

Introduction to

 LangChain &  LangGraph

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10/8/2025

References Used Throughout the Slides

1. [A Hands-On Guide to Building Intelligent Systems](#), Antonio Gulli
2. [LangChain Academy](#) – curated courses & tutorials.
GitHub: <https://github.com/langchain-ai/langchain-academy.git>
3. [LangGraph Cookbook](#)
4. [LangChain Tutorials](#)
5. [Interrupt](#) – the AI Agent Conference by LangChain
6. [Prof. Ghassemi Lectures and Tutorials](#), AI Agents lectures

Agenda

0. Introduction
 - LLM vs Agent
 - LangChain vs LangGraph
1. Setup for Google Colab
2. Basic Usage
 - LangChain Expression Language (LCEL)
3. Routing vs Chaining
4. Tool Use
5. Reflection
6. Retrieval-Augmented Generation (RAG)
7. Multi-Agent Collaboration
8. Human in the Loop

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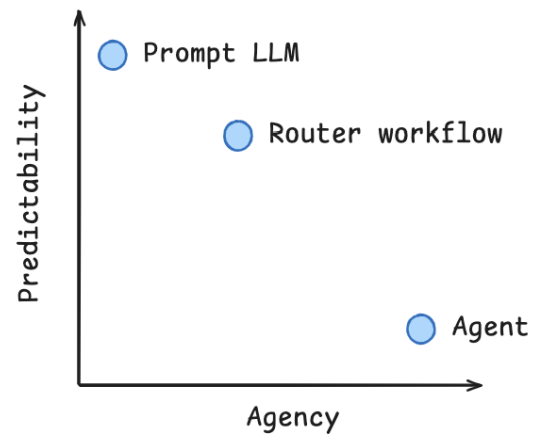
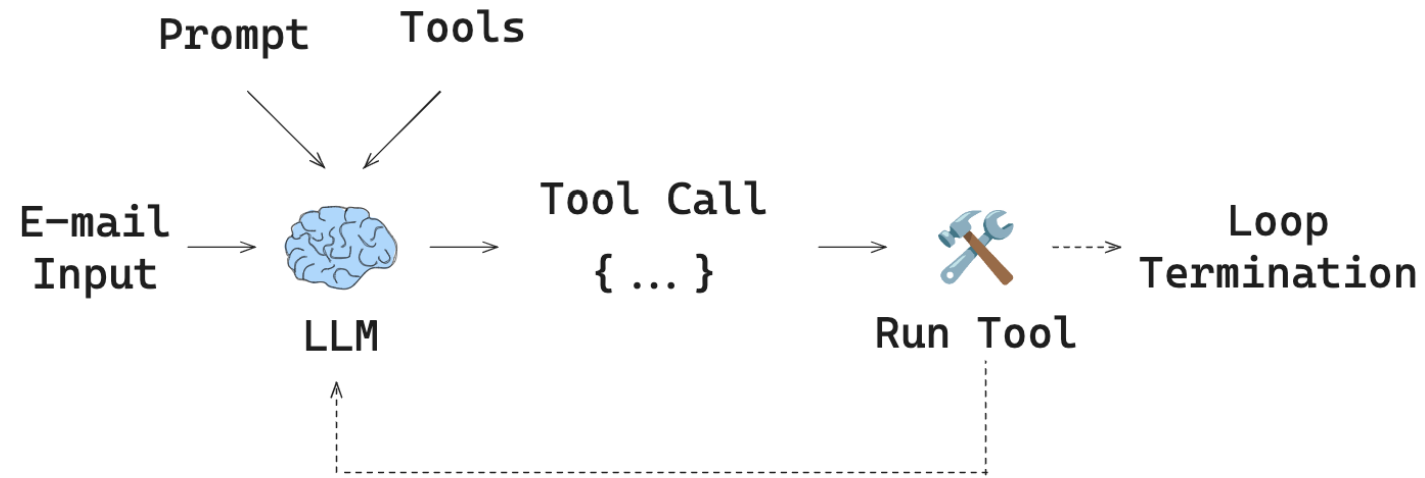
0) Introduction

- LLMs make it possible to embed intelligence into a new class of applications.
- Chat models are the foundation of LLM applications. They are typically accessed through a chat interface that takes a list of messages as input and returns a message as output.

LLM vs Agent

- LLM: a text generator (no goals, tools, memory by itself).
- Consider loop: *Observe* → *Decide* → *Act* → *Reflect*.
- It is incredibly difficult to build systems that reliably execute on these tasks.
- Agents can automate a wide range of tasks that were previously impossible.
- Agent: LLM + tools + memory + policy that decides what to do next (answer, search, call a function, delegate, clarify).

Agent Example



LangChain vs LangGraph



LangChain

- [LangChain](#) is a framework to help developers build applications using power of LLMs.
- Provides abstractions and components to easily create complex workflows, or "chains," by combining different parts.
- Provides [a standardized interface for chat models](#), making it easy to [access many different providers](#).

