Traceability from Intent to Runtime

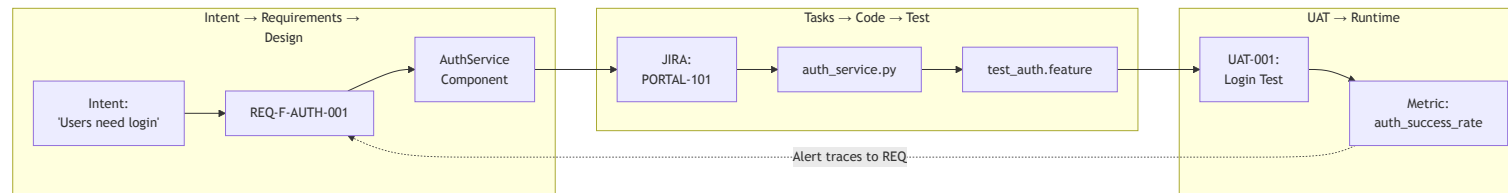


Diagram 5

**Every artifact tagged with REQ keys:** Code (# Implements: REQ-F-AUTH-001), Tests (# Validates: REQ-F-AUTH-001), Logs (extra={"req": "REQ-F-AUTH-001"})

# Slide 9: Code Stage - TDD + Key Principles

## The Heart of Quality: No Code Without Tests

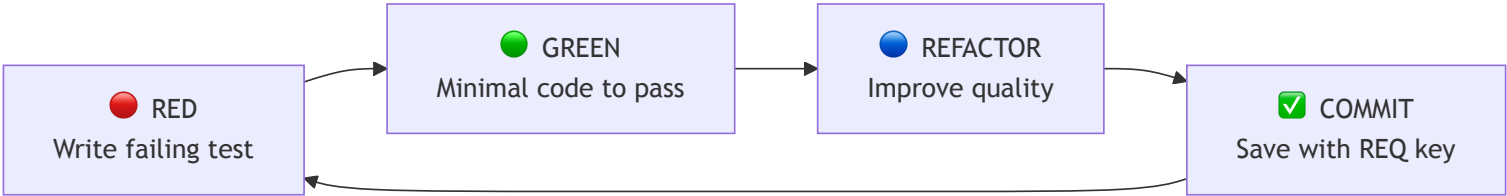


Diagram 6

## The Key Principles (Code Stage Foundation)

#	Principle	Mantra
1	Test Driven Development	“No code without tests”
2	Fail Fast & Root Cause	“Break loudly, fix completely”
3	Modular & Maintainable	“Single responsibility, loose coupling”
4	Reuse Before Build	“Check first, create second”
5	Open Source First	“Suggest alternatives, human decides”
6	No Legacy Baggage	“Clean slate, no debt”
7	Perfectionist Excellence	“Best of breed only”

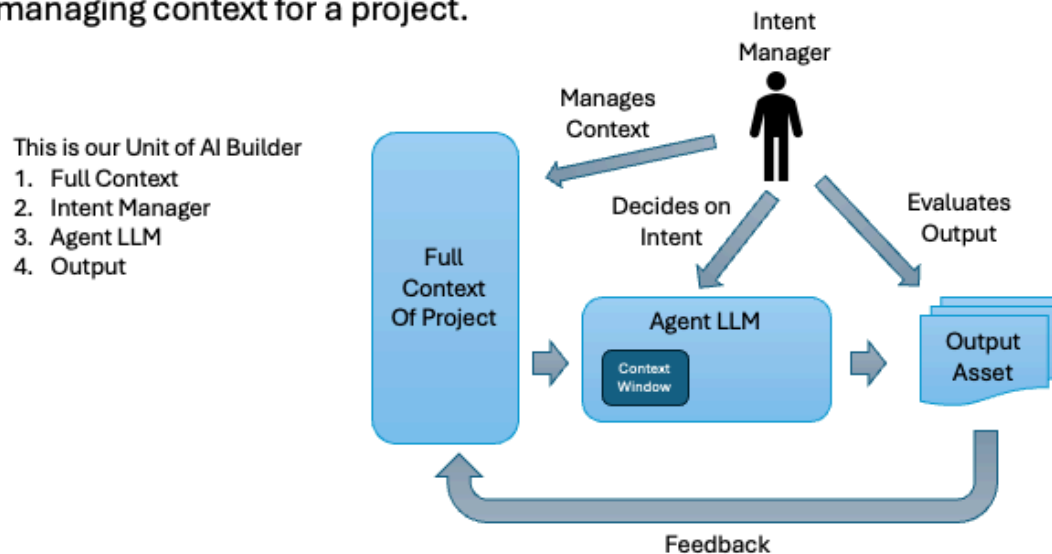
Ultimate Mantra: “Excellence or nothing” 🔥

