UML Design Documentation

NASA Farm Navigators

Version: 2.0

Date: September 2025

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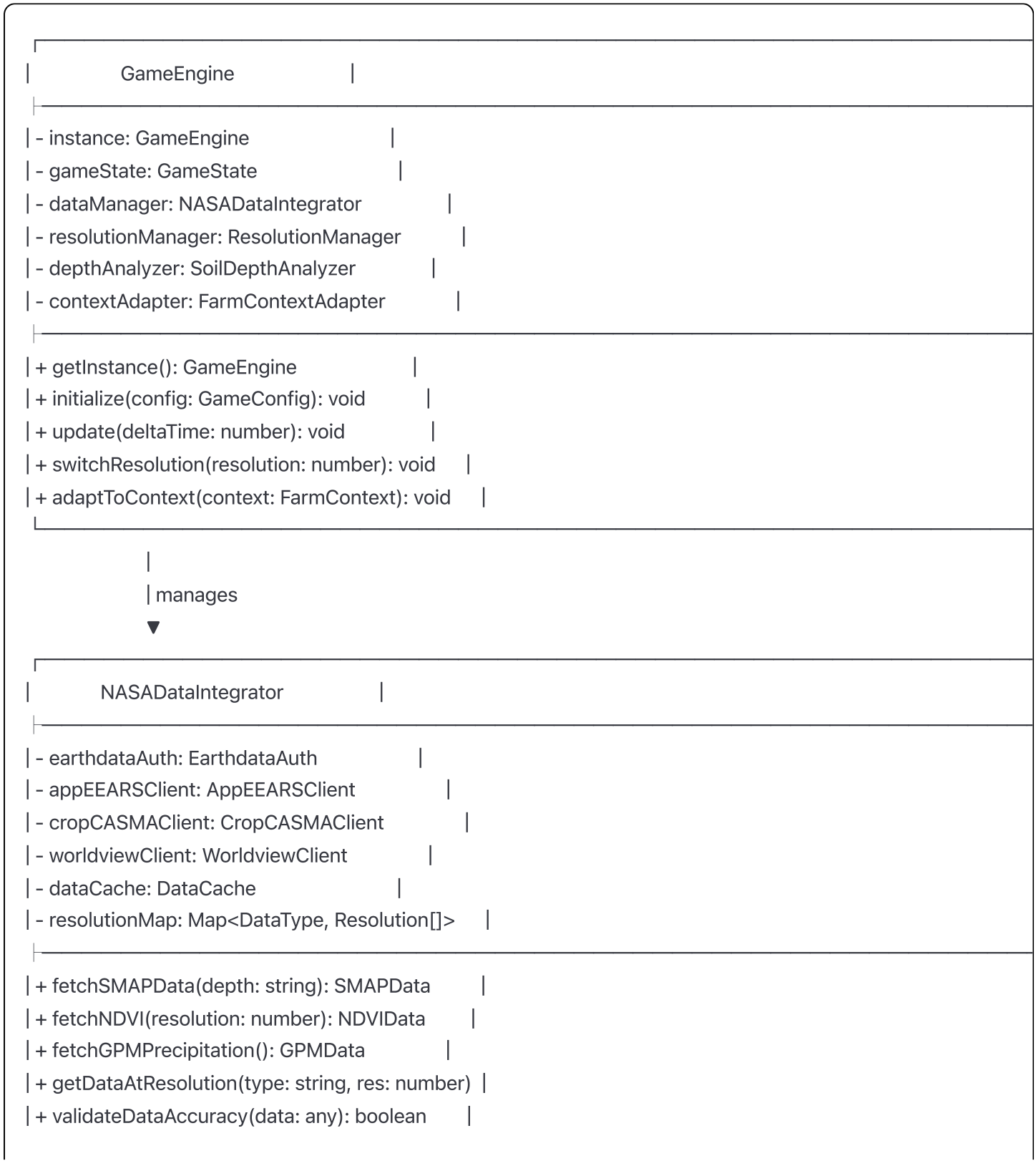
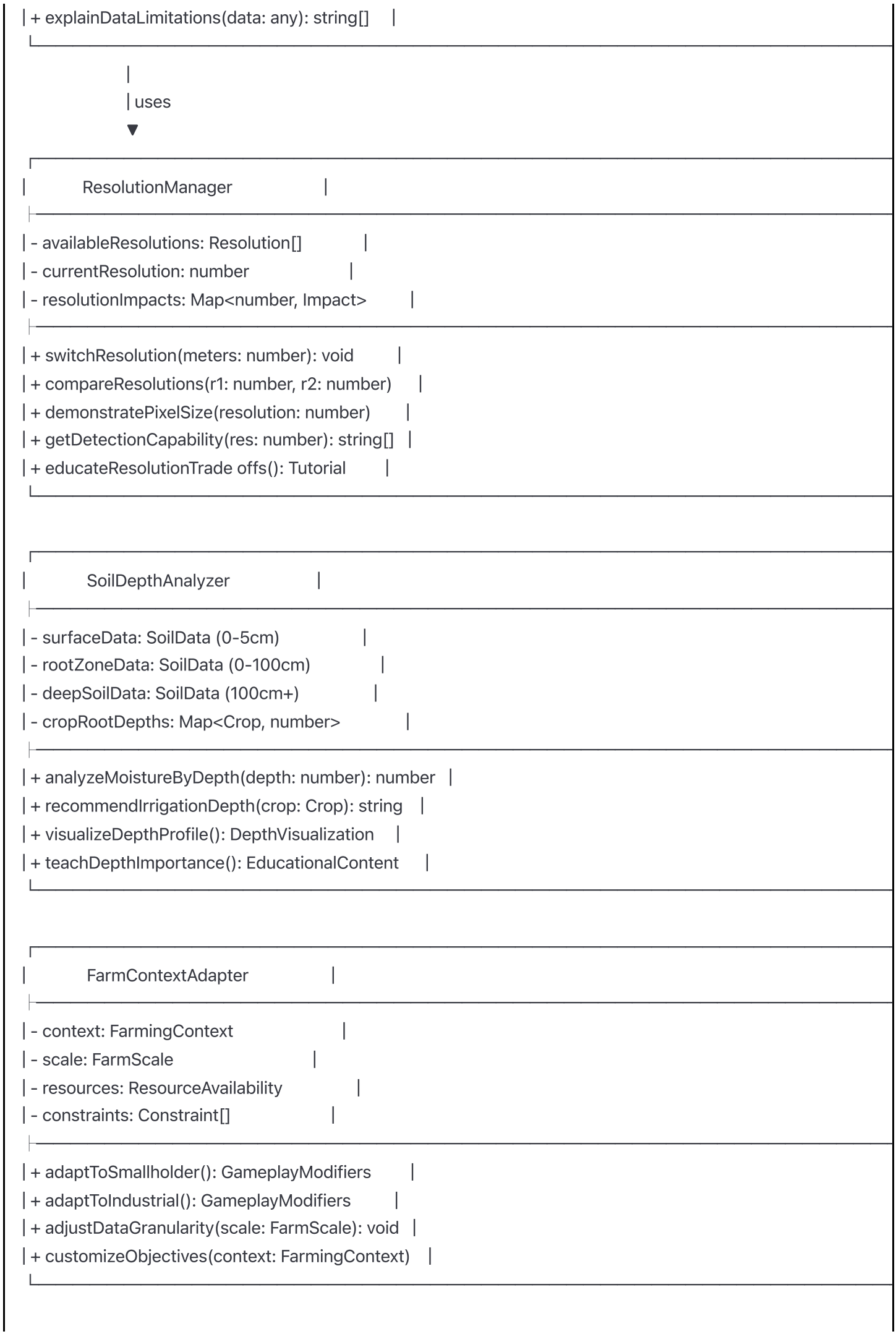
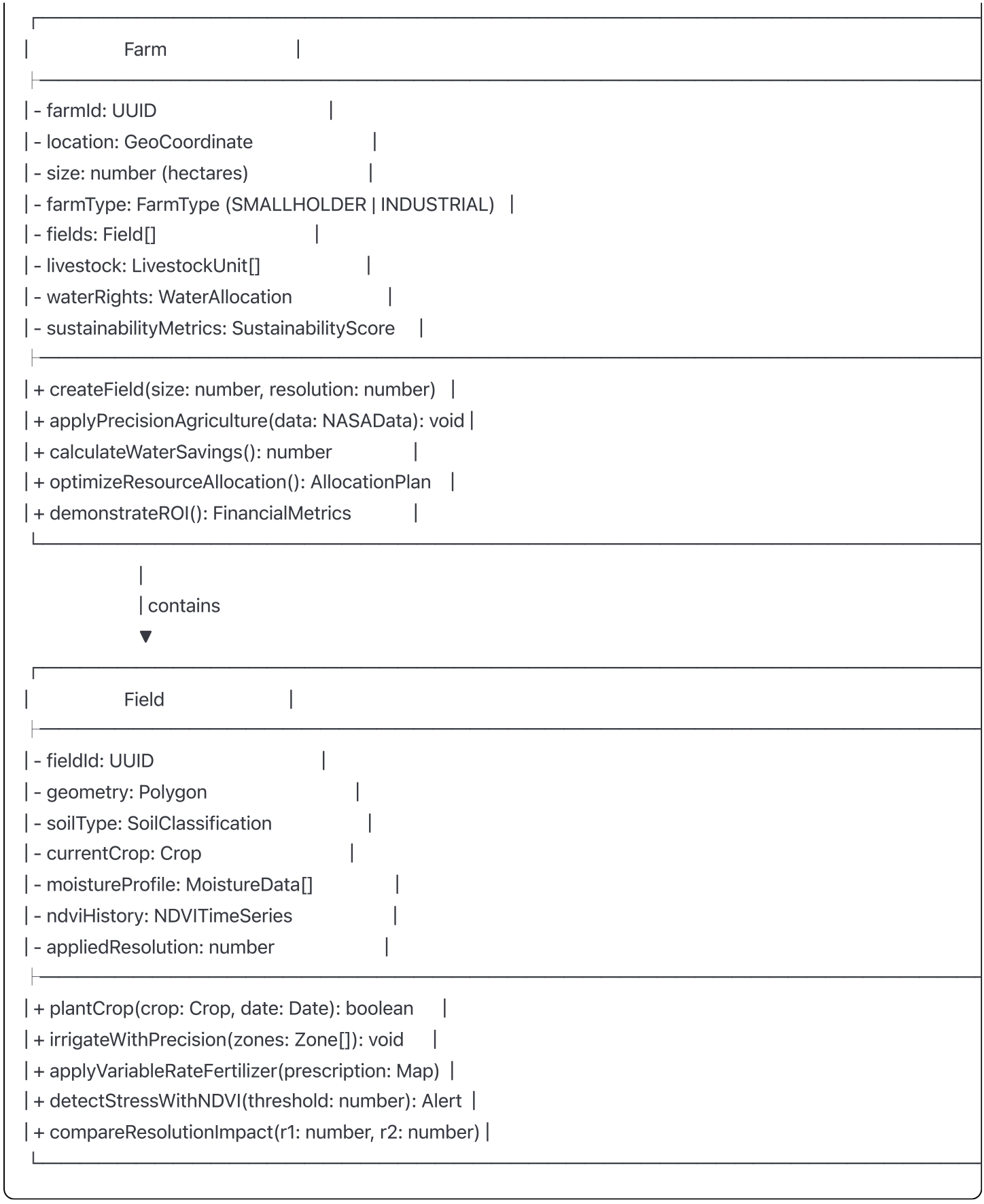
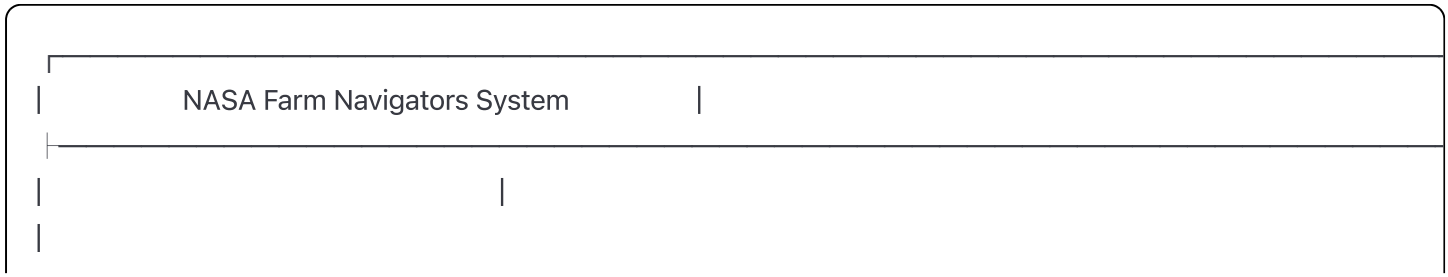
1. Class Diagram - Core System Architecture