LangChain vs LangGraph



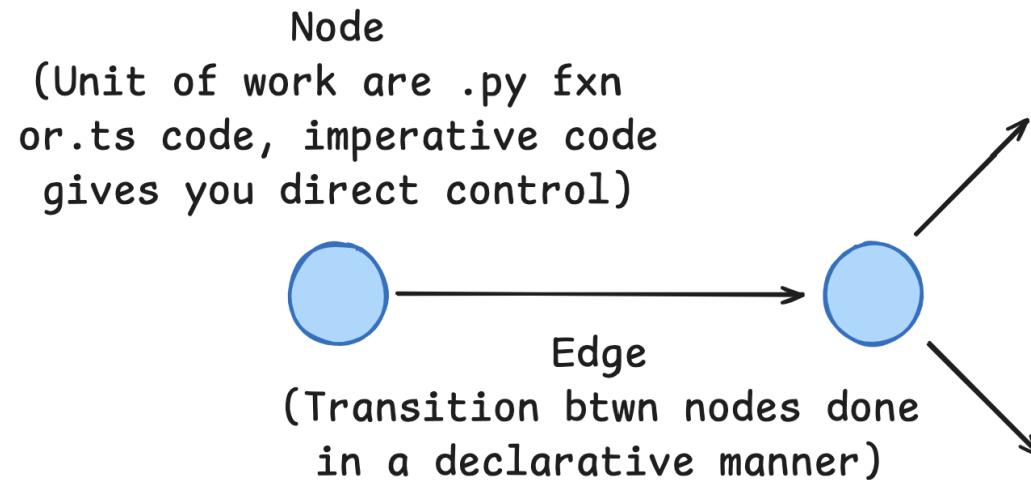
LangGraph

- [LangGraph](#): an extension of LangChain
- Enables creation of multi-agent applications by representing the workflow as a graph.
- Helps developers add better precision and control into agent workflows
- Suitable for complexity of real-world systems.

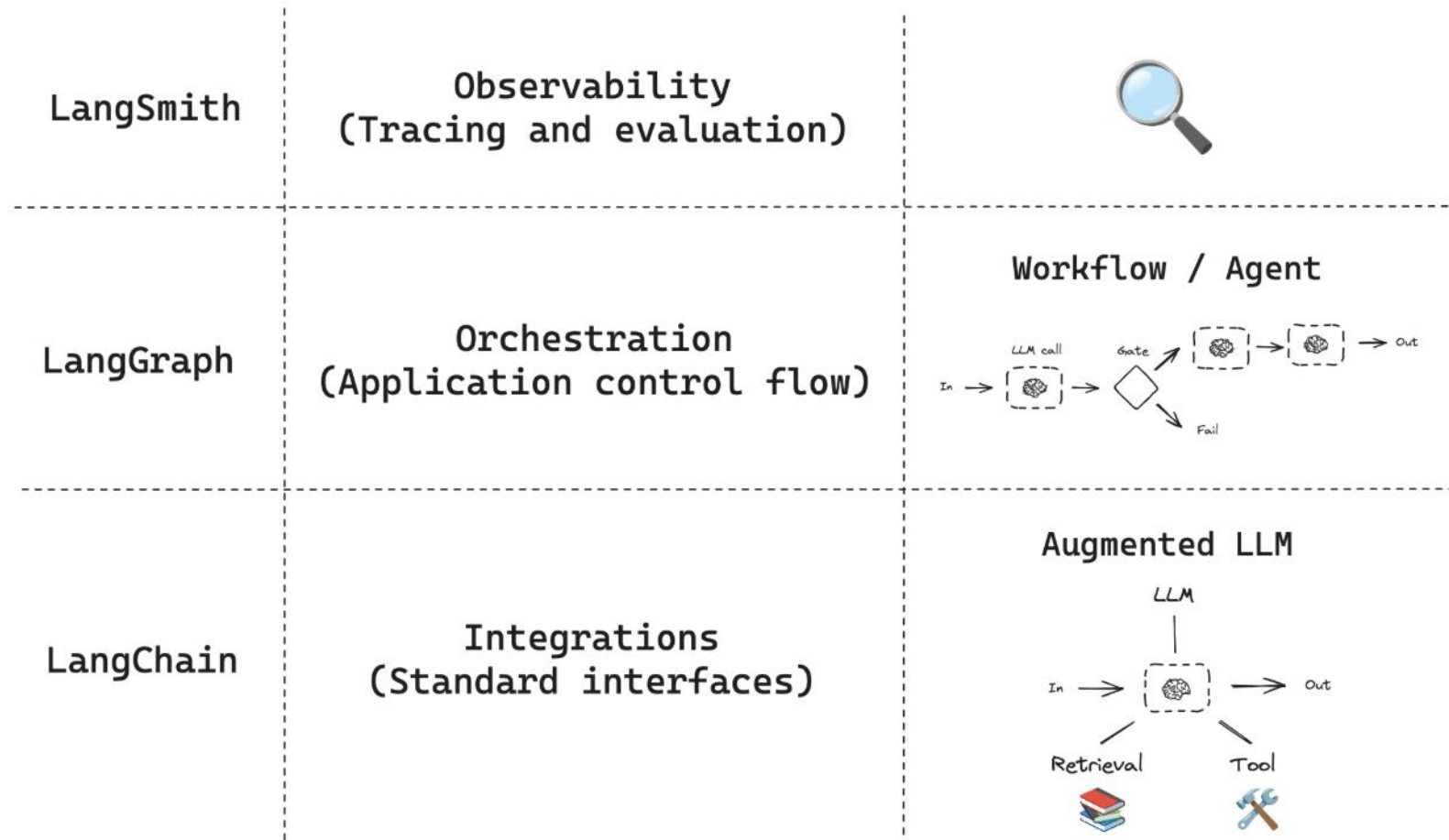
Tip: Start with LangChain for simple flows; move to LangGraph for collaboration/routing/retries/long-lived state.

Node and Edge

LangGraph allows you to define nodes (which can be LangChain runnables or other Python functions) and edges (which define the transitions between nodes).



Ecosystem



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1) Setup for Google Colab

- Requirements for today:
 - **HuggingFace account (for LLMs)**
 - **Personal Google account (for Google Colab)**
- Google Colab:
 - Free tier: usually NVIDIA T4 GPU. it's not the fastest GPU, but it's available for free.
 - Paid subscription (Colab Pro): faster GPUs, more memory, etc.
 - [Google Colab Pro](https://colab.research.google.com/signup) is free for students and teachers! Link: <https://colab.research.google.com/signup>

Link to GitHub
Please Leave a  !



