AGENTIC AI USING LANGGRAPH 🤖🎧

AI Agents and Generative AI

Generative AI (Gen AI)

- A model designed to **create content** like text, images, code, audio, or video.
- Works mainly as **input** → **output**.
- It does not take actions or manage tasks by itself.

Example

Task: Summarize a document.
Gen AI Output: Returns a summary based on the input text.

AI Agents

- Systems built *on top of* Gen AI models.
- They can **plan**, **use tools**, **interact with environments**, and **execute multi-step tasks**.
- Designed to achieve goals autonomously.

Example

Task: "Summarize this PDF and upload it to Google Drive."

What an AI Agent does: 1. Reads the PDF. 2. Extracts the text.
3. Summarizes each section. 4. Generates a final summary. 5. Saves it as a file.

6. Uploads the file to Google Drive. 7. Sends you the link.

Comparison Table

Feature	Generative AI	AI Agents
Creates content	✔️	✔️
Takes actions	❌	✔️
Uses tools	❌	✔️
Multi-step planning	Limited	Strong
Autonomy	Low	High

In Short

- **Gen AI** creates content.
- **AI Agents** use Gen AI + actions + tools + planning to complete tasks autonomously.

What is Agentic AI?

Agentic AI
│
├── What it Is:

│ ├── Type of AI that completes tasks/goals autonomously [1]
│ ├── Plans, acts, adapts, seeks help when needed [1]
│ └── Proactive (vs. Reactive Generative AI) [2-4]
│
└── Key Aspects:
├── Characteristics (How to identify Agentic AI) [5]
│ ├── Autonomy: Independent decision-making & action [5]
│ │ └── Controllable via scope, HITL, override, guard rails [7]
│ ├── Goal-Oriented: Persistent objective guides actions [8]
│ ├── Planning: Breaks down goals into sequenced actions [10]
│ │ └── Involves generating, evaluating, selecting plans [11, 12]
│ ├── Reasoning: Cognitive process for interpreting, concluding, deciding [13]
│ │ └── Needed for both planning & execution [13, 14]
│ ├── Adaptability: Modifies plans/actions to unexpected conditions [15]
│ │ └── Triggered by failures, external feedback, changing goals [15, 16]
│ └── Context Awareness: Understands & retains relevant info for decisions [16]
│ └── Implemented via Short-Term & Long-Term Memory [17, 18]
│
└── Components (Building Blocks of Agentic AI) [18]
├── Brain: The LLM, interprets goals, plans, reasons, selects tools [19]
├── Orchestrator: Executes the plan, manages sequencing, routing, retries [19, 20]
├── Tools: External world interaction (APIs, databases, knowledge bases) [20]
├── Memory: Retains context (Short-Term, Long-Term, state tracking) [20, 21]
└── Supervisor: Manages Human-in-the-Loop

Agentic AI refers to artificial intelligence systems designed to take on tasks and goals from a user and operate autonomously, making decisions and taking actions to achieve specific goals with minimal human intervention.

- Unlike traditional AI, which relies on predefined rules and human oversight, agentic AI exhibits goal-driven behavior, adaptability, and the ability to interact dynamically with its environment.
- These systems leverage AI agents, which are machine learning models capable of mimicking human decision-making. They can perform tasks independently, coordinate with other agents in multi-agent systems, and adapt their strategies based on feedback and learning.

Key Characteristics of Agentic AI (with Examples)

🎯 Running Example

Goal:

> Plan a **3-day trip to Bengaluru** within a **₹20,000 budget** and complete all bookings autonomously.

This same example is used across all characteristics.

1. Autonomy

What it means

The AI agent can **make decisions and take actions independently** without needing step-by-step human instructions.

Example

The agent:

- Searches transport options
- Checks hotel availability
- Compares prices
- Proceeds with booking

All without repeatedly asking the user what to do next.

2. Goal-Oriented Behavior

What it means

The agent works with a **persistent objective** and evaluates every action against that goal.

Example

The agent continuously checks:

- Is the total cost ≤ ₹20,000?
- Are travel dates satisfied?
- Is the trip duration exactly 3 days?

Hotels or transport options that violate the goal are rejected automatically.

3. Planning

What it means

Breaking a high-level goal into **structured, ordered steps** before execution.

