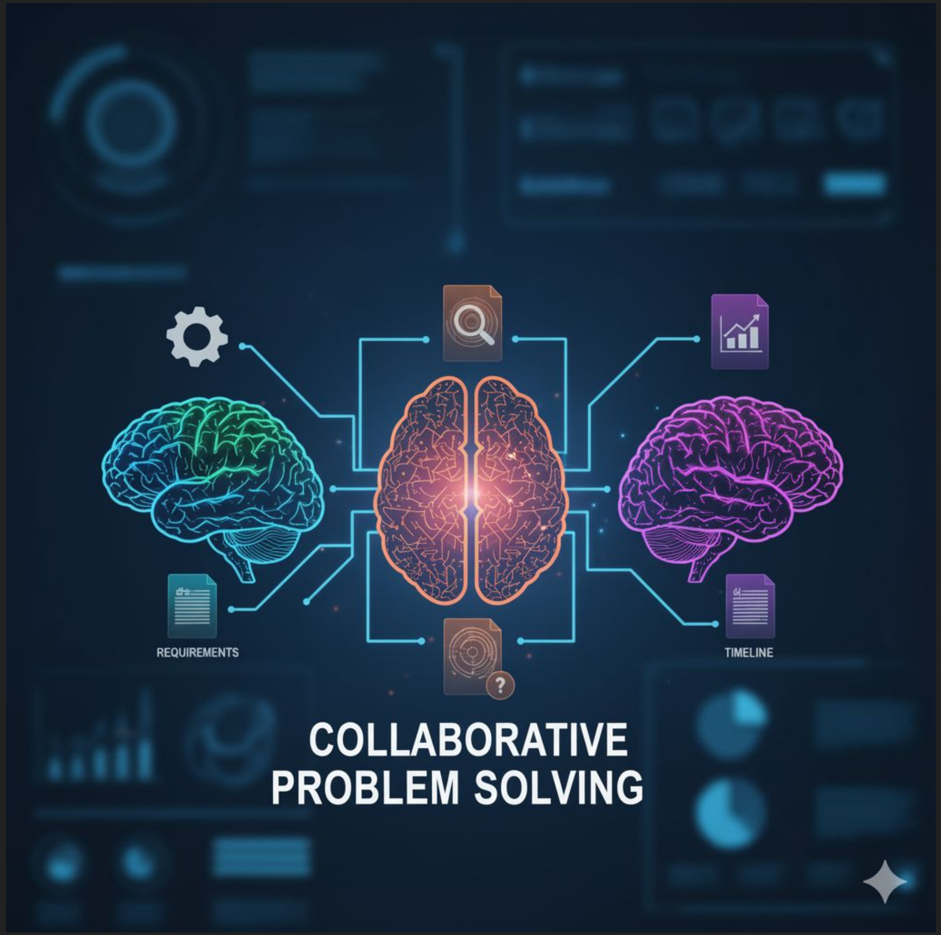
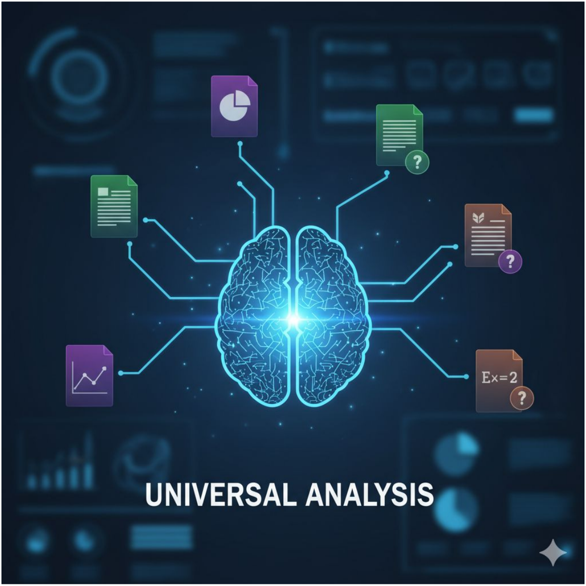