<https://github.com/maryambrij/langchain-langgraph-tutorials.git>

1) Setup for Google Colab

  **Please save a copy before starting to edit the current notebook!** File -> Save a copy in ...

- Running this entire workshop **without paid API keys**.
 - Using models from **HuggingFace**.
- Steps for authenticating with HuggingFace Hub :
 - Create a token in settings: <https://huggingface.co/settings/tokens>
 - Set it as a secret in Google Colab ("🔑" icon, left panel)
 - Name the secret key `HF_TOKEN`
 - Restart the session + select a GPU

1) Setup for Google Colab

- Install:

- ``transformers``
- ``accelerate``
- ``langchain``
- ``langgraph``
- ``langchain-huggingface``
- ``langchain-community``
- ``sentence-transformers``
- ``faiss-cpu``

- Load a small chat model **TinyLlama 1.1B Chat**

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2) Basic Usage

LangChain Expression Language (LCEL)

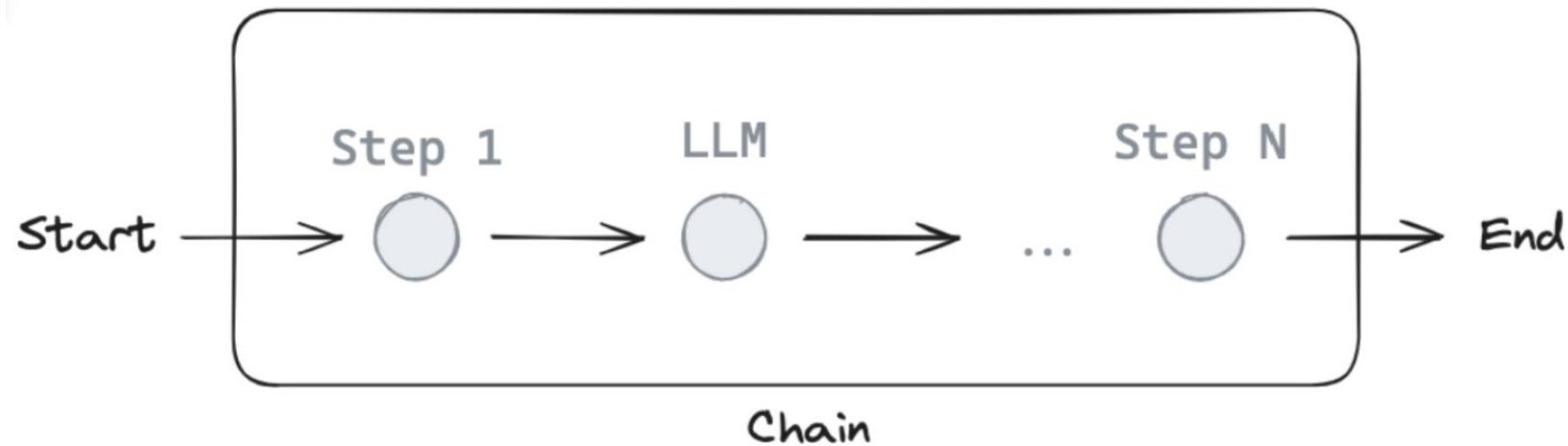
- A declarative way to compose chains.
- Combine various LangChain components, like prompts, models, and output parsers, into complex workflows.
- Build pipelines with features like streaming, async support, and parallel execution.
- Creation of chains by **piping components together using the `|` operator**.

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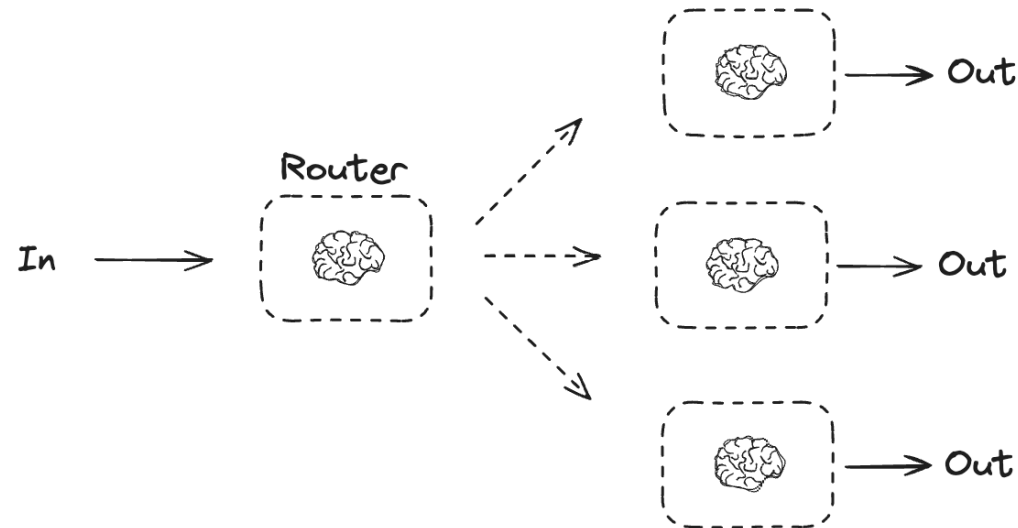
3) Routing vs Chaining

- **Chaining** can be thought of as a linear path:
 - `Step A` (Planner) -> `Step B` (Researcher) -> `Step C` (Writer).
- A fixed sequence of steps