Example Plan

1. Decide travel dates
2. Search transport options
3. Select accommodation
4. Build daily itinerary

5. Calculate total cost
6. Book tickets and hotel
7. Confirm itinerary

The agent creates this plan **before acting**.

4. Reasoning

What it means

The ability to **evaluate options, compare trade-offs, and justify decisions**.

Example

The agent reasons:

- Flight is fast but expensive
- Train is slow but cheap

Decision:

> Choose train for arrival and bus for return to save ₹3,000.

The choice is made using logical comparison.

5. Adaptability

What it means

The agent can **change strategy when conditions change**, while still pursuing the same goal.

Example

If hotel prices increase:

- Switch to a different area
- Reduce stay by one night
- Suggest hostels instead of hotels

The plan changes, but the goal remains unchanged.

6. Context Awareness

What it means

The agent understands and remembers **past interactions, preferences, and current state**.

Example

The agent remembers:

- Preference for AC rooms
- Avoidance of early-morning travel
- Transport already booked

So it avoids irrelevant or repetitive suggestions.

🔍 Agentic AI vs Generative AI

Generative AI	Agentic AI
Responds to prompts	Acts toward goals
No memory of progress	Maintains context
No planning	Structured planning
No adaptation	Dynamic adaptation

🧠 Final Summary

Agentic AI systems **do not just generate responses**.
They **act autonomously**, **plan ahead**, **reason logically**, **adapt to change**, and **use context** to complete real-world tasks effectively.

Components of Agentic AI (with Example)

The below content explains the **core components of an Agentic AI system** using a **single real-world example**.

🎯 Running Example

Goal:
Automatically hire a **backend engineer** with 3+ years of experience.

1. Brain (LLM)

What it is

The **intelligence unit** of the agent, usually a Large Language Model.

Responsibilities

- Understand the goal
- Reason and plan
- Decide next actions
- Interpret tool results

Example

The brain understands the hiring requirement and decides that a job description must be created and posted.

2. Orchestrator

What it is

The **execution controller** that manages workflow.

Responsibilities

- Execute steps in order
- Handle loops and retries
- Decide which component runs next

Example

The orchestrator posts the job, waits for applications, and loops back if candidates are insufficient.

3. Tools

What they are

Interfaces that allow the agent to **act in the real world**.

Examples

- Job portals (LinkedIn, Naukri)
- Email APIs
- Resume parsers
- Databases

Example

The agent uses tools to post jobs, parse resumes, and send interview emails.

4. Memory

What it is

Storage for **context and learning**.

Types

- Short-term: current task state
- Long-term: preferences and past outcomes

Example

The agent remembers preferred skills and avoids previously rejected candidates.

5. Supervisor (Human-in-the-loop)

What it is

A **safety and control layer**.

Responsibilities

- Review critical decisions
- Approve or reject actions

Example

Before sending offer letters, human approval is requested.

🔄 Component Flow

User Goal → Brain → Orchestrator → Tools → Memory → Supervisor

🧠 Summary

- Brain thinks
- Orchestrator controls
- Tools act
- Memory remembers
- Supervisor ensures safety

Together, they form a complete **Agentic AI system**.

LangChain Vs LangGraph

- LangGrap0h is an graph based orchestration framework for building intelligent, stateful, and multi-step LLM workflows
- It enables advanced featues like parallelism, loops, branching, memory, and resumability - making it ideal for agentic and production grade AI applications
- It models your logic as a graph of nodes (tasks) and edges (routing) instead of linear chain.

It allows you to define:

- **Nodes** → actions (LLM calls, tools, logic)
- **Edges** → control flow between actions
- **State** → shared memory passed across steps

LLM Workflows

- Step by step process using which we build complex LLM applications
- Each step in a workflow performs a distint task - such as prompting, reasoning, tool calling, memory access, or decision making.
- Workflows can be linear, parallel, branched, or looped.

Common Workflows:

- Prompt Chaining
- Routing
- Parallelization
- Orchestrator Workers
- Evaluator Optimizer

Why LangGraph Exists

Traditional agent frameworks struggle with:

- Infinite or uncontrolled loops
- Hard-to-debug execution
- Poor visibility into decision flow
- Limited support for retries and human approval

LangGraph solves these problems by making agent execution **explicit, deterministic, and inspectable**.