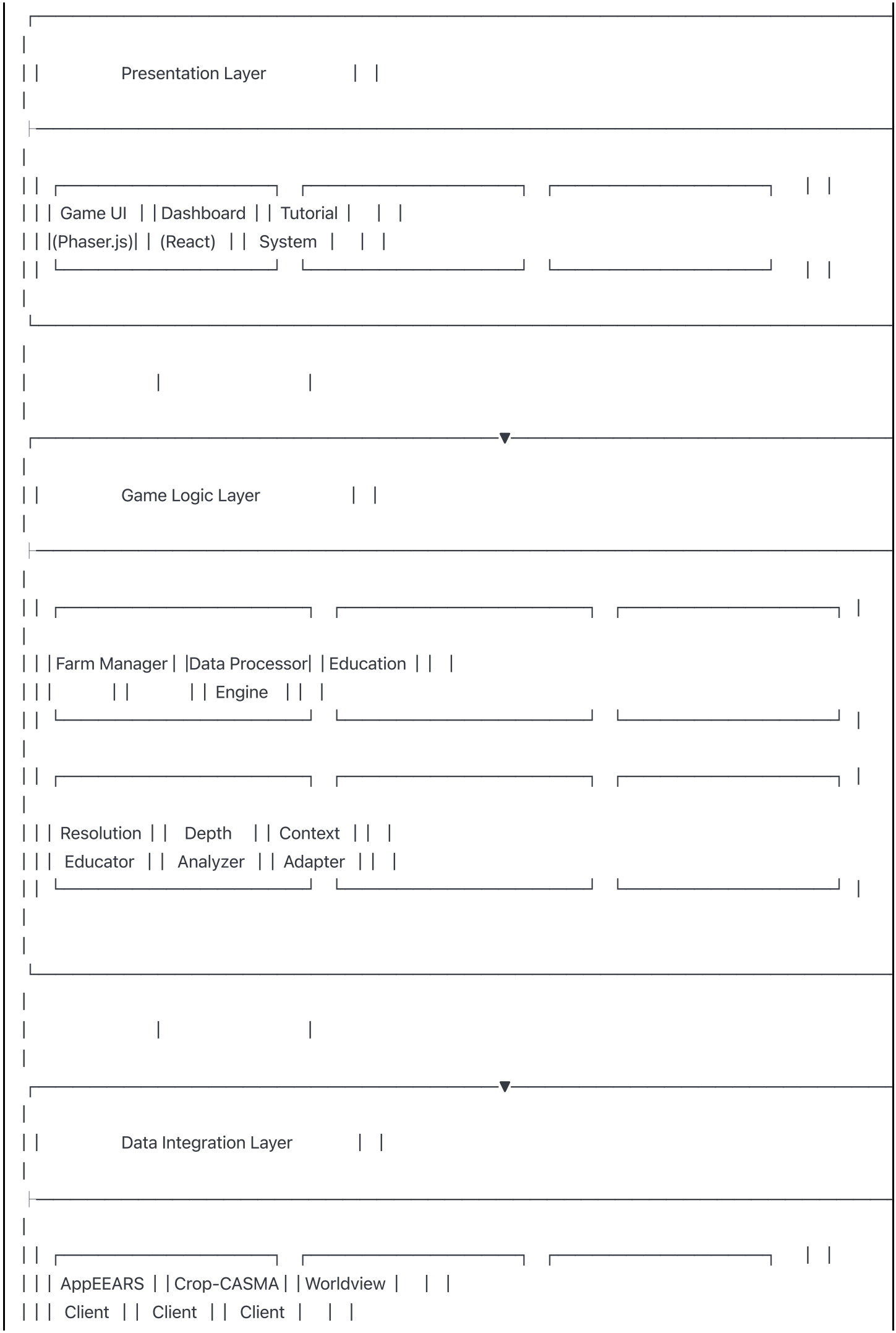


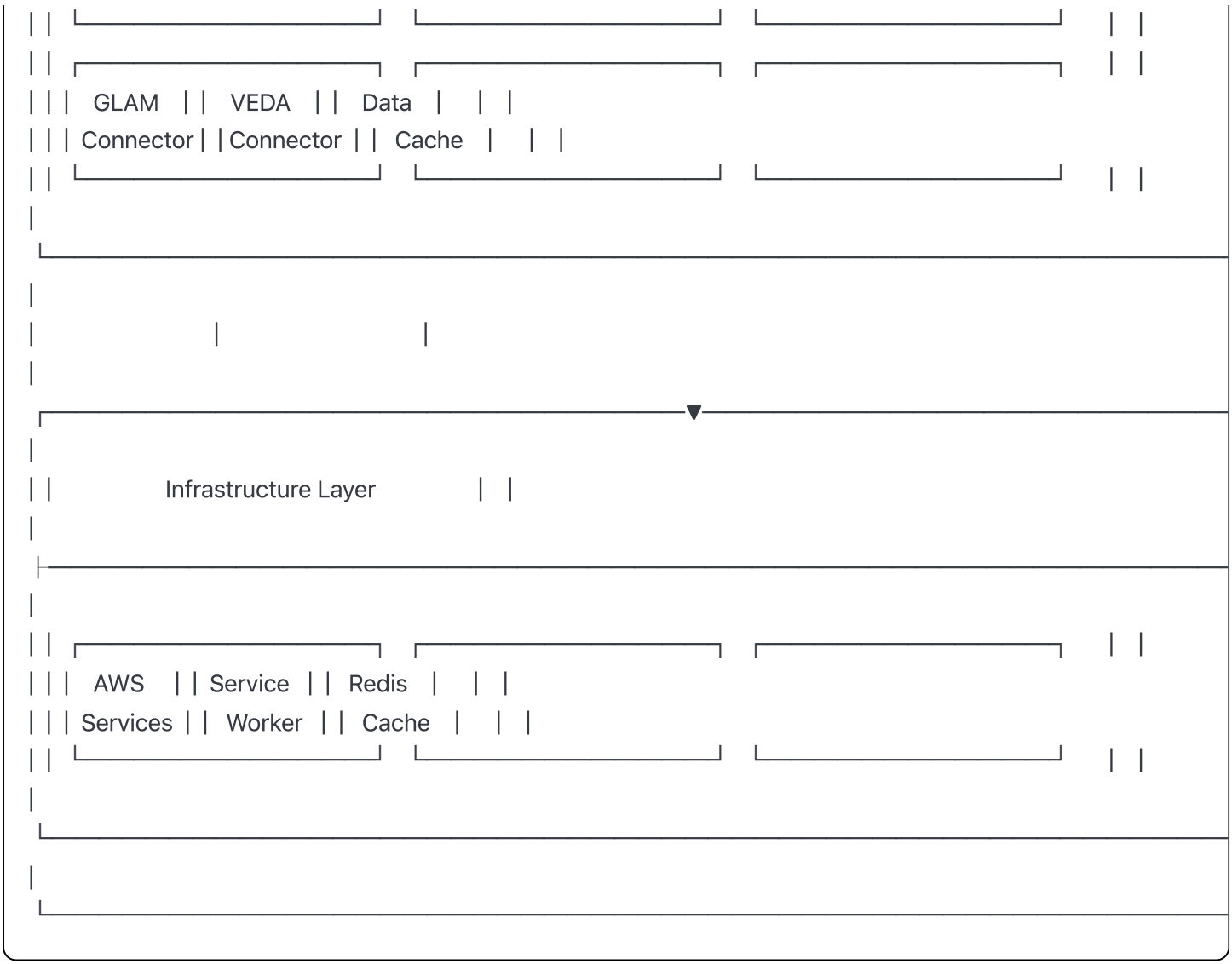

+ explainDataLimitations(data: any): string[]
uses
ResolutionManager
- availableResolutions: Resolution[]
- currentResolution: number
- resolutionImpacts: Map<number, Impact>
+ switchResolution(meters: number): void
+ compareResolutions(r1: number, r2: number)
+ demonstratePixelSize(resolution: number)
+ getDetectionCapability(res: number): string[]
+ educateResolutionTrade offs(): Tutorial
SoilDepthAnalyzer
- surfaceData: SoilData (0-5cm)
- rootZoneData: SoilData (0-100cm)
- deepSoilData: SoilData (100cm+)
- cropRootDepths: Map<Crop, number>
+ analyzeMoistureByDepth(depth: number): number
+ recommendIrrigationDepth(crop: Crop): string
+ visualizeDepthProfile(): DepthVisualization