# Slide 10: AI Augmented Asset Building

## Human in the Middle - Managing Context

### AI Augmented Asset Building

AI augmented Asset Building is all about human in the middle managing context for a project.



AI Augmented Asset Building

**The Unit of AI Builder:** 1. **Full Context** - Complete project knowledge available 2. **Intent Manager** - Human decides on intent, manages context 3. **Agent LLM** - AI executes within context window 4. **Output** - Assets evaluated by human before acceptance

**Key Principle:** AI augments human capability; human maintains control and context.

# Slide 11: BDD - Executable Specifications

## Business-Readable Tests That Validate Requirements

### System Test Stage (Technical BDD):

Feature: User Authentication

# Validates: REQ-F-AUTH-001

Scenario: Successful login

Given a user exists with email "user@example.com"

When they log in with correct password

Then authentication succeeds

And a session token is returned

### UAT Stage (Business BDD - No Technical Jargon):

Feature: Customer Self-Service Portal

Scenario: Customer views account

Given I am logged in as a customer

When I navigate to my dashboard

Then I should see my account balance

And I should see my recent transactions

**Coverage Requirements:** - Unit tests:  $\geq 80\%$  (critical paths 100%) - BDD scenarios: Every REQ must have  $\geq 1$  scenario - Requirement coverage:  $\geq 95\%$

# Slide 12: Ecosystem-Aware Development

## Acknowledging External Reality: $E(t)$

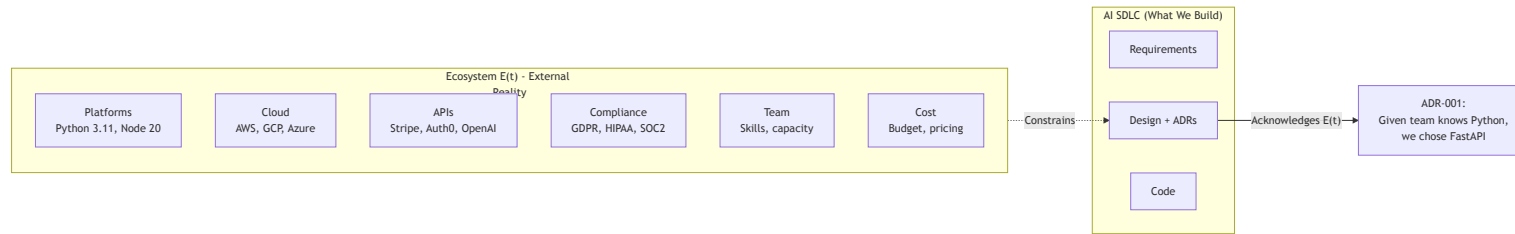


Diagram 7

**Key Distinction:** -  $E(t)$  is **GIVEN** (external reality we operate within) - **Design** is **CHOSEN** (decisions we make given  $E(t)$ )

**ADRs document:** “Given these ecosystem constraints, we chose X”



# Slide 13: What Makes AI SDLC Unique

## Differentiators from Traditional and Ad-hoc Approaches

Feature	Traditional	Ad-hoc AI	AI SDLC
Traceability	Manual	None	Automatic
Requirements	Static	None	Living
Quality Gates	Human only	None	Auto + Human
Feedback Loop	Quarterly	None	Continuous
AI Role	None	Uncontrolled	Augmenter

**Unique to AI SDLC:** Requirements as homeostasis, REQ key propagation, Ecosystem-aware ADRs, Sub-vectors, Federated plugins