Core Concepts

1. Nodes

Each node represents a **unit of work**, usually a function.

Examples:

- Call an LLM
- Use a tool (search, database, API)
- Validate output
- Ask for human approval

Conceptually:

```
Think → Search → Decide → Act
```

2. Edges

Edges define **what runs next** after a node.

Types:

- Normal edge (A → B)
- Conditional edge (if / else)
- Loop edge (retry, replan)

Example:

```
If confidence < 0.7 → Re-think
Else → Act
```

3. State

State is a **shared object** passed between nodes.

Example state:

```
{
  "goal": "Answer user query",
  "plan": [],
  "tool_result": null,
  "approved": false
}
```

State acts as:

- Memory
- Progress tracker
- Context store

4. Deterministic Control

LangGraph lets you explicitly define:

- When the agent stops
- When it retries
- When it branches
- When it asks for human approval

This avoids uncontrolled LLM loops.

Example Flow (Conceptual)

Goal: Answer a user question with verification.

```
Start
 ↓
LLM (reason)
 ↓
Search Tool
 ↓
LLM (verify)
 ↓
If confident → Final Answer
Else → Loop back to LLM
```

This structure is natural and safe in LangGraph.

LangGraph vs LangChain

Aspect	LangChain	LangGraph
Execution model	Linear chains	Graph-based
Loops	Limited	Native support
Branching	Basic	First-class
State handling	Minimal	Strong
Agent control	Implicit	Explicit
Debuggability	Medium	High

LangGraph builds **on top of LangChain**, it does not replace it.

LangGraph in Agentic AI Architecture

Agentic Component	LangGraph Role
Brain	LLM node
Orchestrator	LangGraph engine
Tools	Tool nodes
Memory	Graph state
Supervisor	Approval nodes

LangGraph primarily acts as the **orchestrator**.

When to Use LangGraph

Use it when:

- Your agent needs loops or retries
- You need human-in-the-loop approval
- You want predictable execution
- You are building production agents

Avoid it when:

- Task is a simple one-shot prompt
- Linear flow is sufficient

🧠 One-Line Summary

LangGraph enables agentic AI systems with explicit control, memory, and safety—similar to how backend workflows are designed.

LangGraph Core Concepts

LLM workflow patterns

1. Prompt Chaining

What it is
Breaking a complex task into multiple sequential LLM prompts, where each output feeds the next.

Why it exists

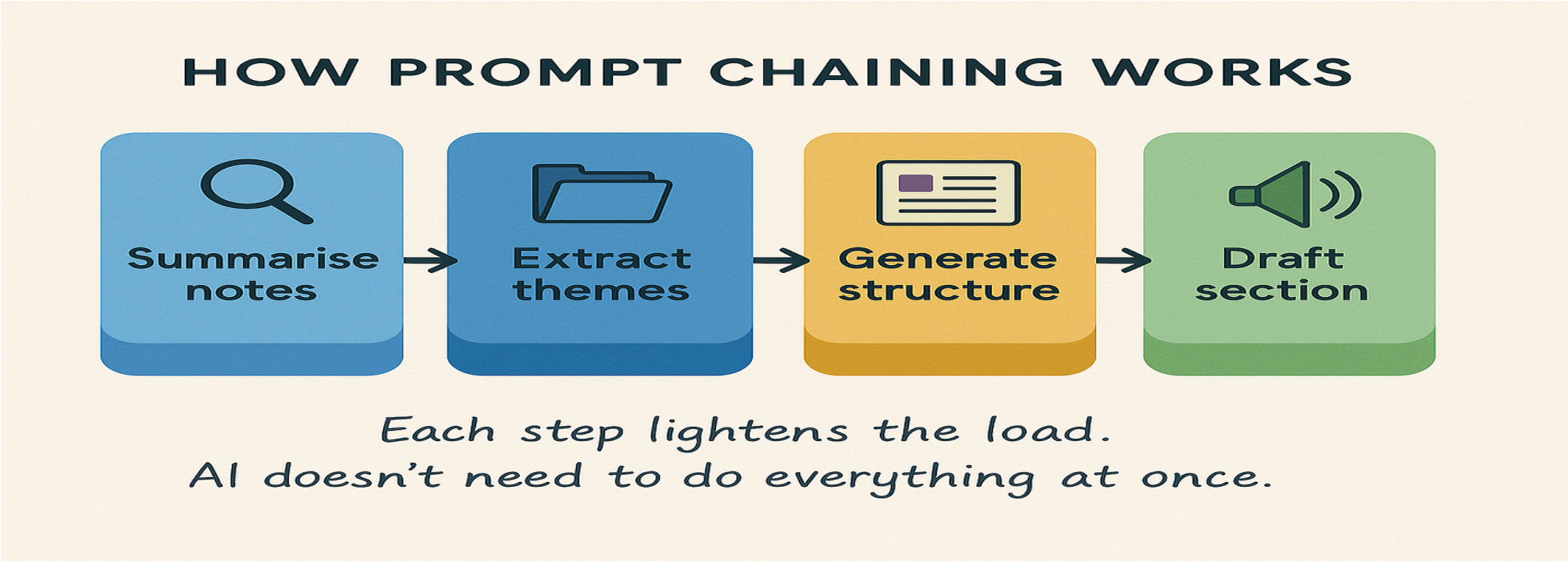
- Improves accuracy
- Makes reasoning explicit
- Easier debugging