+ teachDepthImportance(): EducationalContent
FarmContextAdapter
- context: FarmingContext
- scale: FarmScale
- resources: ResourceAvailability
- constraints: Constraint[]
+ adaptToSmallholder(): GameplayModifiers
+ adaptToIndustrial(): GameplayModifiers
+ adjustDataGranularity(scale: FarmScale): void
+ customizeObjectives(context: FarmingContext)



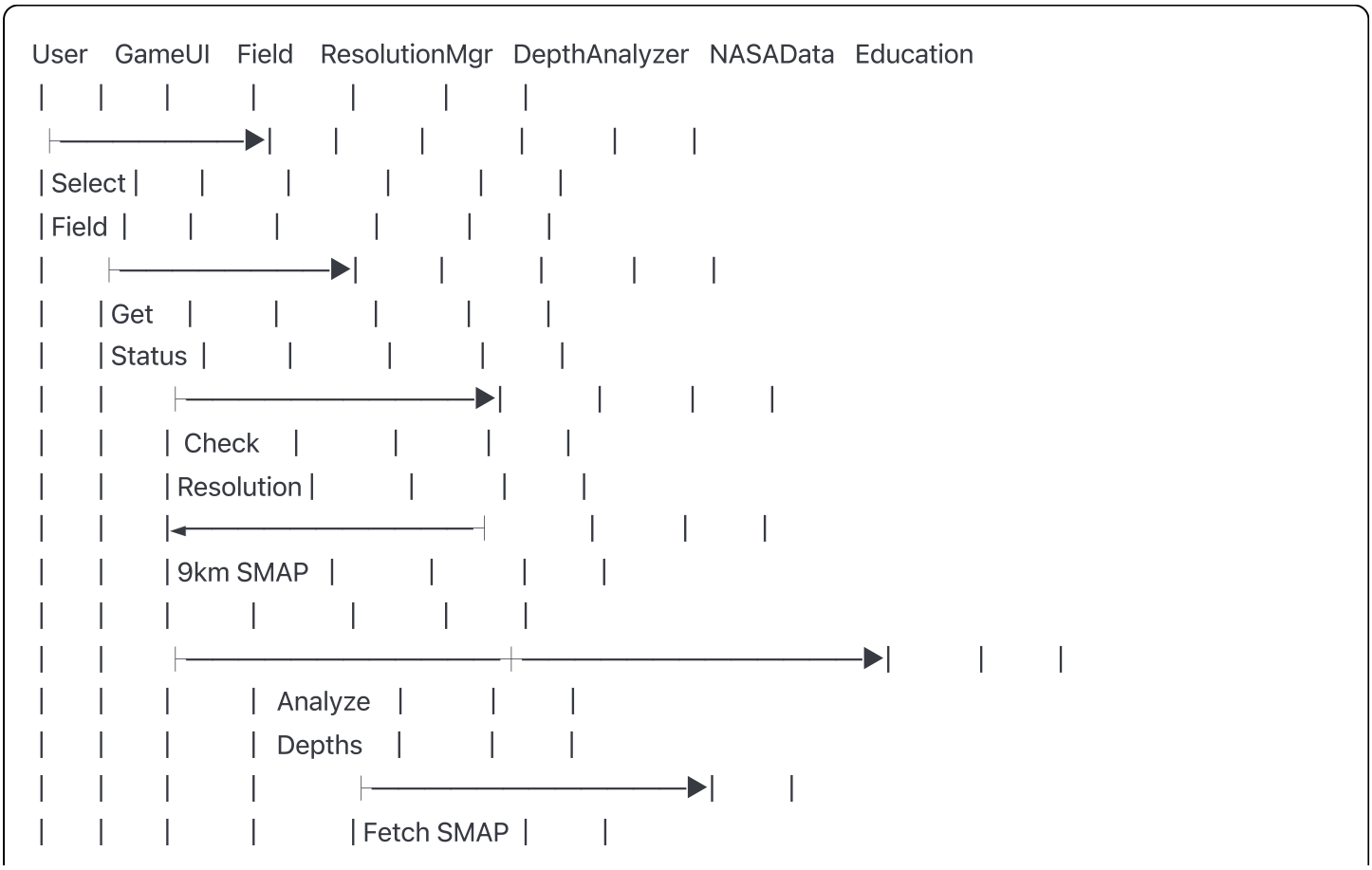
2. Component Diagram - System Architecture

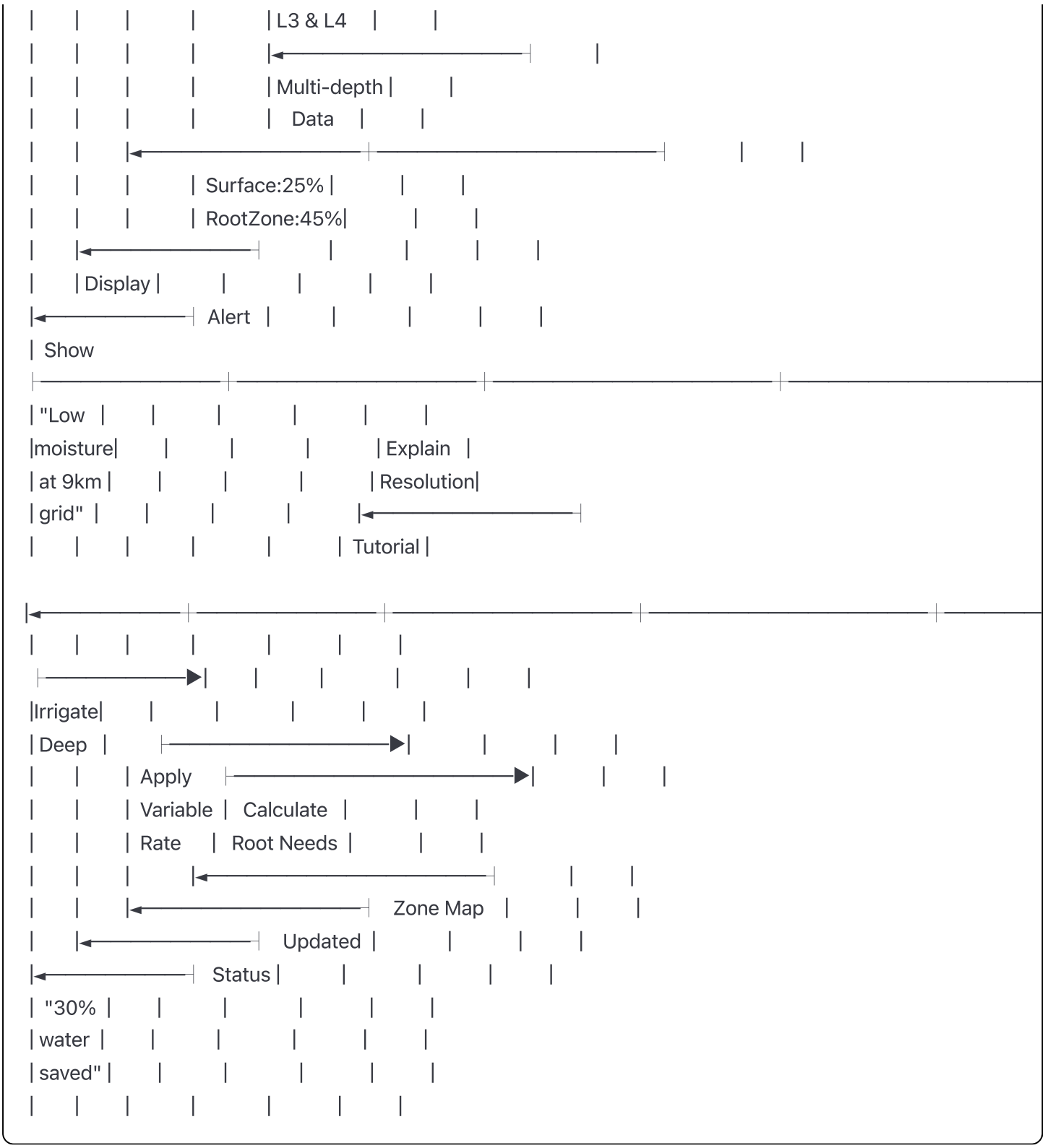



Presentation Layer
Game UI
(Phaser.js)
Dashboard
(React)
Tutorial
System
Game Logic Layer
Farm Manager
Data Processor
Education
Engine
Resolution
Educator
Depth
Analyzer
Context
Adapter
Data Integration Layer
AppEEARS
Client
Crop-CASMA
Client
Worldview
Client