# Slide 14: Sub-Vectors - Concurrent Development

## Complex Activities Spawn Their Own AI SDLC

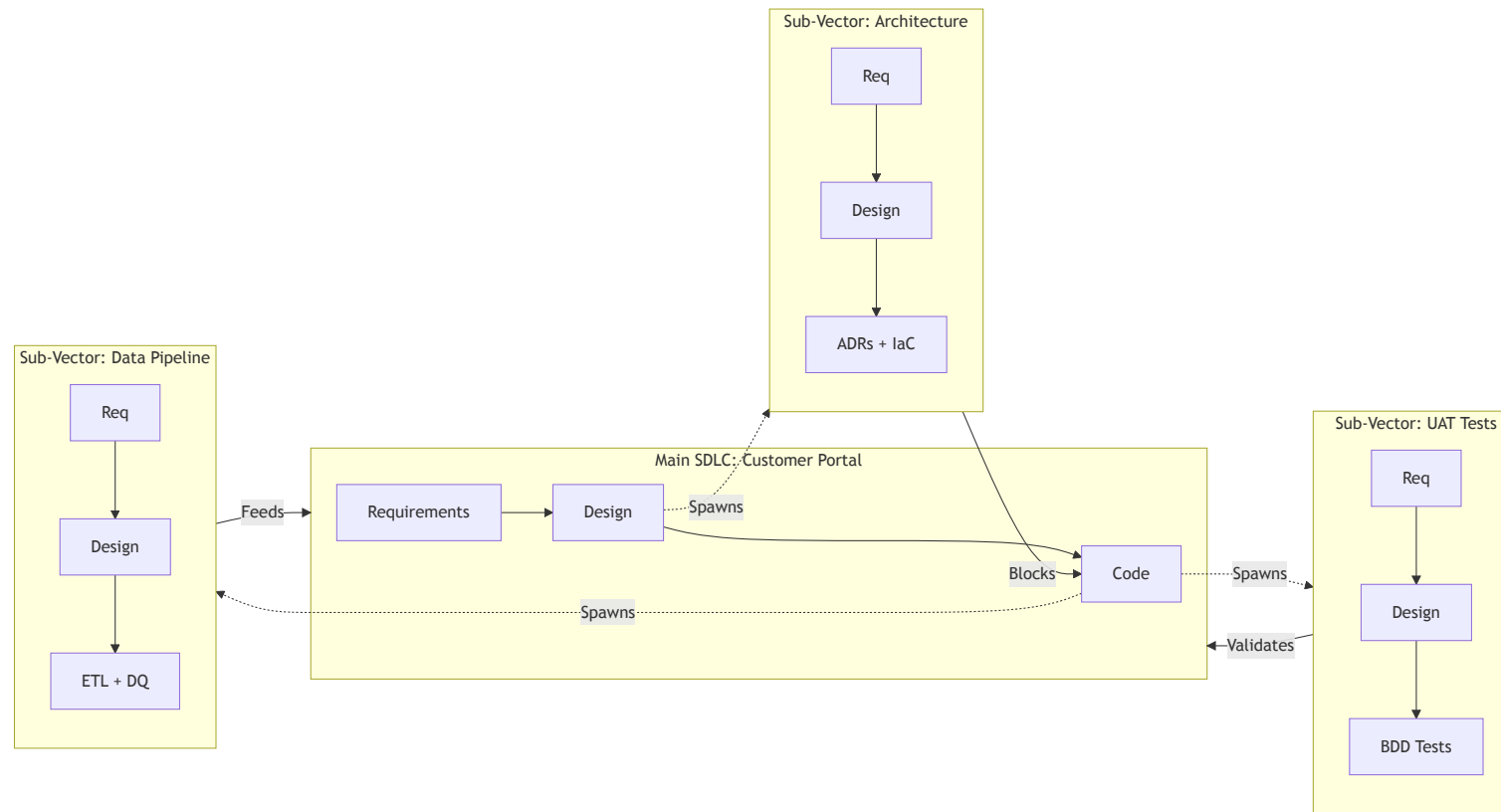


Diagram 8

**Single developer orchestrates multiple AI agents:** - Main code agent: Develops authentication feature - UAT test agent: Simultaneously develops test coverage - Data agent: Builds analytics pipeline