Example
Task: Write a technical blog

Steps:

- Generate outline
- Expand sections
- Polish language

```
Input
↓
Prompt 1 (Outline)
↓
Prompt 2 (Expand)
↓
Prompt 3 (Refine)
↓
Final Output
```



2. Routing

What it is

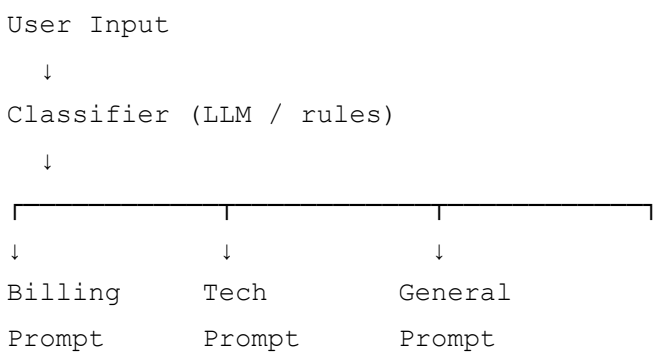
Classifying input and routing it to the correct prompt, model, or tool.

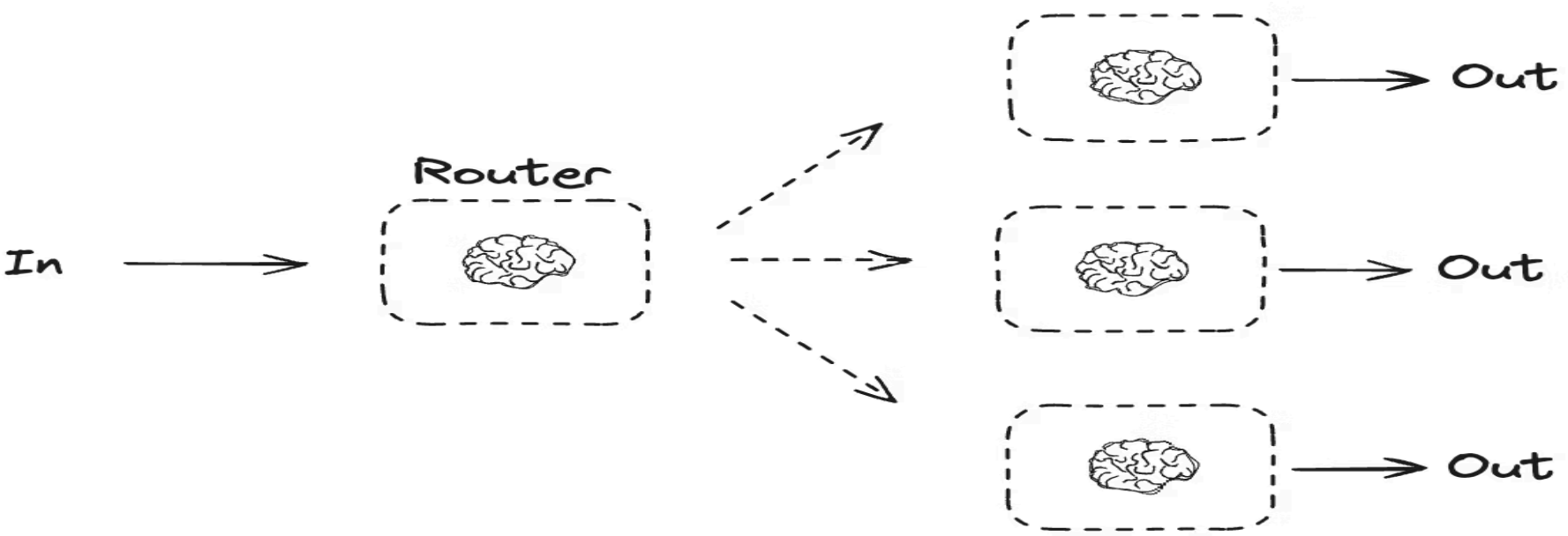
Important correction

Routing is not reasoning — it’s decision-based dispatching.

Example

- Customer query handling:
- Billing question → Finance prompt
- Bug report → Tech support prompt
- General query → FAQ prompt





3. Parallelization

What it is

Running multiple LLM calls simultaneously and combining results.