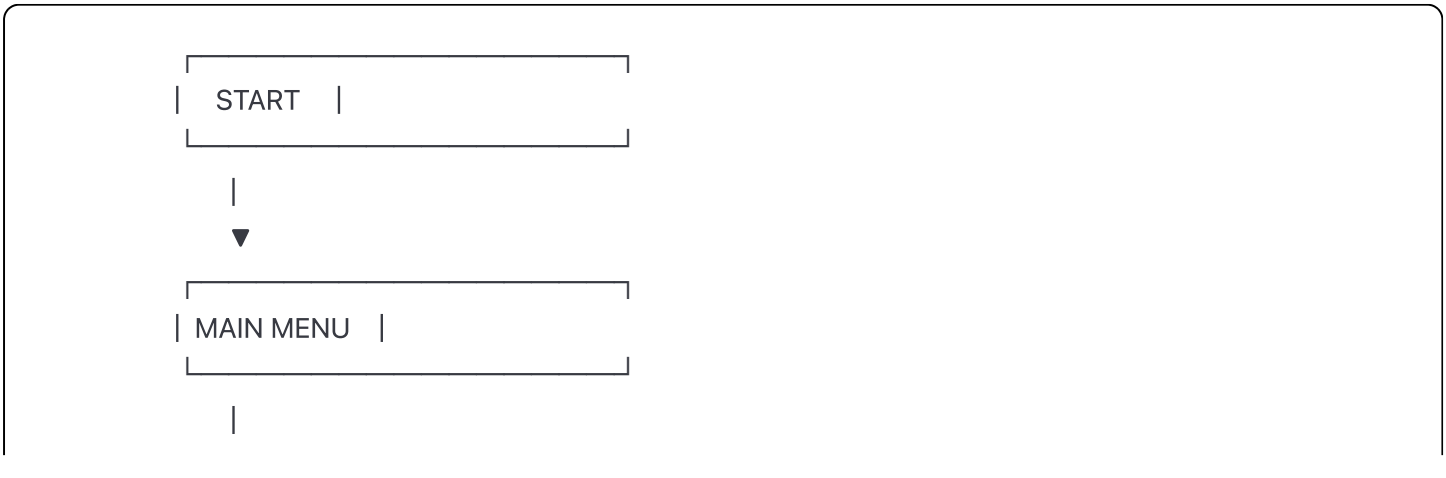


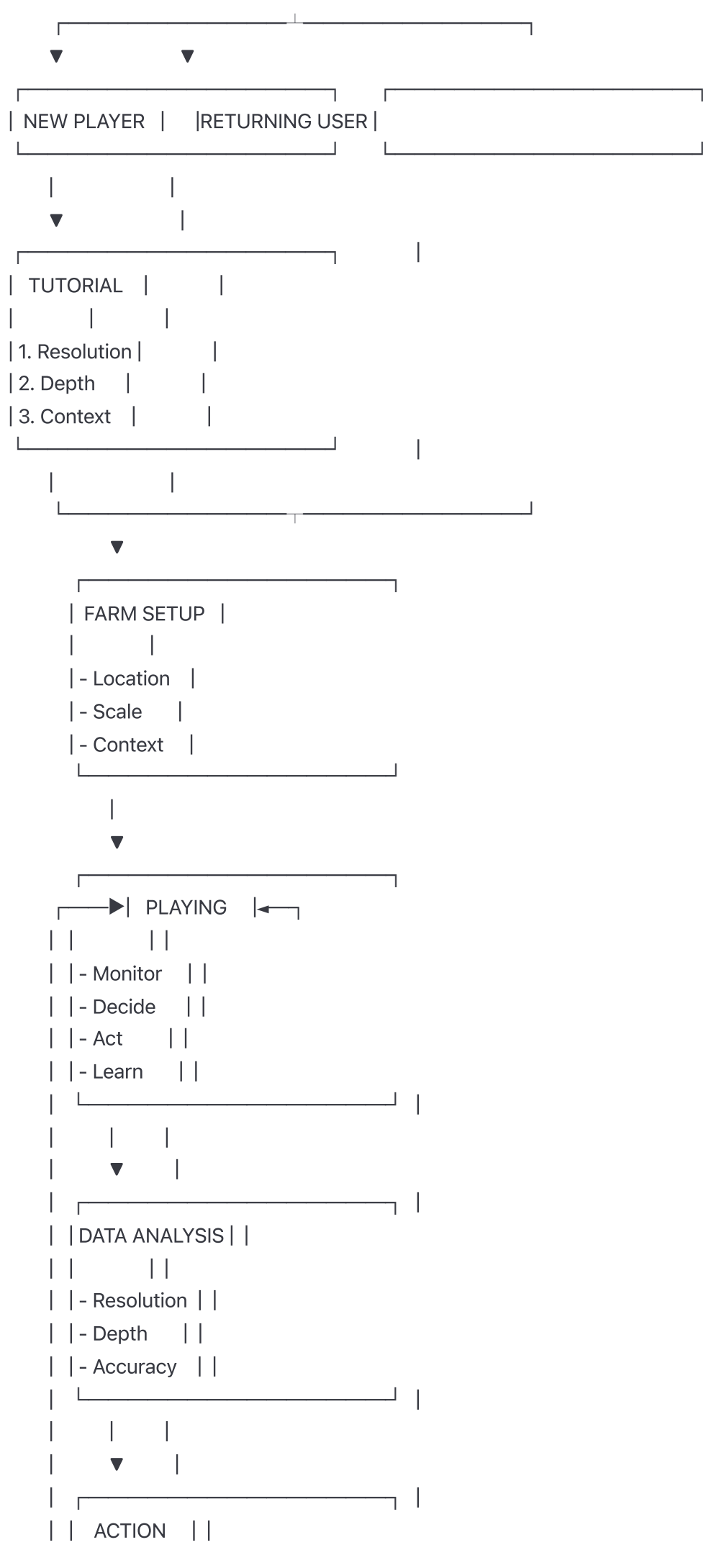
3. Sequence Diagram - Precision Irrigation Decision Flow