**Synchronization:** Shared requirement keys provide natural integration points

# Slide 15: Complete Walkthrough

## REQ-F-AUTH-001: From Intent to Runtime

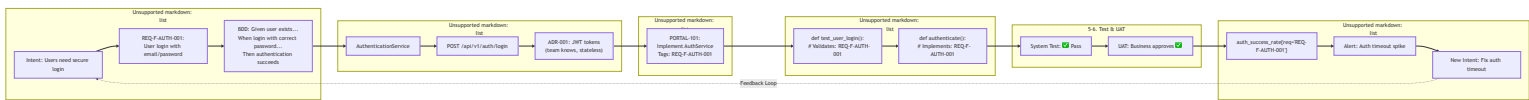


Diagram 9

# Slide 16: Getting Started

## Three Paths to Adoption

### Quick Start (5 minutes)

```
# Install Claude Code plugin
/plugin marketplace add foolishimp/ai_sdlc_method
/plugin install @aisdlc/aisdlc-methodology
```

```
# Claude now follows 7-stage methodology
```

### Full Setup (30 minutes)

```
# Clone and install workspace
git clone https://github.com/foolishimp/ai_sdlc_method
python installers/setup_workspace.py /your/project
python installers/setup_commands.py /your/project
```

### Enterprise Deployment

```
Corporate Marketplace
├─ aisdlc-methodology
├─ python-standards
└─
  ↓
Division Marketplace
├─ payment-services-standards
└─
  ↓
Project Plugin
├─ customer-portal-context
```

# Summary: Why AI SDLC?

Benefit	How
10× Faster	AI accelerates every stage
Full Traceability	REQ keys from intent to runtime
Self-Correcting	Homeostasis model auto-generates intent
Enterprise Ready	Audit trails, compliance, governance
Quality Built-In	TDD mandatory, BDD validation
Future-Proof	Requirements control AI-generated code

## The Bottom Line:

| “AI SDLC gives you the speed of AI with the discipline of traditional engineering.”

## Resources

- **Repository:** [github.com/foolishimp/ai\\_sdgc\\_method](https://github.com/foolishimp/ai_sdgc_method)
- **Examples:** [github.com/foolishimp/ai\\_sdgc\\_examples](https://github.com/foolishimp/ai_sdgc_examples)
- **Documentation:** docs/requirements/AI\_SDLC\_OVERVIEW.md
- **Full Methodology:** docs/requirements/AI\_SDLC\_REQUIREMENTS.md (3,300+ lines)

“Excellence or nothing” 🔥

# Appendix A: Use Case Example - Categorical Data Mapping Engine (CDME)

## Real-World Demonstration of AI SDLC in Practice

**Project:** `/ai_sdgc_examples/local_projects/data_mapper.test02`

This production-grade example demonstrates the complete 7-stage AI SDLC methodology applied to a mathematically rigorous data transformation engine.

### A.1: Project Overview

#### What is CDME?

A **type-safe data transformation engine** built on Category Theory principles that:

- **Prevents silent data bugs** through compile-time validation
- **Proves no data loss** with accounting ledger invariants
- **Tracks complete lineage** from source to destination
- **Enforces grain safety** (can't accidentally mix atomic and aggregated data)

#### Technology Stack

Component	Choice
Language	Scala 2.13.12
Engine	Apache Spark 4.0.1
Runtime	Java 25
Testing	ScalaTest (BDD)
Methodology	AI SDLC (all 7 stages)

Quality Metrics

Metric	Value
Formal Requirements	60+ (REQ-* tagged)
Architectural Decisions	24 ADRs
Passing Tests	234
BDD Scenarios	53
Test Coverage	≥80%

A.2: Stage-by-Stage Implementation

Stage 1: Requirements

Artifact: docs/requirements/AISDLC\_IMPLEMENTATION\_REQUIREMENTS.md

Intent: INT-001 "Build categorical data mapping engine"

- ↓
- Requirements (60 formal specifications):
- REQ-LDM-01 through REQ-LDM-06: Logical Data Model
  - REQ-PDM-01 through REQ-PDM-05: Physical Data Model
  - REQ-TRV-01 through REQ-TRV-06: Traversal & Composition
  - REQ-TYP-01 through REQ-TYP-07: Type System
  - REQ-ADJ-01 through REQ-ADJ-05: Adjoint Morphisms
  - REQ-ACC-01 through REQ-ACC-05: Accounting Ledger
  - REQ-ERROR-\*, REQ-AI-\*, REQ-CFG-\*: Cross-cutting concerns