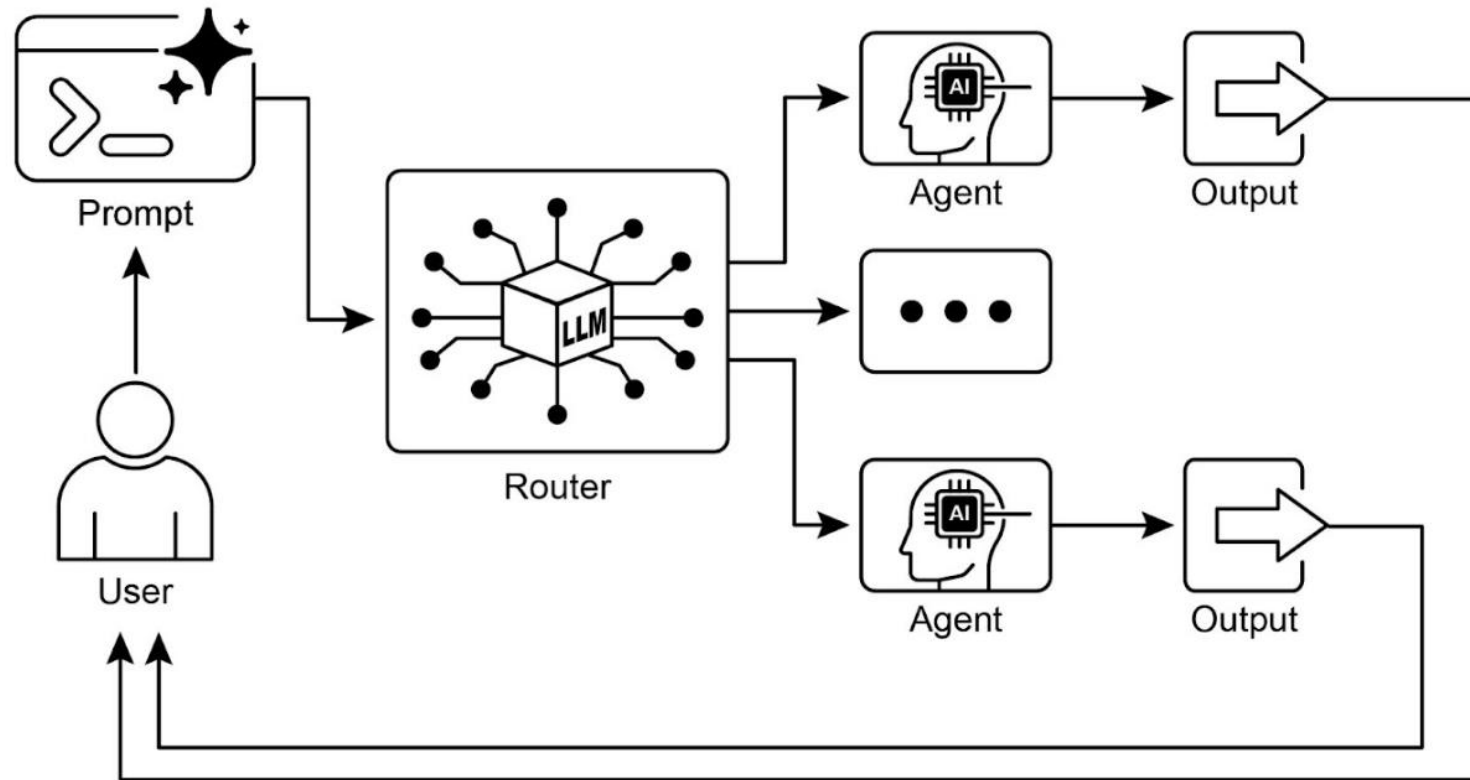


3) Routing vs Chaining

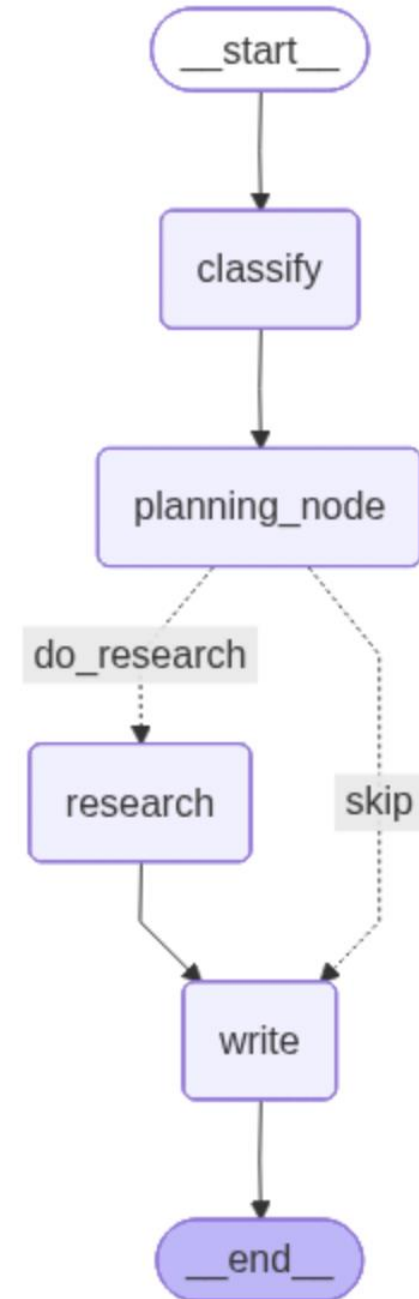
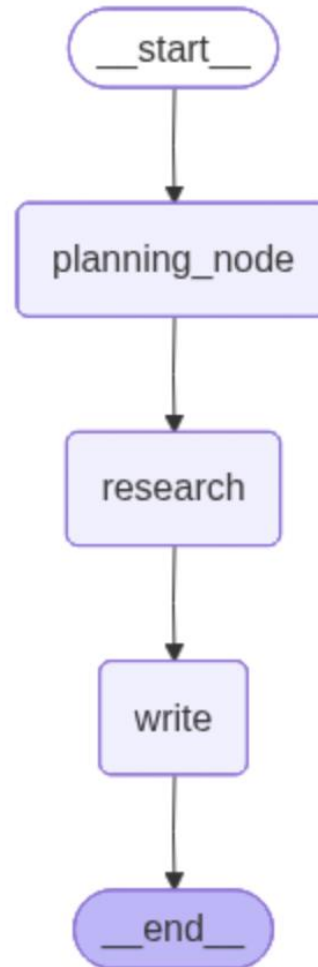
- **Routing:** More complex applications require dynamic workflows where the next step depends on the output of the previous one or on some condition.
 - Workflows with **loops** and **dynamic** paths
- Allows for **conditional** paths:
 - After `Step A` (Planner), based on the result, the workflow might go to `Step B` or `Step C`
- **LangGraph** supports conditional edges and routing logic