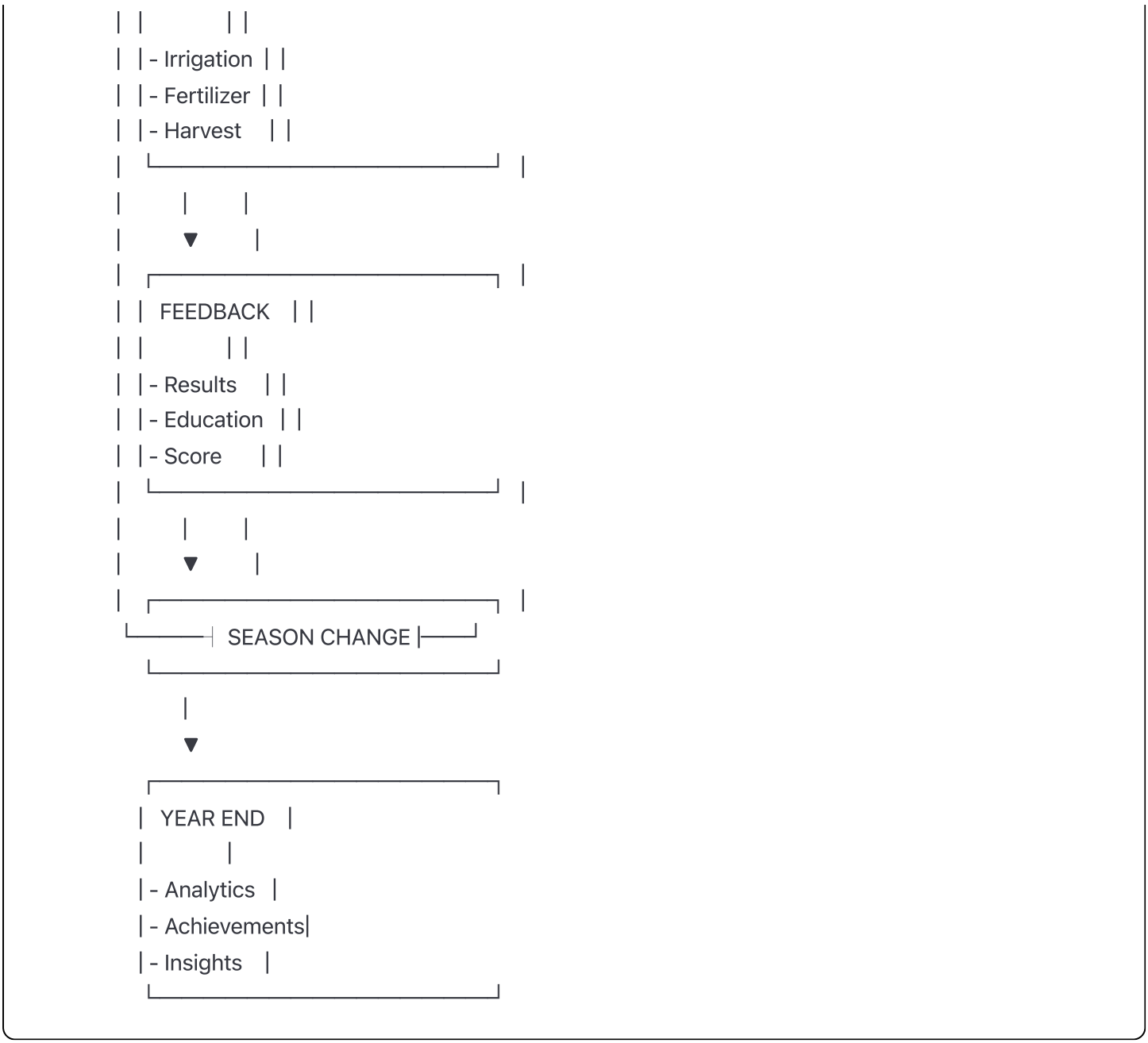




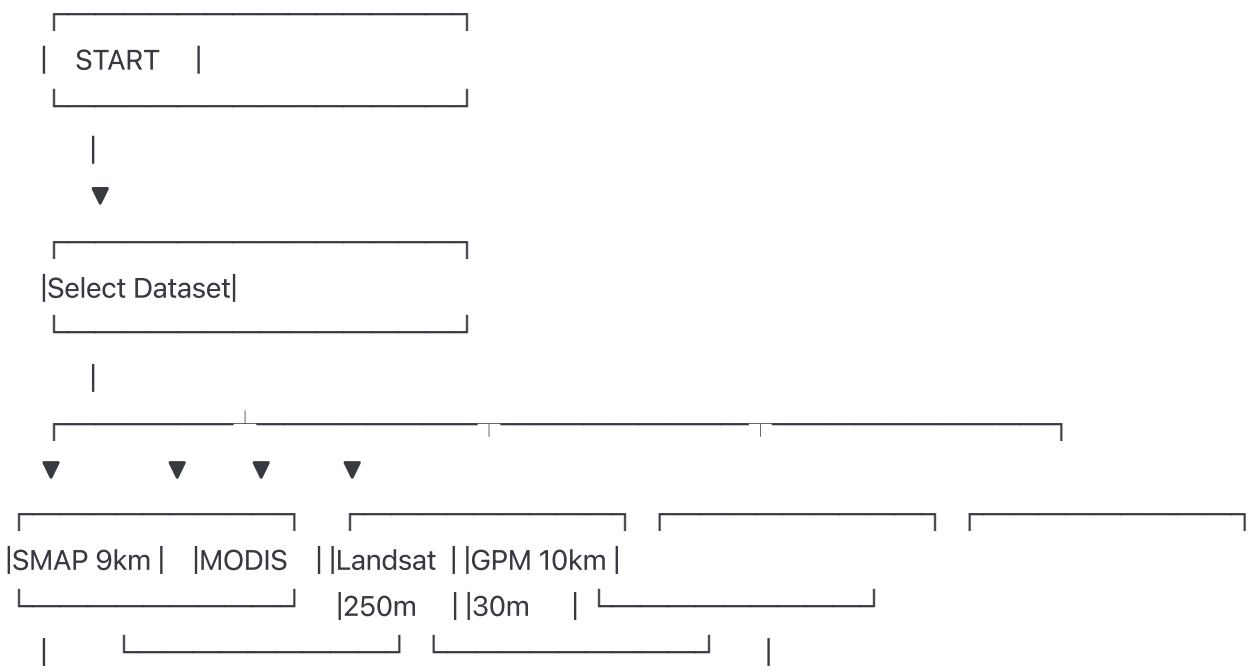
4. State Diagram - Game Progression States

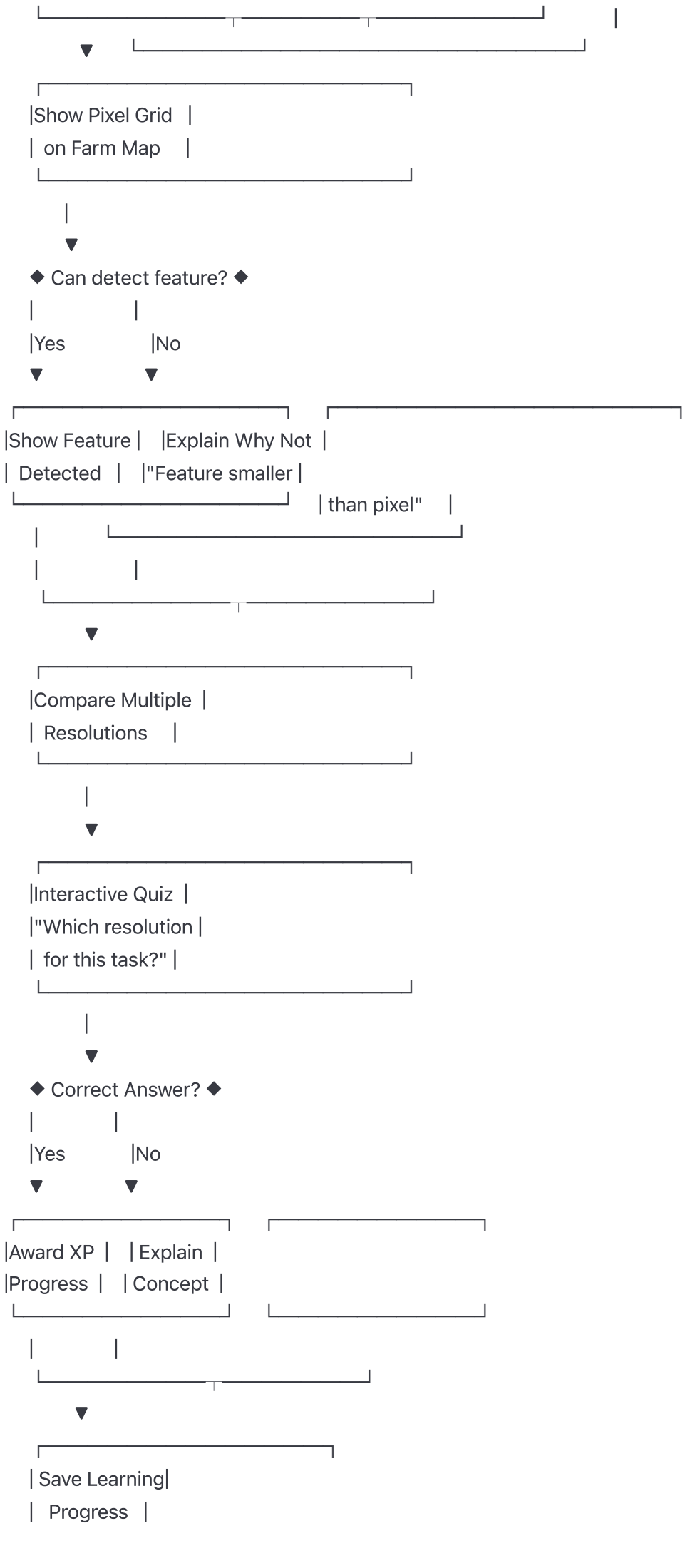



NEW PLAYER
RETURNING USER
TUTORIAL
1. Resolution
2. Depth
3. Context
FARM SETUP
- Location
- Scale
- Context
PLAYING
- Monitor
- Decide
- Act
- Learn
DATA ANALYSIS
- Resolution
- Depth
- Accuracy
ACTION