Why it's used

- Speed
- Diversity of answers
- Cross-validation

Characteristics

- No decision-making
- No task breakdown
- Same input → multiple executions

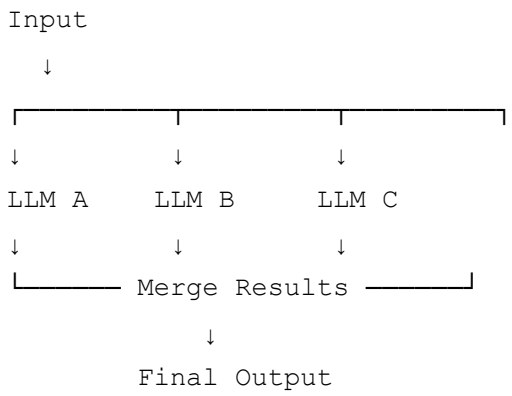
- Fire-and-forget

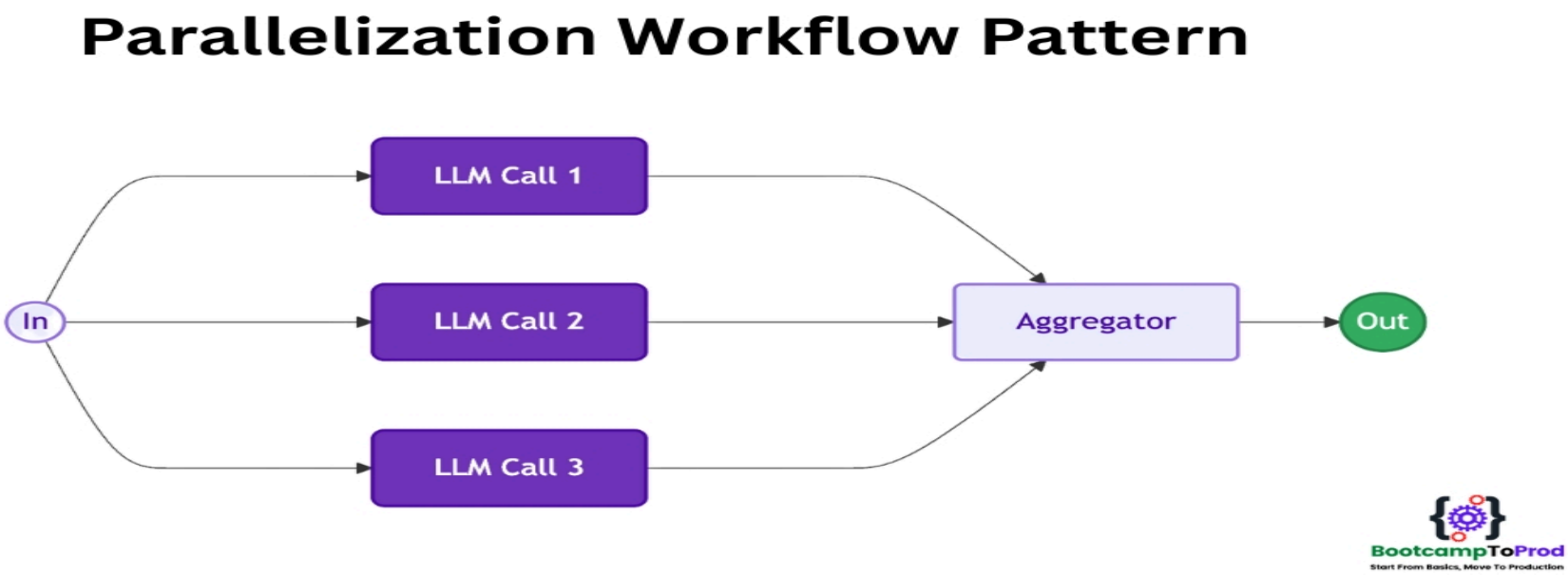
Example

Analyze a document for:

- Summary
- Risks
- Key points

  All at the same time.





✅ Fast
✅ Robust
❌ Needs merge logic

4. Orchestrator–Workers Pattern

What it is

One controller (orchestrator) delegates tasks to multiple worker LLMs.

Key correction