AIde Solutions

Understanding Multi-Agent Systems

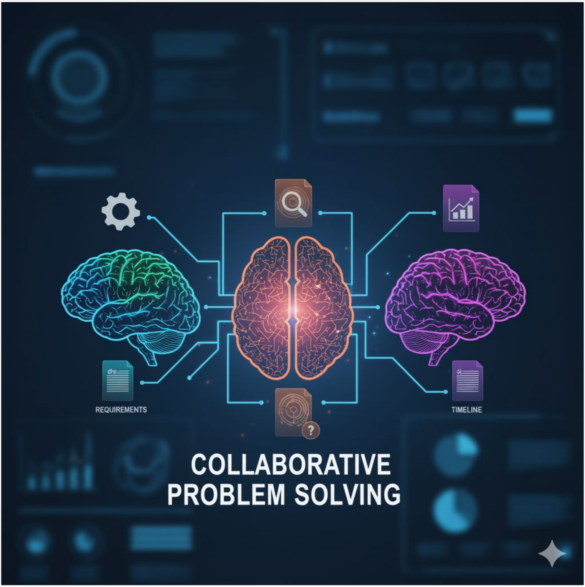
barisdeniz@aidesolutions.net

From “One” to “Many”



Single Agent System:

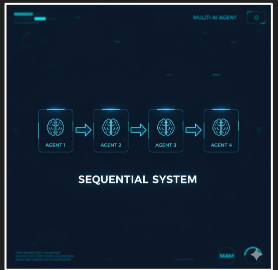
One “brain”, one perspective, one approach



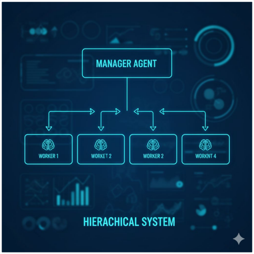
Multi-Agent System:

Multiple "brains" with different perspectives and specializations

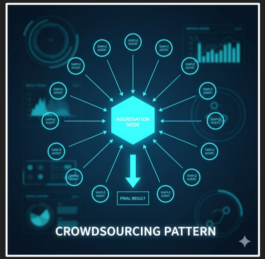
Common Multi-Agent Design Patterns



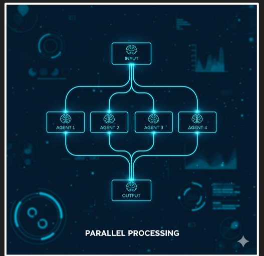
Sequential Systems



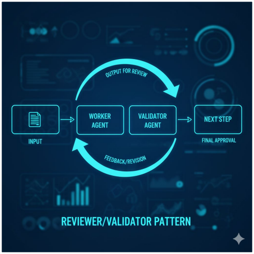
Hierarchical Systems



Crowdsourcing Systems



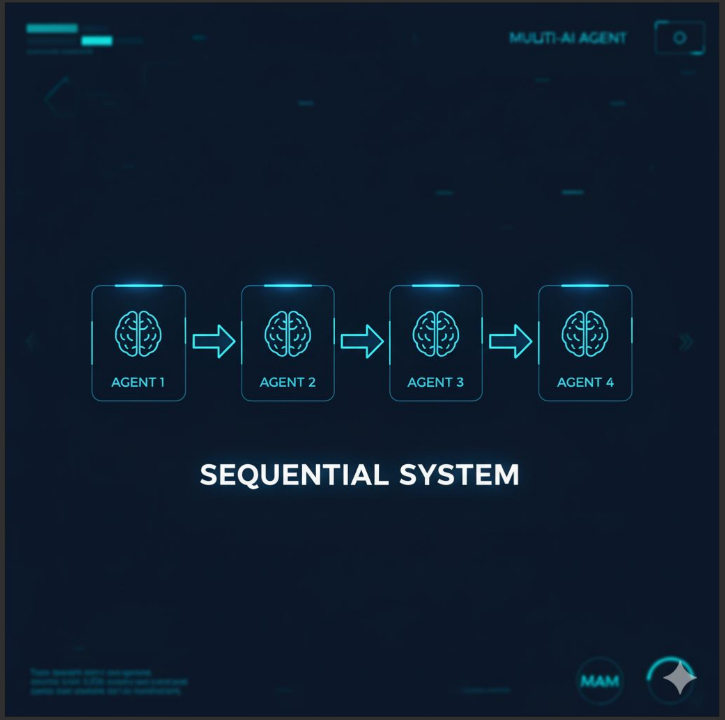
Parallel Systems



Reviewer Systems

Hybrid Systems

Pattern 1: Task Decomposition (Sequential System)