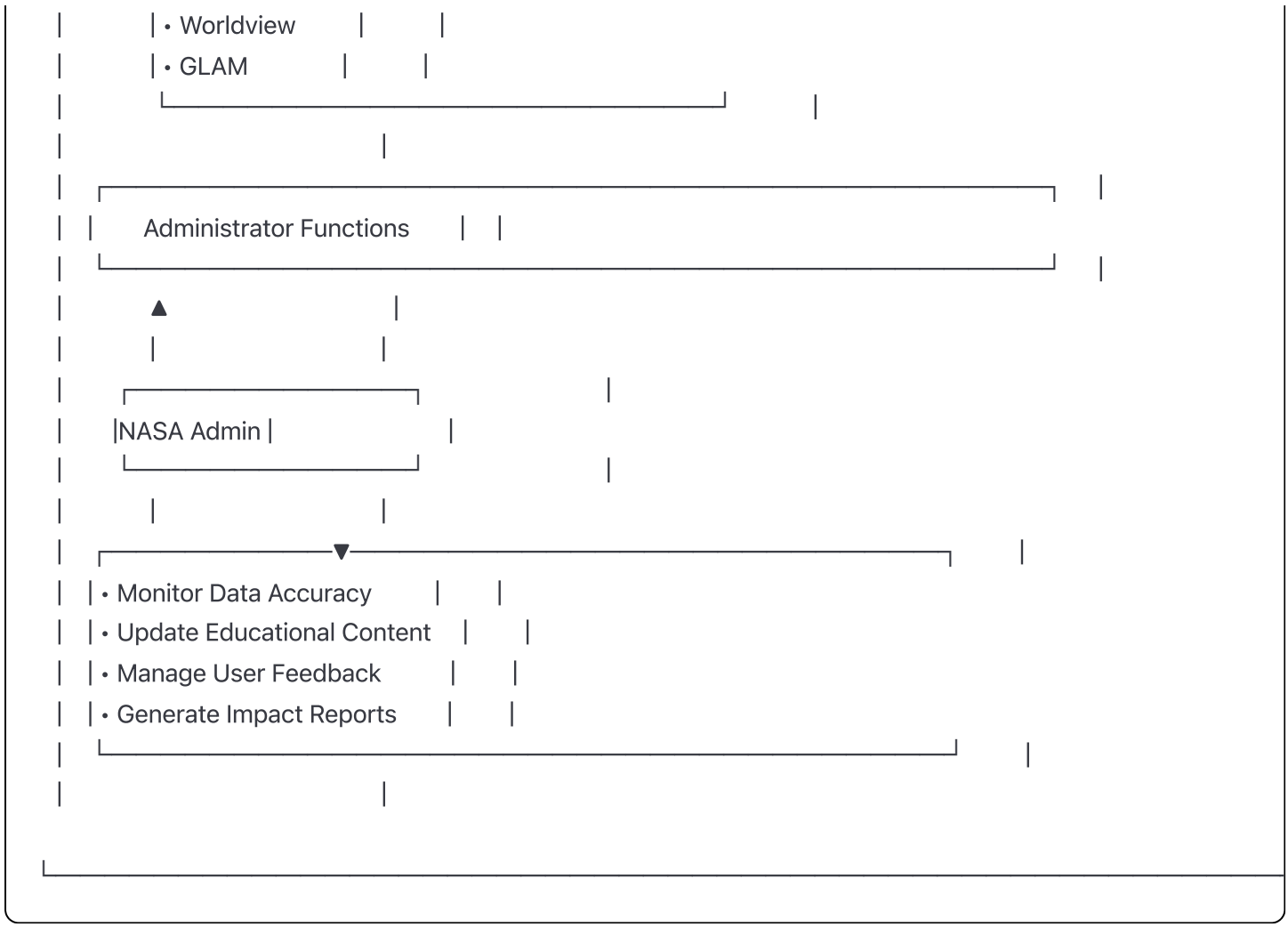


5. Activity Diagram - Data Resolution Education Flow

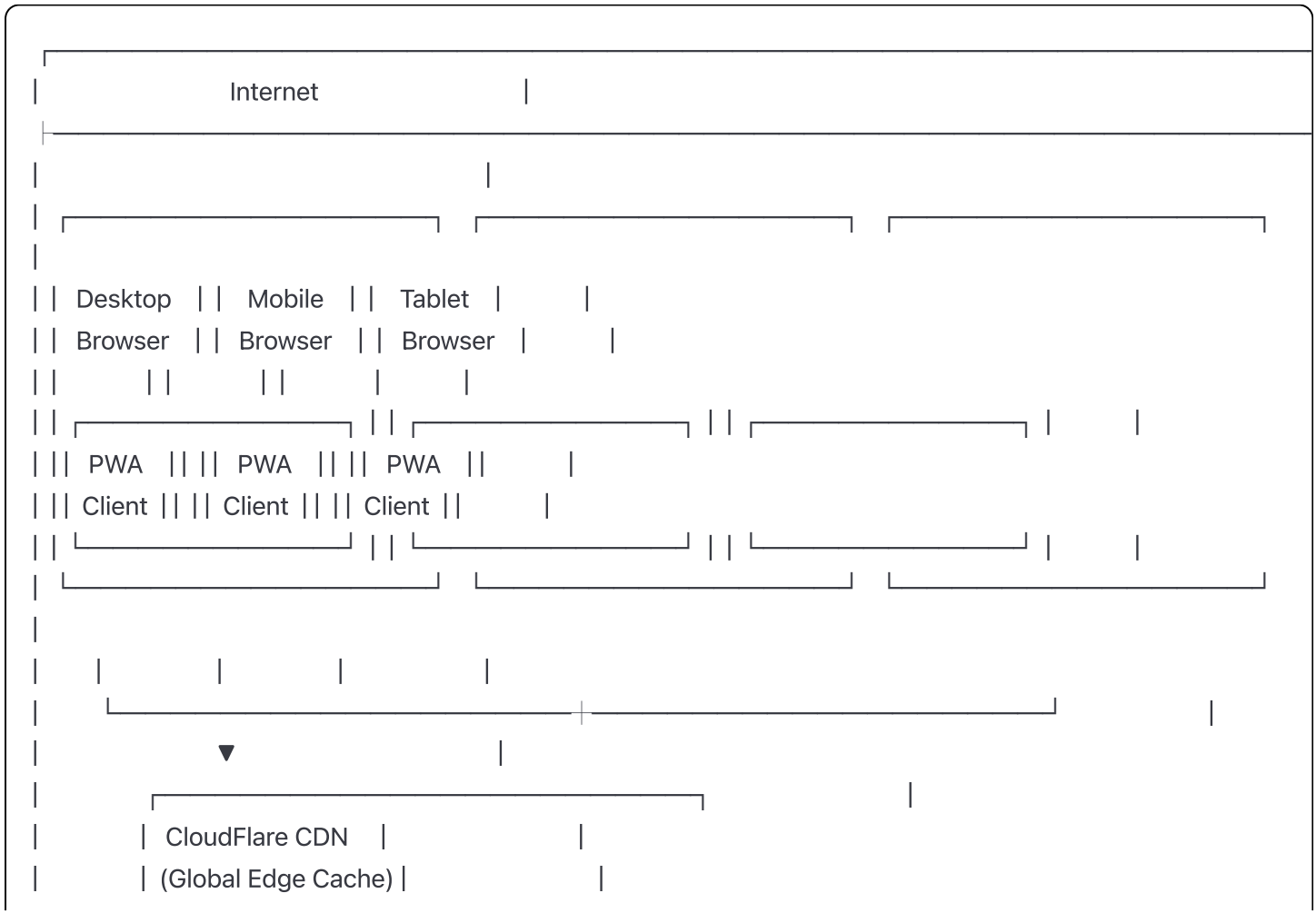


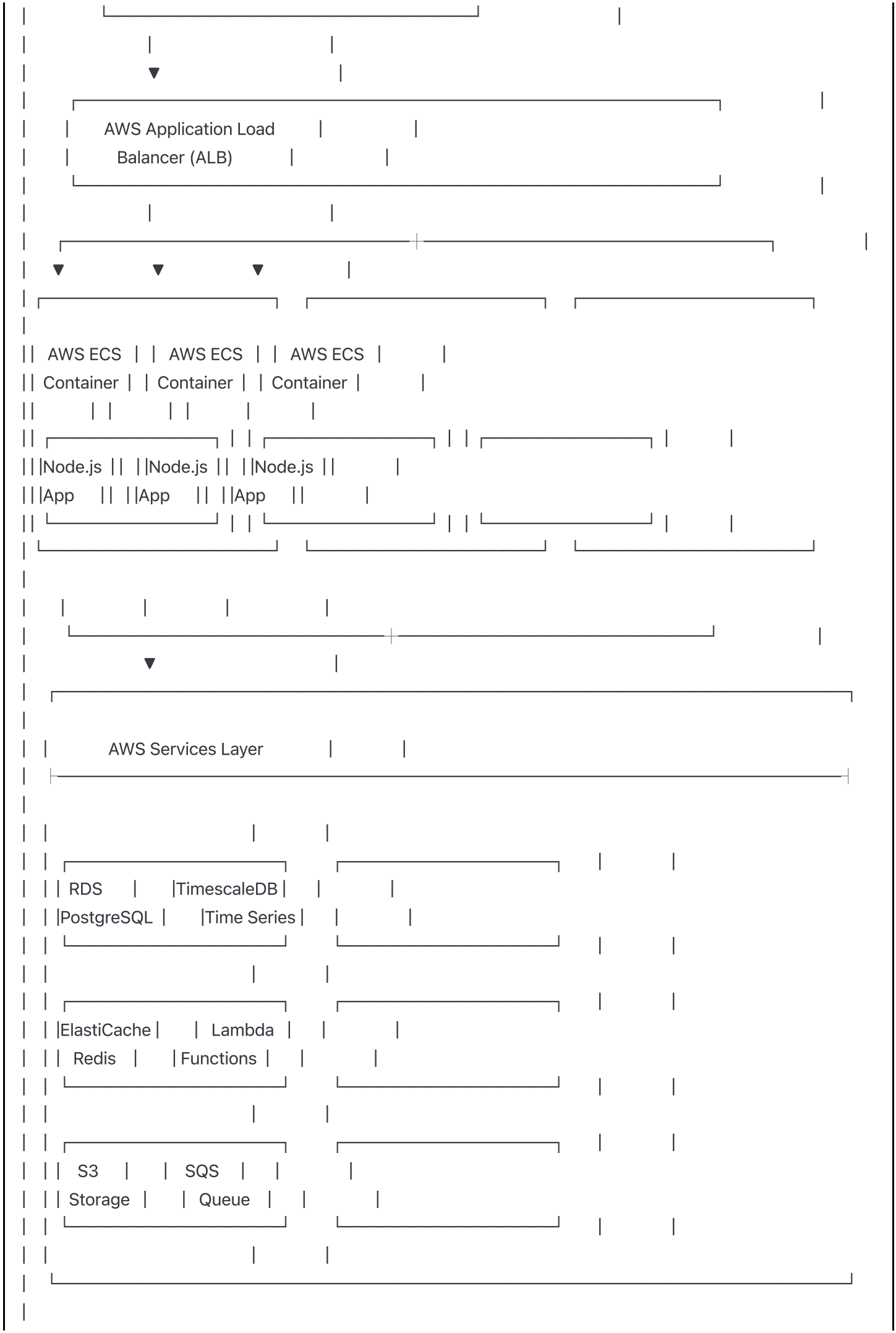

Show Pixel Grid on Farm Map
Can detect feature?
Yes
No
Show Feature Detected
Explain Why Not "Feature smaller than pixel"
Compare Multiple Resolutions
Interactive Quiz "Which resolution for this task?"
Correct Answer?
Yes
No
Award XP Progress
Explain Concept
Save Learning Progress