Workers do not decide the goal — the orchestrator does.

A central orchestrator:

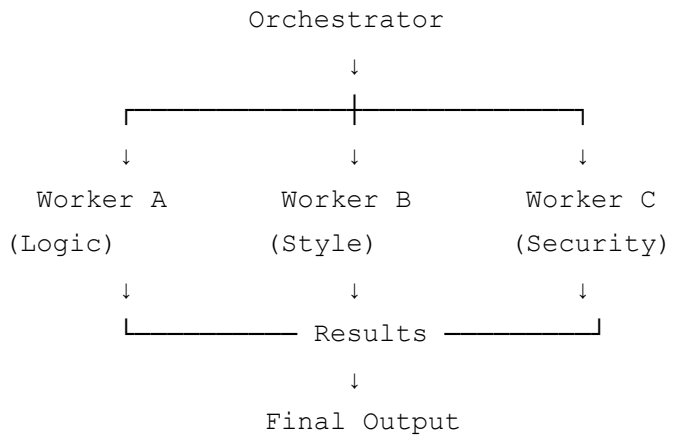
- Understands the goal
- Breaks it into tasks

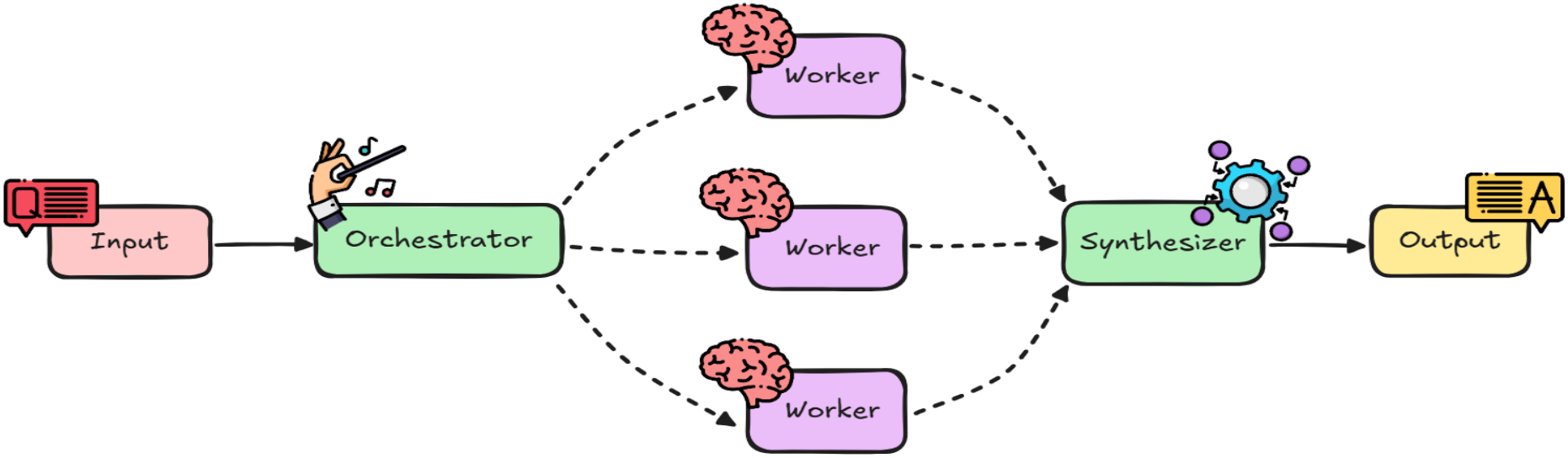
- Assigns tasks to workers
- Collects and integrates results

Example

Task: Code review

- Orchestrator splits work
- Workers review different aspects
- Orchestrator merges feedback





✅ Scalable
✅ Clean separation of concerns

5. Evaluator–Optimizer Pattern

What it is

A feedback loop where one LLM generates output and another evaluates it.