HEOR Example:

Literature review→

Data extraction →

Quality assessment →

Evidence synthesis

Problem it Solves:

Large, complex tasks overwhelm single agents
Context windows have limits
Quality degrades with task complexity

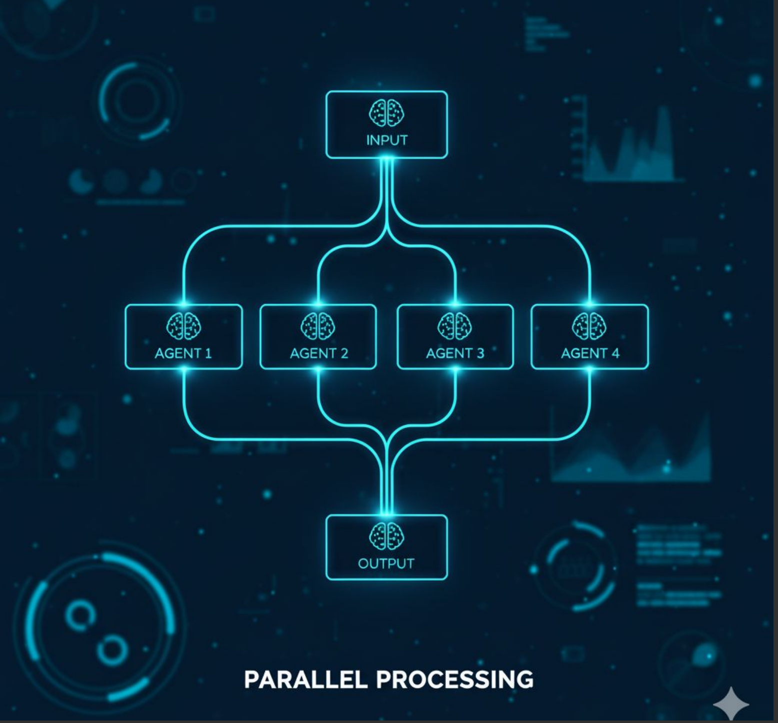
How it works

Break complex task into smaller, logical subtasks
Each agent specializes in one subtask
Output from Agent 1 becomes input for Agent 2
Each agent maintains focus and expertise, and so on

Key Consideration

Define well-contained, isolated tasks with singular focus - avoid creating dependencies that could cascade errors

Pattern 2: Independent Validation (Parallel Processing)



HEOR Example:

Two agents independently assess same clinical study for bias risk

Problem it Solves:

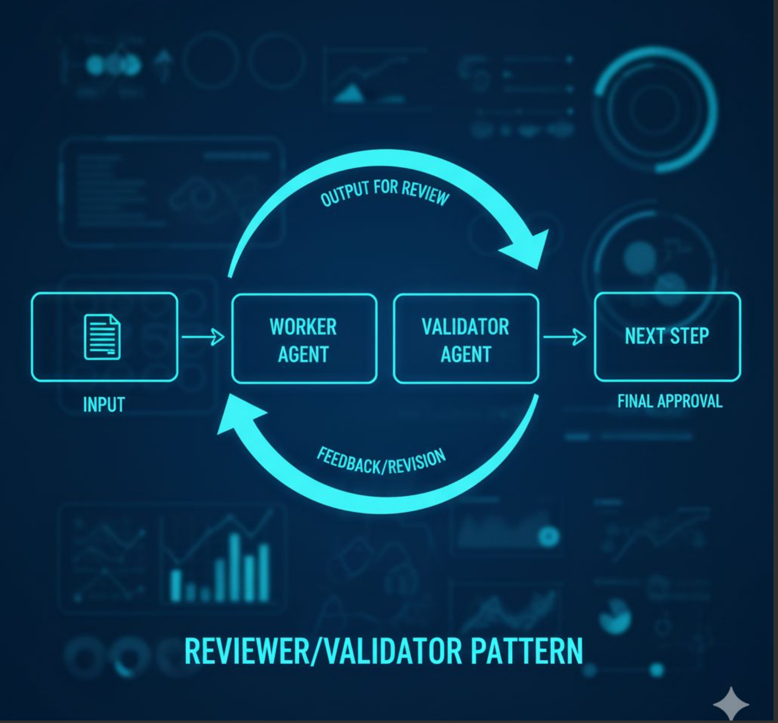
Single agent responses lack confidence indicators
No way to assess reliability without human review
Difficult to identify potential errors or biases