LLM as a Router



Example: Research Agent



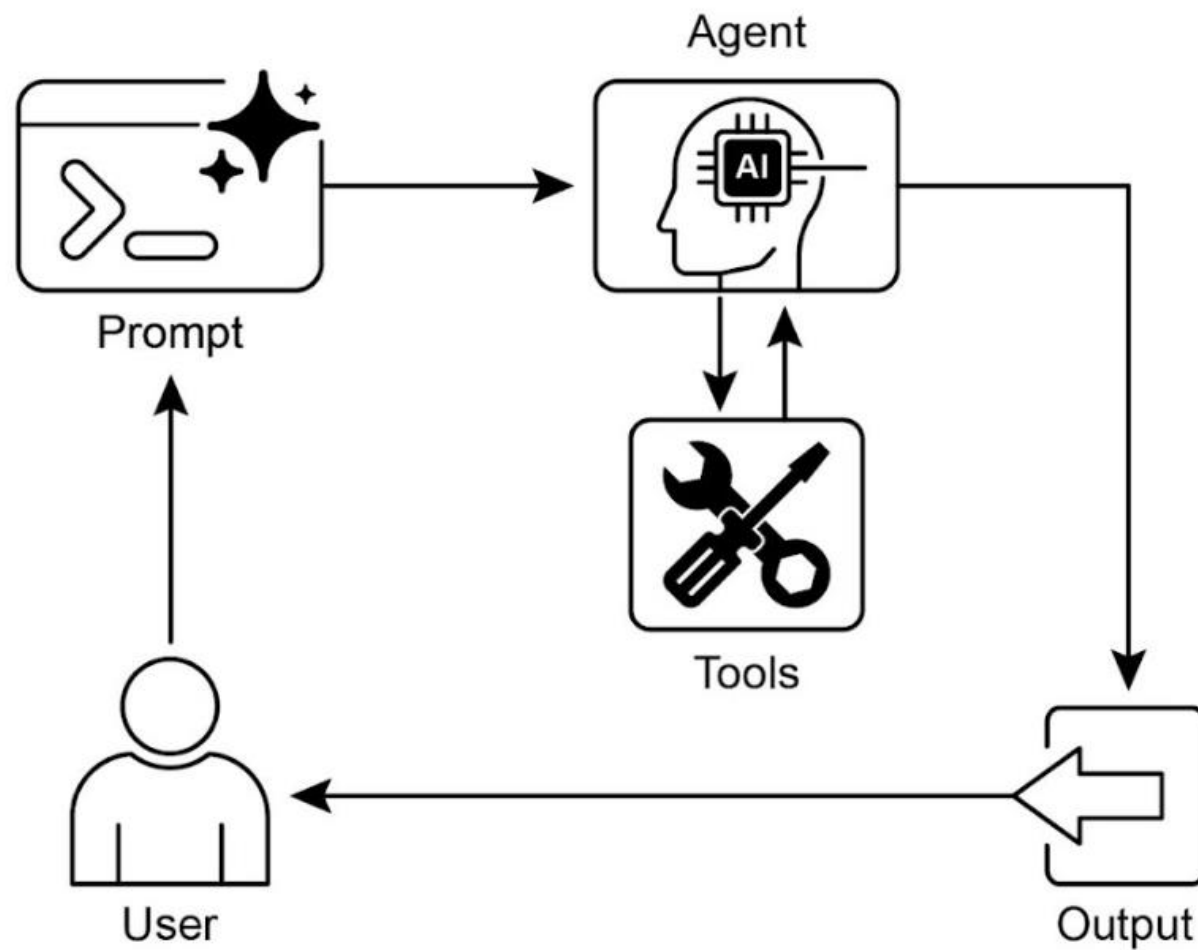
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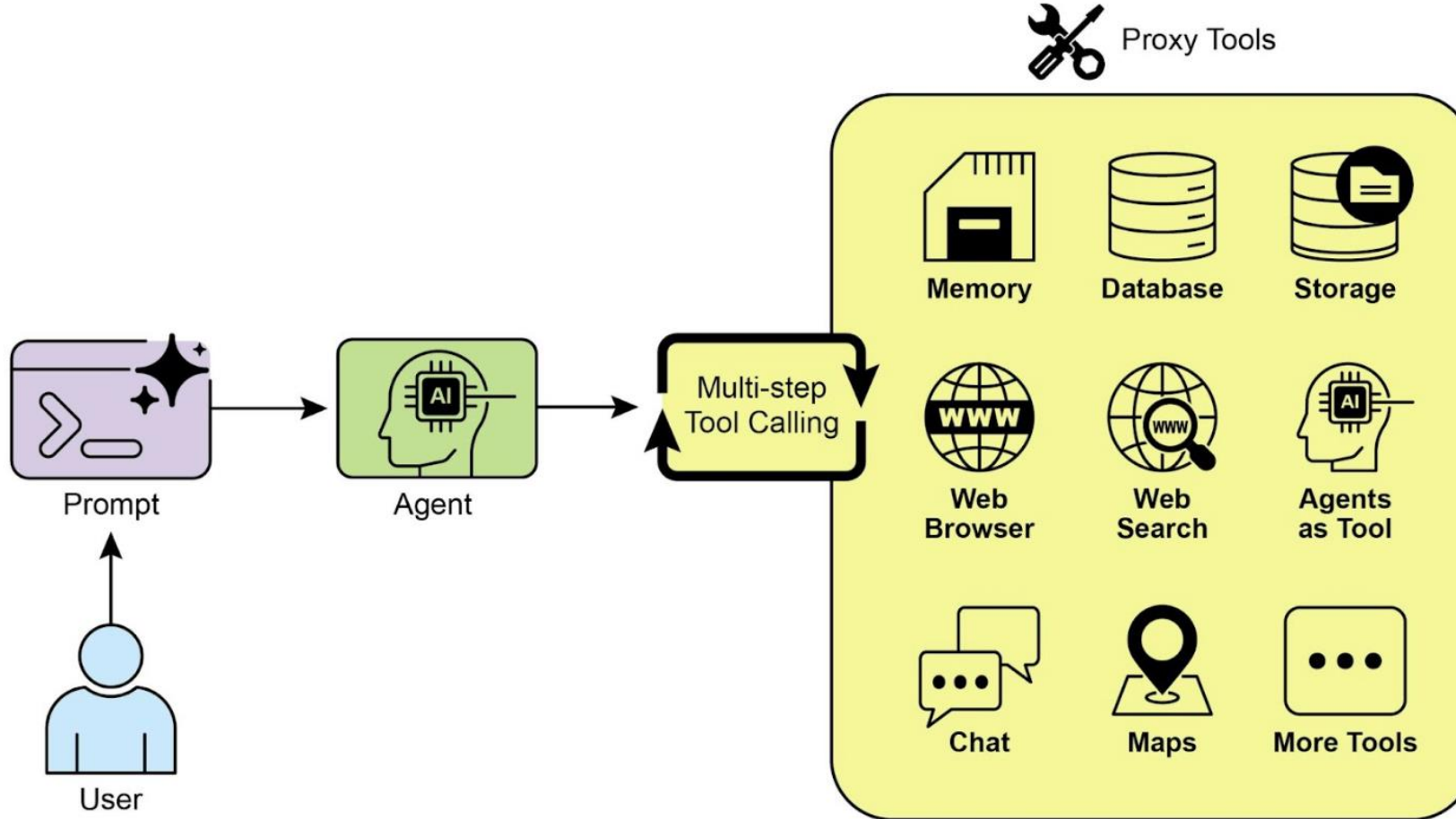
4) Tool Use