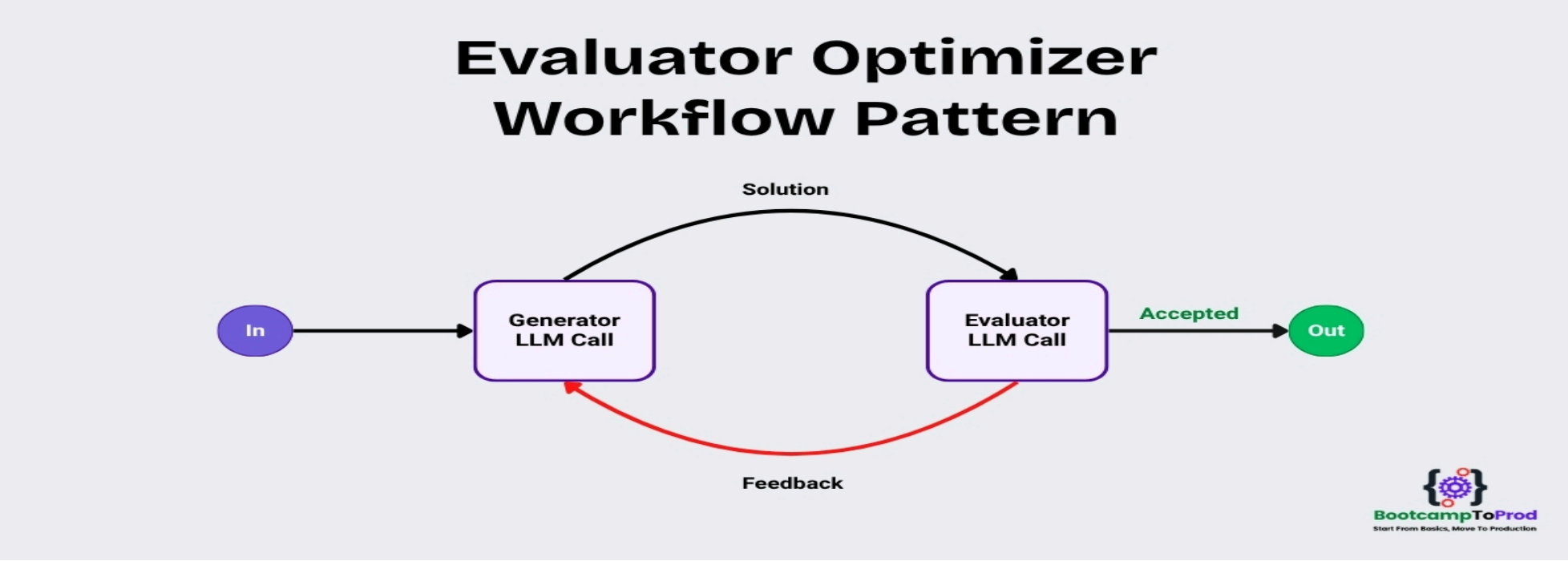
Critical distinction

Evaluator never generates
Optimizer never judges

Example

Improve an answer until quality threshold is met.

```
Prompt
  ↓
Optimizer (Generate)
  ↓
Evaluator (Score)
  ↓
Score OK?
├── Yes → Final Answer
└── No  → Feedback → Optimizer
```



This is controlled looping, not autonomous behavior.

Workflows

1.Sequential Workflows:

Tasks are executed one after another in a specific, linear order.