Example Requirement:

REQ-ACC-01: Accounting Invariant

Description: Every input record must appear in exactly one output  
(either valid results or error domain)

Rationale: Prove no data loss during transformations

Priority: MUST

Acceptance:  $\text{sum}(\text{input}) = \text{sum}(\text{valid\_output}) + \text{sum}(\text{errors})$

Stage 2: Design

Artifact: docs/design/data\_mapper/AISDLC\_IMPLEMENTATION\_DESIGN.md (3,279 lines)

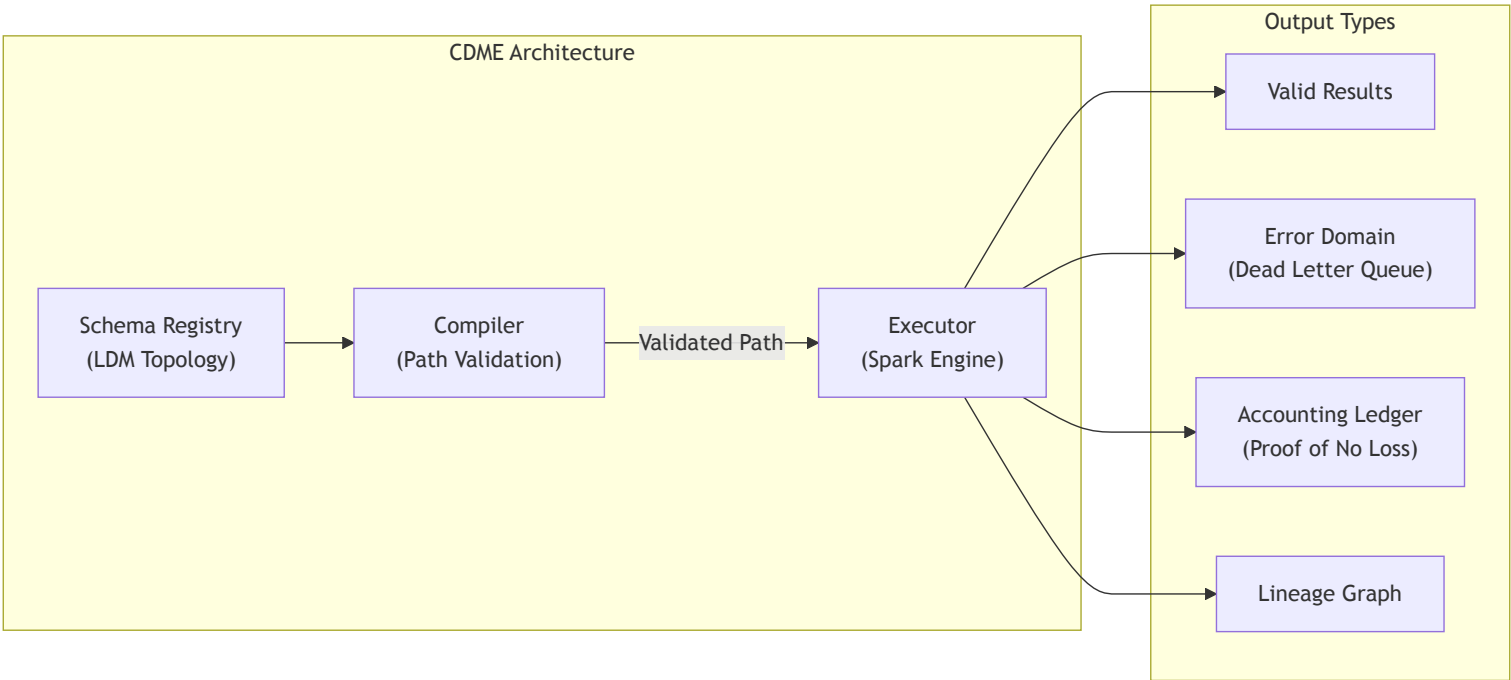


Diagram 10

Key ADRs:

ADR	Decision	Rationale
ADR-001	Adjoint over Dagger	Cleaner reversibility semantics
ADR-002	Schema Registry as source of truth	Single validation point
ADR-003	Either monad for errors	Type-safe error propagation
ADR-005	Grain as first-class concept	Prevent aggregation bugs
ADR-006	Deterministic execution	Reproducible results



### Stage 3: Tasks

**Artifact:** `.ai-workspace/tasks/active/ACTIVE_TASKS.md`

#### ## Task #11: Tax Agent Domain Model

Status: COMPLETE

Requirements: REQ-LDM-01 through REQ-LDM-06, REQ-TRV-01, REQ-TRV-02

Deliverable: Domain model with 6 business types

#### ## Task #12: Tax Agent Data Generator

Status: COMPLETE

Requirements: REQ-TRV-05 (reproducibility)

Deliverable: Generator producing 818,876 entries in 8.5s

#### ## Task #13: Tax Agent System Spec

Status: COMPLETE

Requirements: REQ-LDM-03, REQ-TRV-02, REQ-INT-01, REQ-ACC-01-05

Deliverable: 20 BDD scenarios, 234 total tests passing

### Stage 4: Code (TDD)

**Location:** `src/data_mapper.spark.scala/src/main/scala/cdme/`

**TDD Cycle Applied:**

```
// 🚫 RED: Write failing test first
"AccountingLedger" should "prove no data loss" in {
  val input = generateTestData(1000)
  val result = executor.run(input)

  // Validates: REQ-ACC-01
  result.ledger.inputCount shouldBe 1000
  result.ledger.validCount + result.ledger.errorCount shouldBe 1000
}

// 🟢 GREEN: Implement minimal solution
// Implements: REQ-ACC-01, REQ-ACC-02, REQ-ACC-03, REQ-ACC-04
class AccountingLedger {
  def record(input: DataFrame, valid: DataFrame, errors: DataFrame): Proof = {
    val inputCount = input.count()
    val validCount = valid.count()
    val errorCount = errors.count()

    require(inputCount == validCount + errorCount,
      s"Accounting invariant violated: $inputCount != $validCount + $errorCount")

    Proof(inputCount, validCount, errorCount, verified = true)
  }
}

// 🔵 REFACTOR: Improve quality
// ✅ COMMIT: "feat: Implement AccountingLedger (REQ-ACC-01/02/03/04)"
```

## Stage 5: System Test (BDD)

**Artifact:** src/test/scala/cdme/airline/AirlineSystemSpec.scala

Feature: Multi-Leg International Booking with Currency Conversion

# Validates: REQ-TRV-02, REQ-TYP-03, REQ-ADJ-01, REQ-ACC-01

Scenario: Daily revenue summary for cross-border flights

Given FlightSegment entities (SFO→LHR, LHR→CDG) with currencies (USD, GBP, EUR)

When traversing path FlightSegment.Journey.Customer

And aggregating revenue to daily grain

Then grain transitions from Atomic to Daily

And currency normalizes to reporting currency (USD)

And adjoint metadata captures reverse path

And accounting ledger proves all segments accounted for

**Tax Agent Example** (TaxAgentSystemSpec.scala):

Feature: Tax Form Consolidation

# Validates: REQ-LDM-03, REQ-TRV-02, REQ-ACC-01

Scenario: Route PersonalLedger entries to TaxForm.PersonalSection

Given PersonalLedger with income/deductions/credits (atomic grain)

When aggregating to TaxForm (yearly grain) grouped by customer\_id, tax\_year

Then grain safety prevents invalid direct copy

And only valid (status='POSTED') entries included

And accounting invariant holds

And adjoint metadata traces each line to source entries

## Stage 6: UAT

**Artifact:** src/test/scala/cdme/UATSpec.scala (33 scenarios)

Feature: Business User Data Transformation

# Pure business language, no technical jargon

Scenario: Accountant views daily revenue summary

Given I have flight booking data for last week

When I request a daily revenue summary

Then I should see totals by day

And every booking should be accounted for

And I can trace any total back to individual bookings

## Stage 7: Runtime Feedback

**Implementation:** AccountingLedger.scala

```
// Runtime proof artifact
case class LedgerProof(
  runId: String,
  timestamp: Instant,
  inputCount: Long,
  validCount: Long,
  errorCount: Long,
  invariantHolds: Boolean,
  // Tagged with requirement for traceability
  requirement: String = "REQ-ACC-01"
)

// If production issue occurs:
// Alert: "VIOLATION: REQ-ACC-01 - Accounting invariant failed"
//   → Traces to: REQ-ACC-01 specification
//   → Generates: New intent INT-042 "Fix data loss in aggregation"
//   → Feedback loop completes
```