How it works

Multiple agents tackle identical tasks independently
Each agent uses different approaches/prompts
Compare outputs to assess confidence and identify discrepancies
Agreement = higher confidence; disagreement = flag for review

Key Consideration

"Use different LLMs or significantly different approaches to the same problem - avoid identical setups that would produce identical errors"



Pattern 3: Conflict Resolution (Reviewer System)

Problem it Solves:

When parallel agents disagree, how do you decide which is correct?
Human review of all disagreements defeats the purpose of automation
Need systematic way to resolve conflicts and make decisions

How it works

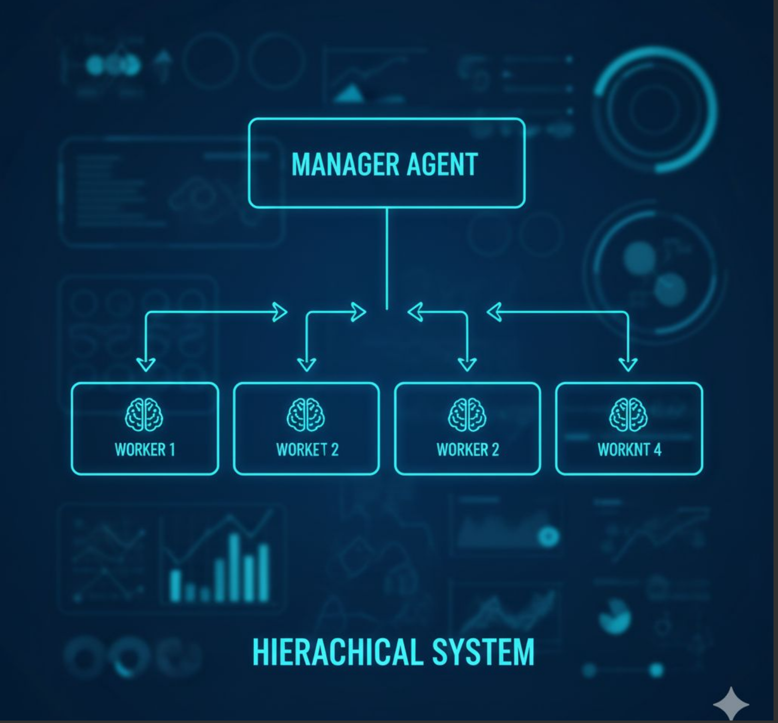
Third agent acts as adjudicator for disagreements
Reviews original data plus both conflicting outputs
Makes final decision or escalates to human review
Focused solely on decision-making, not task execution

Key Consideration

"Carefully define tie-breaker role and constraints - the reviewer agent should have different instructions than task execution agents"

HEOR Example:

Two agents disagree on whether a study meets inclusion criteria for systematic review



Pattern 4: Hierarchical (Manager/Worker System)

Problem it Solves:

Complex projects need coordination and task distribution
Different subtasks require different expertise levels
Need oversight and quality control across multiple work streams
Resource allocation and prioritization decisions