2.Parallel Workflows:

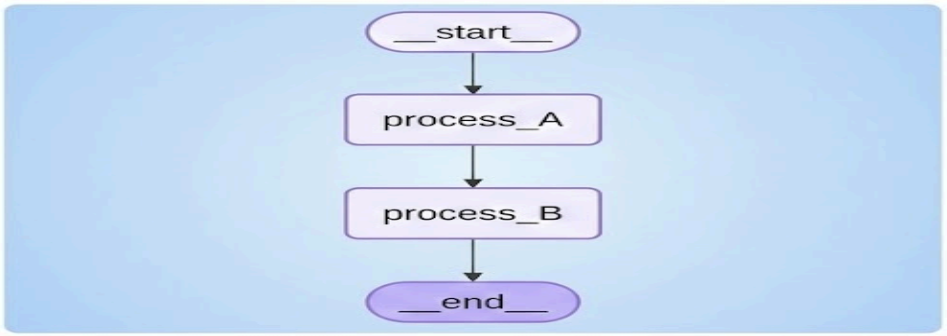
Multiple tasks are executed simultaneously across different branches.

3.Conditional Workflows:

The path of execution is determined by a decision or criteria, leading to different outcomes.

4.Iterative Workflows:

A set of tasks is repeated multiple times in a loop until a specific condition is met.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process_B
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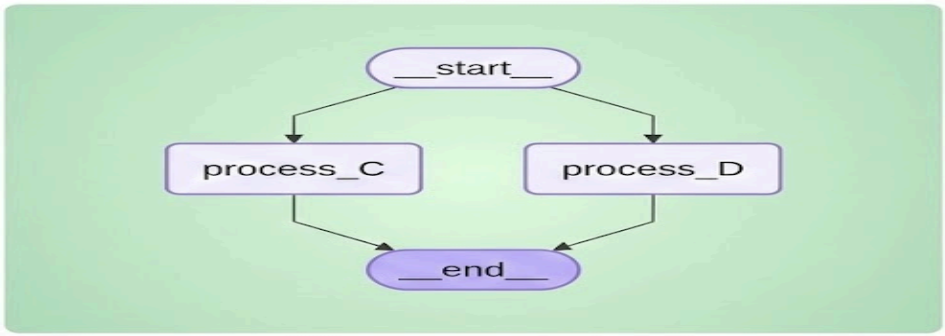
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process_C
process_D
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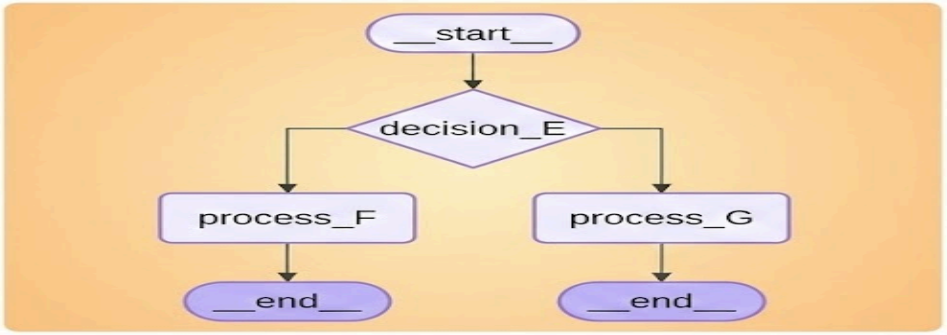
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decision_E
process_F
process_G
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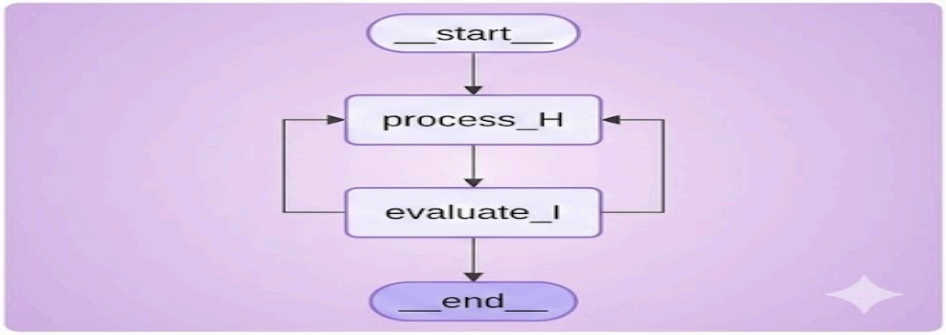
__start__
process_H
evaluate_I
__end__

Langgraph Persistant