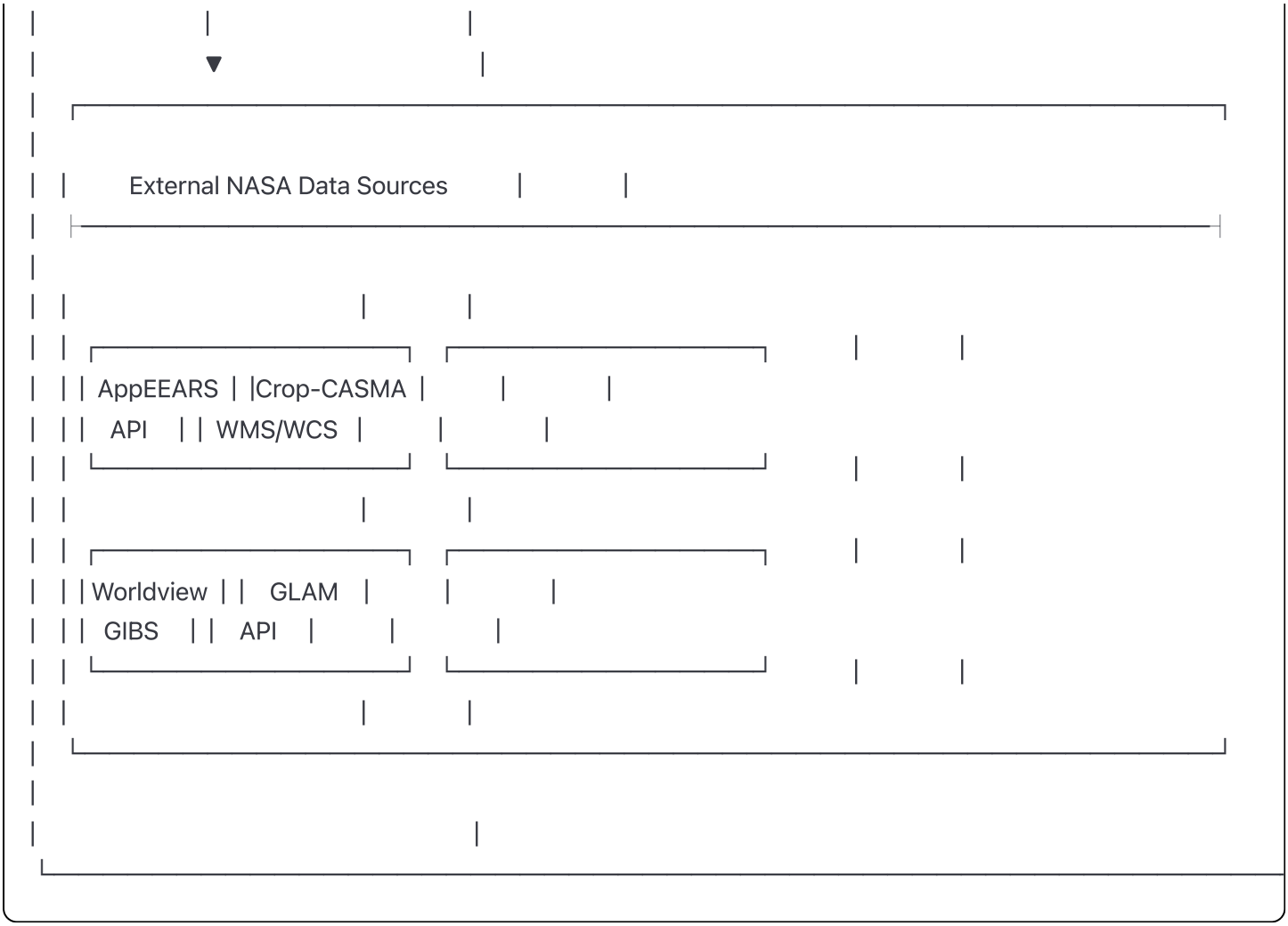
6. Use Case Diagram - System Actors and Functions



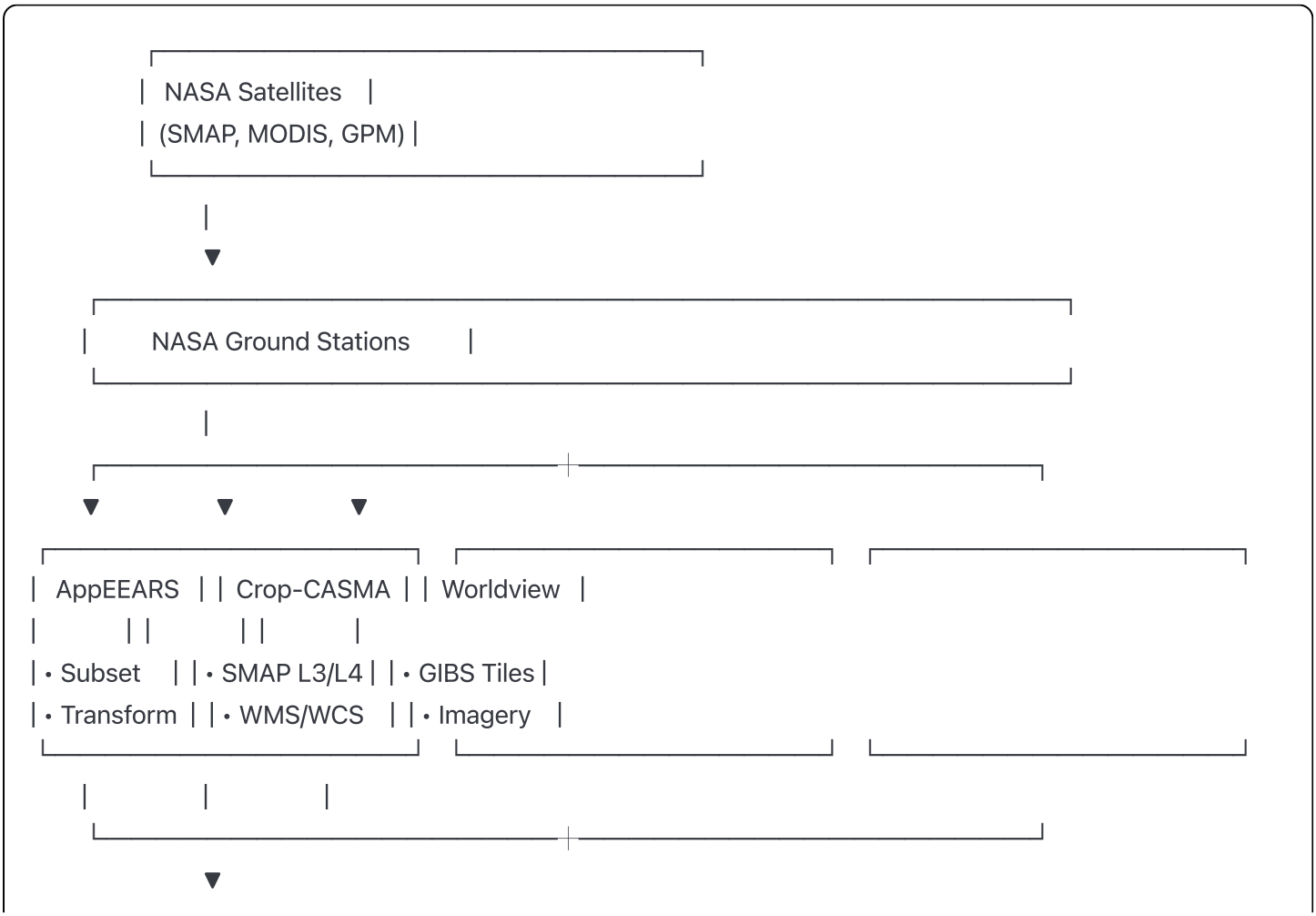
7. Deployment Diagram - Infrastructure Architecture