How it works

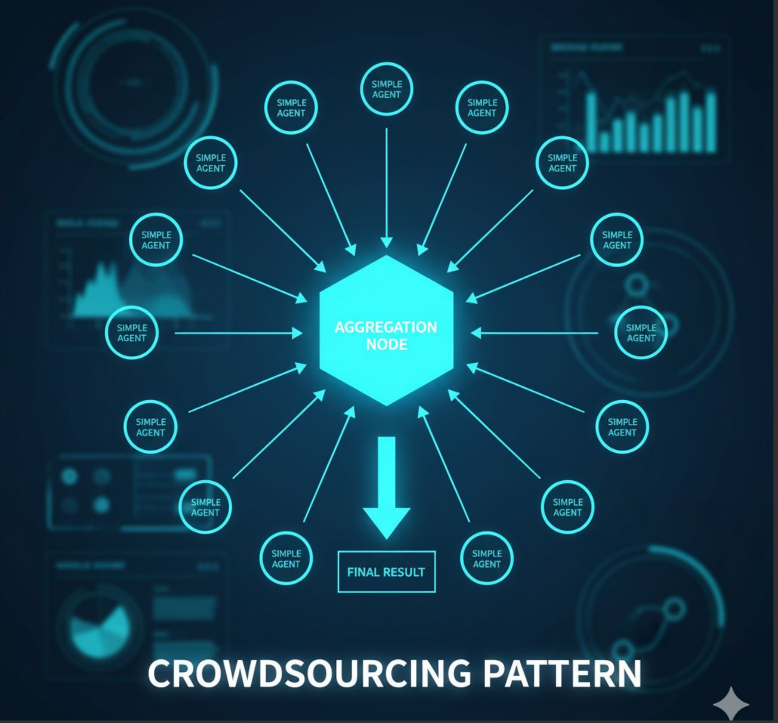
Manager agent coordinates overall workflow and assigns tasks
Worker agents execute specialized tasks based on assignments
Two-way communication: manager gives instructions, workers provide updates
Manager synthesizes results and makes high-level decisions

Key Consideration

Manager agent needs different skills than workers - focus on coordination, decision-making, and synthesis rather than detailed task execution"

HEOR Example:

Manager agent coordinates HEM development by directing **research assistant** to gather disease information, sharing findings with **concept developer**



Pattern 5: Crowdsourcing (Collective Intelligence)

Problem it Solves:

Large-scale data processing tasks that are tedious for sophisticated agents
Cost-effective approach when many simple judgments are needed
Need for statistical confidence through volume of simple assessments
Reducing individual agent bias through collective decision-making

How it works

Many simple agents each perform focused, limited tasks
Each agent operates independently with basic instructions
Central aggregator combines all individual contributions
Final output emerges from collective patterns, voting, or statistical aggregation

Key Consideration

Individual agents should be simple and focused - complexity comes from aggregation, not from sophisticated individual reasoning"

HEOR Example:

Fifteen agents each evaluate the same economic model's "assumption realism: Reasonable/Questionable/Unrealistic"

Pattern 6: Hybrid Networks (Combined Approaches)

Problem it Solves:

Most HEOR projects require multiple types of coordination and validation
No single pattern addresses all workflow needs
Different phases of analysis benefit from different multi-agent approaches
Need flexibility to adapt pattern to specific project requirements

How it works

Combines multiple patterns within one integrated system
Different workflow stages use different multi-agent approaches
Seamless transitions between patterns as project progresses
Flexible architecture adapts to changing analytical needs

Key Consideration

Design clear transition points between patterns - avoid complexity that obscures rather than improves the workflow

HEOR Example:

Two agents disagree on whether a study meets inclusion criteria for systematic review

Multi-Agent Systems: Key Considerations

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Improved Quality: Multiple perspectives and validation reduce errors

Increased Confidence: Agreement between agents provides reliability indicators

Specialized Expertise: Each agent optimized for specific tasks

Reduced SME Burden: AI-to-AI validation before human review

Scalability: Handle complex, large-scale analyses systematically

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Increased Complexity: More components to design, test, and maintain

Slower Processing: Sequential dependencies and validation loops take time

Coordination Overhead: Managing agent interactions and data flow

Debugging Challenges: Harder to identify where errors originate

Higher Costs: Multiple API calls and computational resources

Multi-agent systems require significant development, debugging and monitoring complexity in return for potentially higher quality outputs