- Tools: external functionalities agents can use to extend their capabilities
- Can be anything: from a calculator or a search engine stub to more complex integrations with databases, APIs, or other services.
- Creating tools: can be done using the `@tool` decorator, which transforms Python functions into callable tools.

4) Tool Use



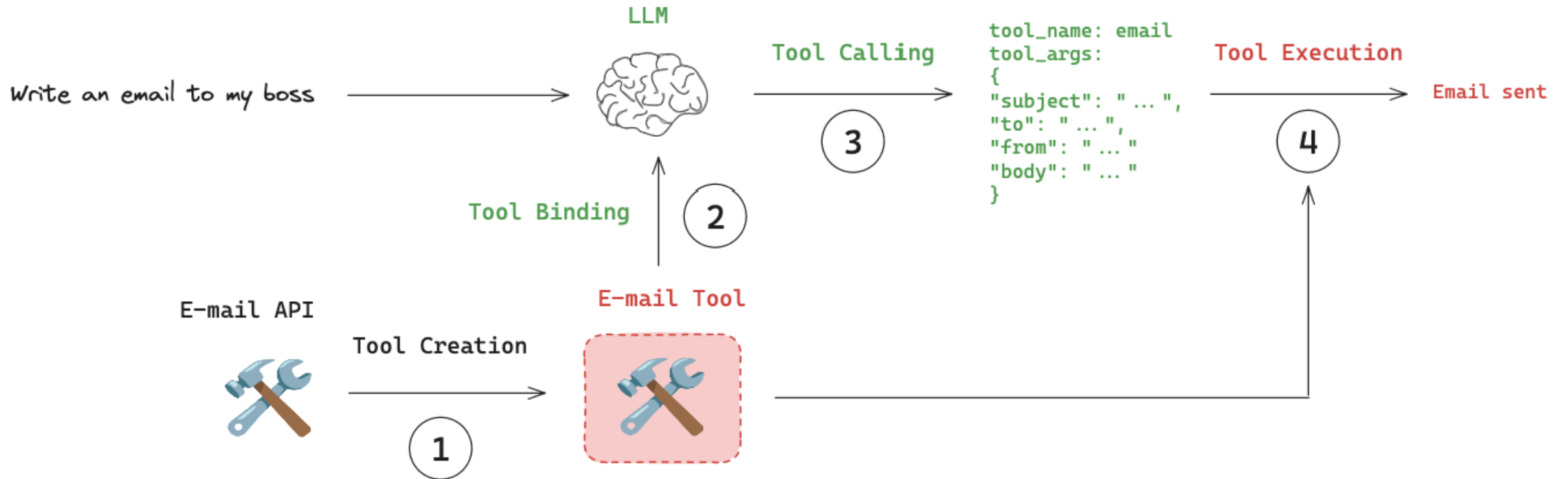
4) Tool Use



4) Tool Use

- LangChain provides a framework for defining and integrating various types of tools
- Agents can decide when and how to use these tools to achieve their goals.
- They automatically infer the tool's name, description, and expected arguments from the function definition.
- [Model Context Protocol \(MCP\) servers](#) can also be used as LangChain-compatible tools.