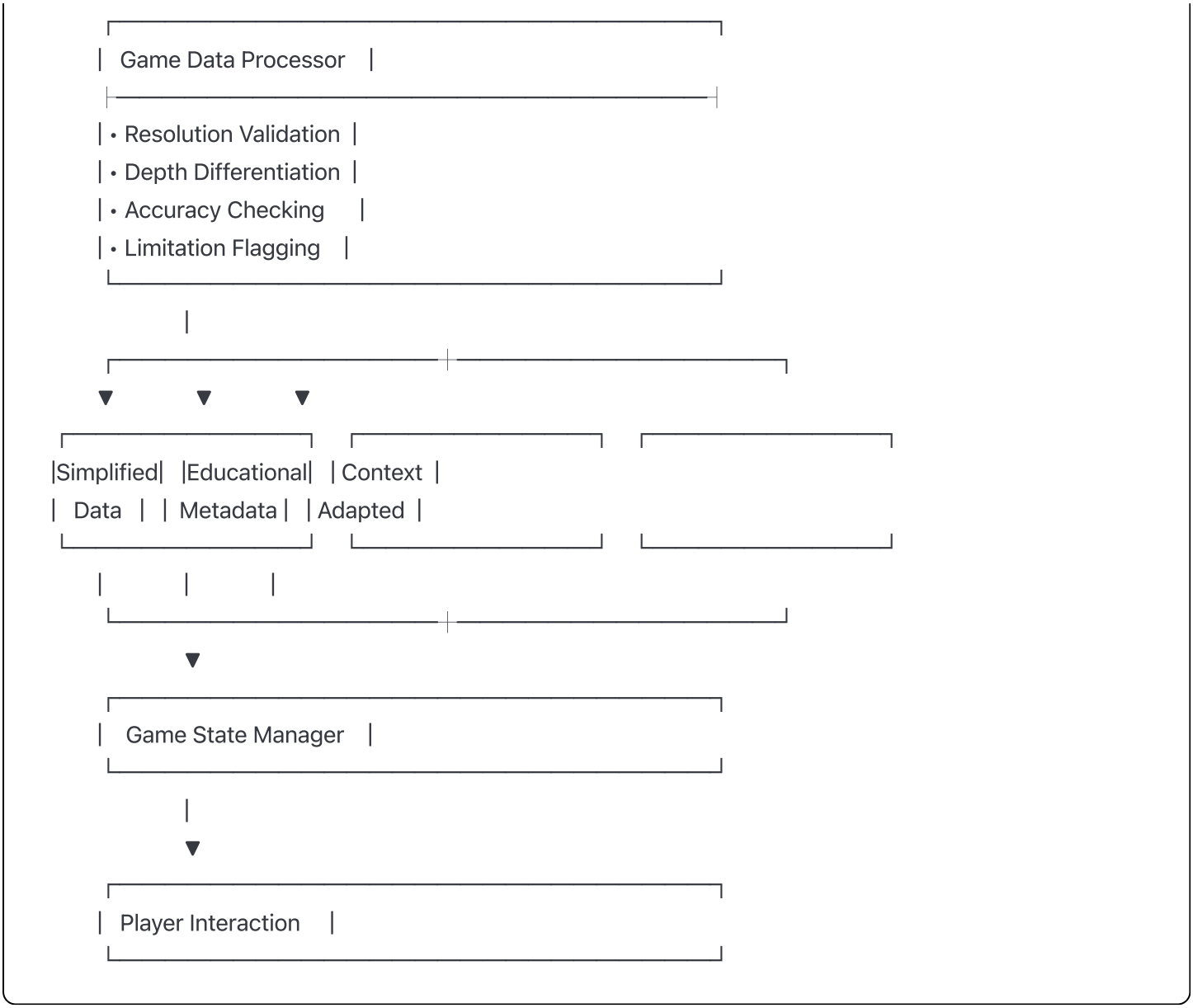



AWS Application Load
Balancer (ALB)
AWS ECS
Container
Node.js
App
AWS Services Layer
RDS
PostgreSQL
TimescaleDB
Time Series
ElastiCache
Redis
Lambda
Functions
S3
Storage
SQS
Queue

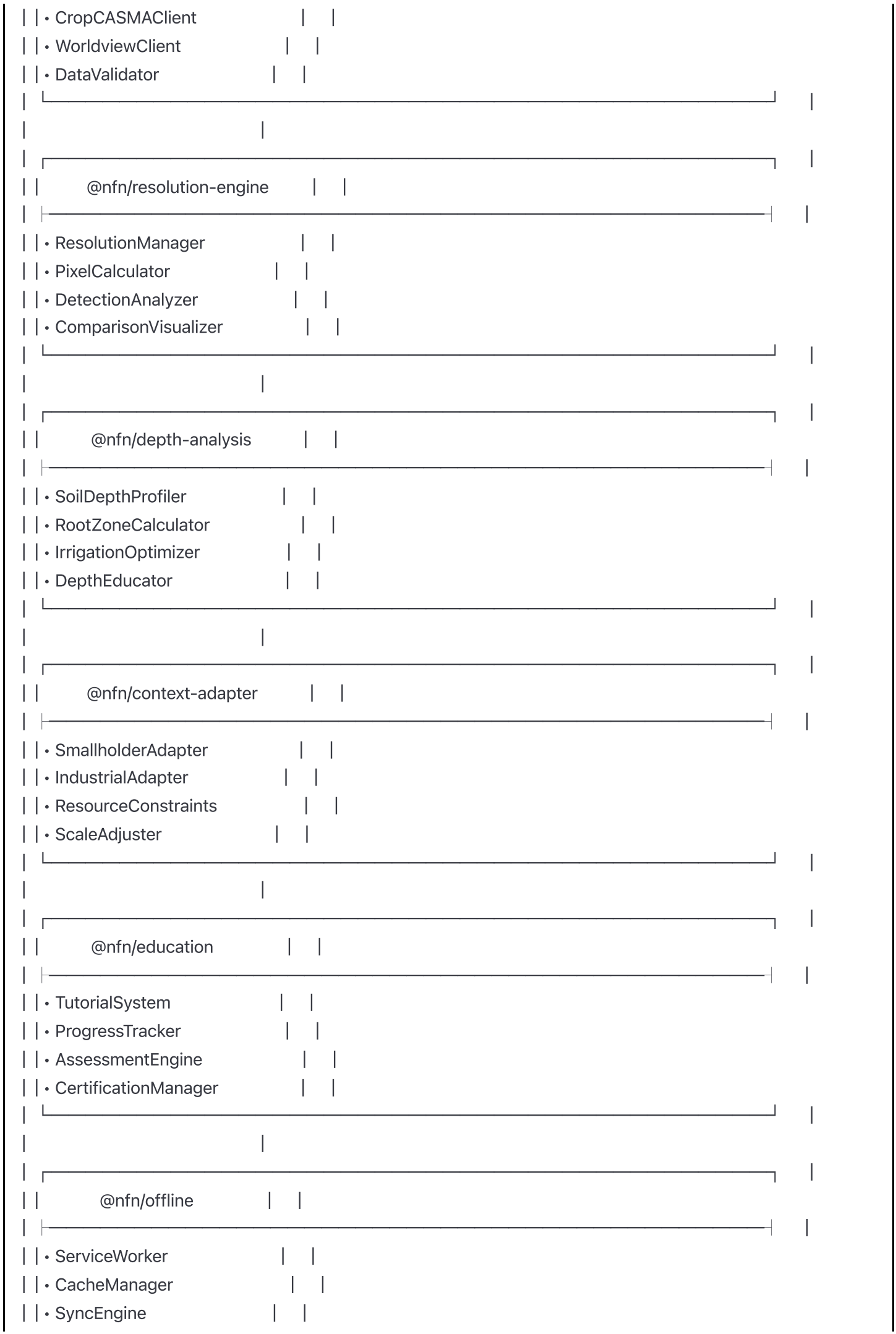


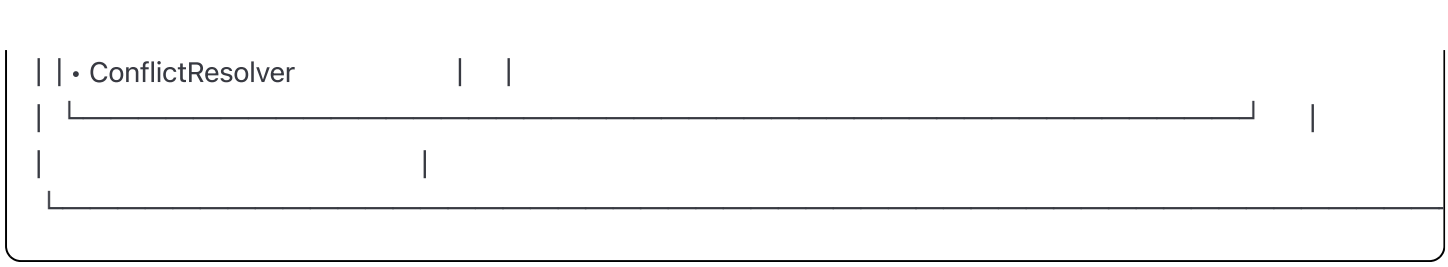
8. Data Flow Diagram - NASA Data Processing Pipeline





9. Package Diagram - System Modules


• CropCASMAClient
• WorldviewClient
• DataValidator
@nfn/resolution-engine
• ResolutionManager
• PixelCalculator
• DetectionAnalyzer
• ComparisonVisualizer
@nfn/depth-analysis
• SoilDepthProfiler
• RootZoneCalculator
• IrrigationOptimizer
• DepthEducator
@nfn/context-adapter
• SmallholderAdapter
• IndustrialAdapter
• ResourceConstraints
• ScaleAdjuster
@nfn/education
• TutorialSystem
• ProgressTracker
• AssessmentEngine
• CertificationManager
@nfn/offline
• ServiceWorker
• CacheManager
• SyncEngine


• ConflictResolver