# A.3: Traceability Matrix

INT-001 (Build CDME)

- REQ-ACC-01 (Accounting Invariant)
  - ADR-009 (Immutable Run Hierarchy)
    - Task #11 (Implement AccountingLedger)
      - AccountingLedger.scala
        - └─ Comment: "// Implements: REQ-ACC-01"
      - AccountingLedgerSpec.scala
        - └─ Comment: "// Validates: REQ-ACC-01"
      - AirlineSystemSpec.scala
        - └─ Scenario: "accounting ledger proves..."
      - UATSpec.scala
        - └─ Scenario: "every booking accounted for"- [60+ other requirements with similar chains]

## A.4: Key Takeaways

### What This Example Demonstrates

AI SDLC Concept	How CDME Shows It
REQ Key Propagation	60 requirements flow from intent to code to tests to runtime
TDD Discipline	234 tests, RED→GREEN→REFACTOR cycle in every commit
BDD Validation	53 business-readable scenarios validating requirements
ADR Documentation	24 decisions with explicit rationale and ecosystem context
Task Traceability	Each task links to specific REQ keys
Runtime Feedback	AccountingLedger proves correctness, alerts trace to REQ keys
Mathematics as Enforcement	Category Theory guarantees prevent entire bug classes

### Why This Matters

- 1. **AI-Generated Code is Verified:** Compiler rejects invalid paths before runtime
- 2. **No Silent Failures:** Type system catches errors at compile time
- 3. **Audit Trail:** Every transformation traced and accounted for
- 4. **Human Oversight:** LLM-generated code must pass type-checker to execute
- 5. **Self-Correcting:** Runtime violations generate new intents automatically

## A.5: Project Structure

```
data_mapper.test02/
├── INTENT.md # Original intent
├── docs/
│   ├── requirements/
│   │   ├── AISDLC_IMPLEMENTATION_REQUIREMENTS.md # 60 REQ-* keys
│   │   └── INTENT.md # 6 formal intents
│   └── design/
│       ├── data_mapper/
│       │   ├── AISDLC_IMPLEMENTATION_DESIGN.md # 3,279 lines
│       │   └── adrs/ # 11 ADRs
│       └── design_spark/
│           └── adrs/ # 13 Scala/Spark ADRs
├── src/data_mapper.spark.scala/
│   └── src/
│       ├── main/scala/cdme/ # Production code
│       │   ├── core/ # Types, Domain, Algebra
│       │   ├── compiler/ # Path validation
│       │   └── executor/ # Spark execution
│       └── test/scala/cdme/ # 234 tests
│           ├── UATSpec.scala # 33 BDD scenarios
│           ├── airline/ # 22 scenarios
│           └── taxagent/ # 20 scenarios
└── .ai-workspace/
    └── tasks/active/ACTIVE_TASKS.md # Task tracking
```

## A.6: Try It Yourself

*# Clone the examples repository*

```
git clone https://github.com/foolishimp/ai_sdlc_examples
```

```
cd ai_sdlc_examples/local_projects/data_mapper.test02
```

*# Run all 234 tests*

```
cd src/data_mapper.spark.scala
```

```
sbt test
```

*# Run specific test suites*

```
sbt "testOnly cdme.airline.*"      # Airline domain (22 tests)
```

```
sbt "testOnly cdme.taxagent.*"    # Tax Agent domain (50 tests)
```

```
sbt "testOnly cdme.UATSpec"       # UAT scenarios (33 tests)
```

**Explore the Traceability:** 1. Read docs/requirements/AISDLC\_IMPLEMENTATION\_REQUIREMENTS.md 2. Find REQ-ACC-01 (Accounting Invariant) 3. Grep for “REQ-ACC-01” across the codebase 4. See how it appears in design, code, and tests

*This appendix demonstrates that AI SDLC is not just theory—it’s a practical methodology producing real, tested, traceable software.*

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