4) Tool Use



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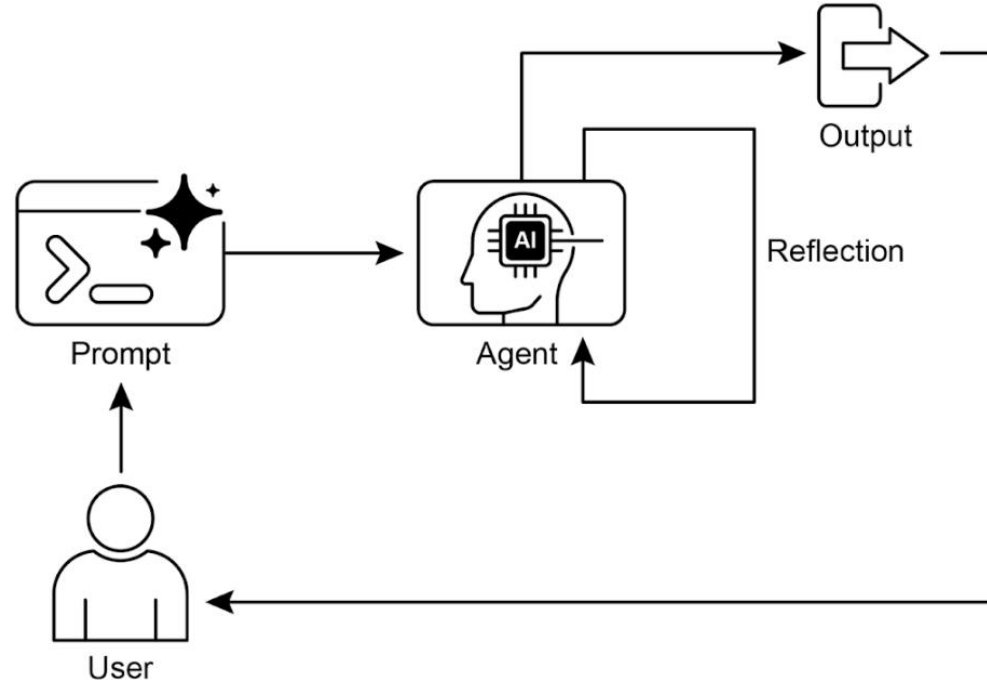
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5) Reflection

- Agents can improve their outputs through reflection, a process where they evaluate and refine their work.
- This allows the agent to iteratively improve its response.

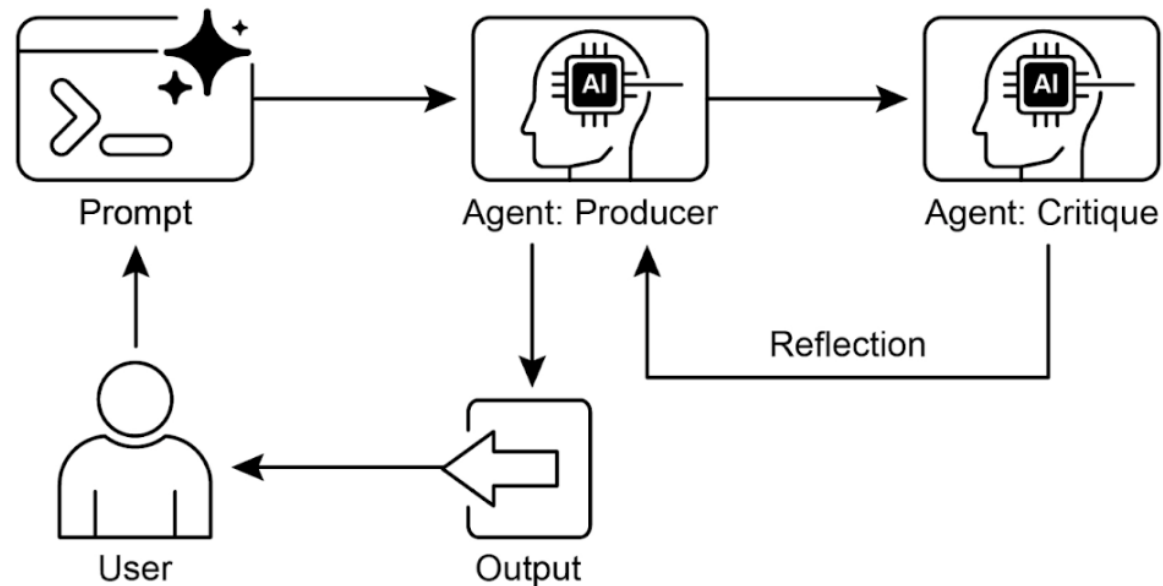
Two main types of reflection:

- **Self-reflection:** agent critiques **its own** generated output.



5) Reflection

- **External reflection:** A *separate agent* or component acts as a critic, providing feedback on the initial draft generated by the primary agent.
- External feedback can offer a different perspective.



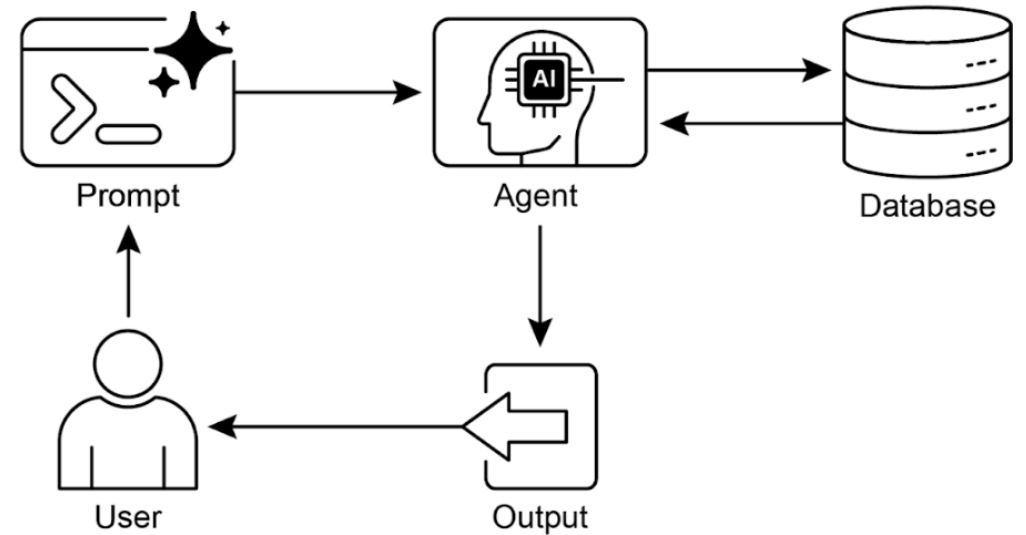
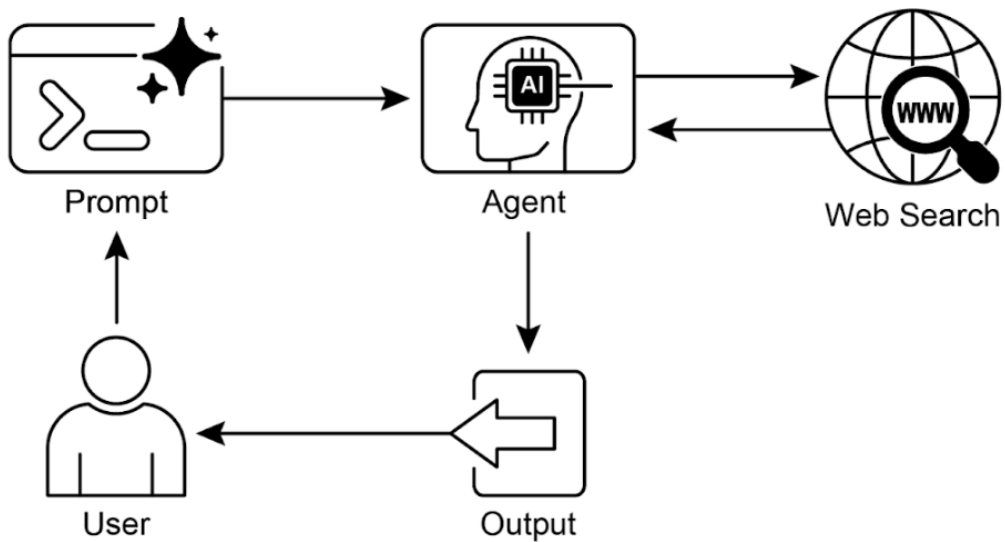
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6) Retrieval-Augmented Generation (RAG)

- A technique that combines the power of LLMs with external knowledge sources to generate more accurate and informed responses.
- Instead of relying solely on the knowledge encoded in the model's parameters during training, RAG systems retrieve relevant information from a separate knowledge base
 - Database
 - Collection of documents
 - Internet
- Use this retrieved information as context when generating an answer.
- Reduce the likelihood of:
 - Hallucination
 - Providing outdated information

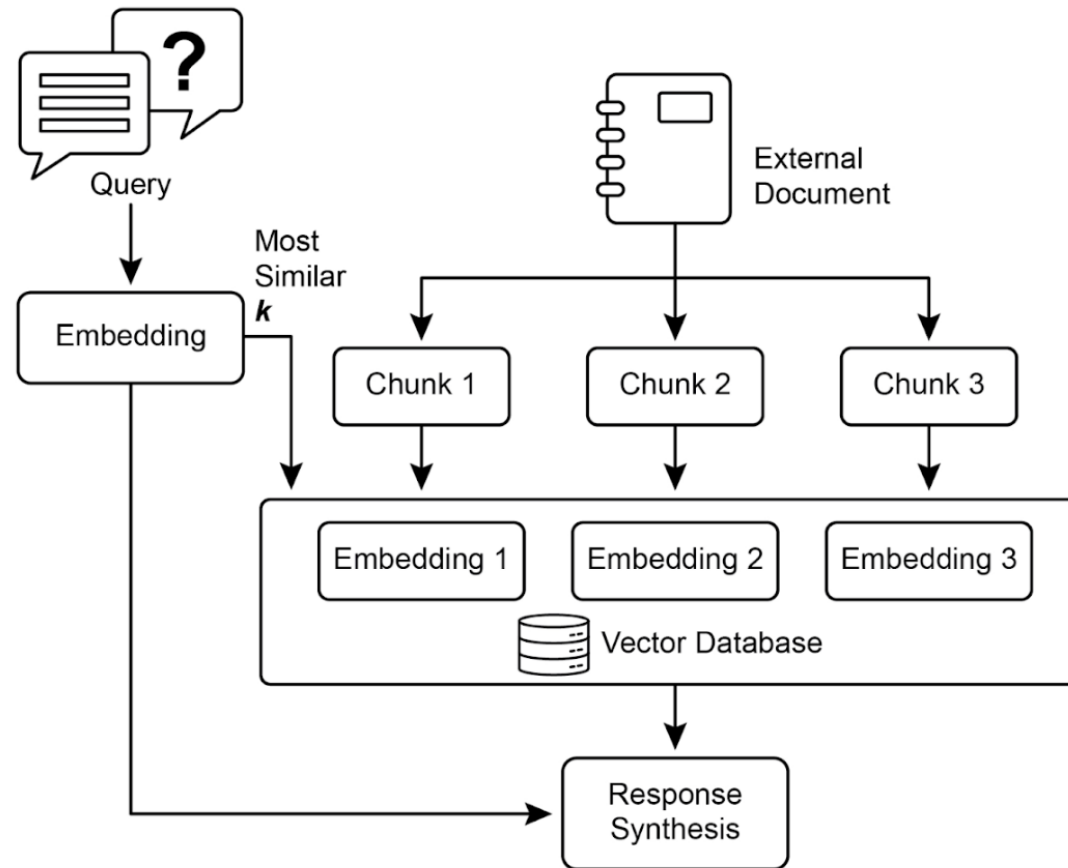
6) Retrieval-Augmented Generation (RAG)



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RAG Core Concepts:

- Chunking
- Embeddings
- Vector database



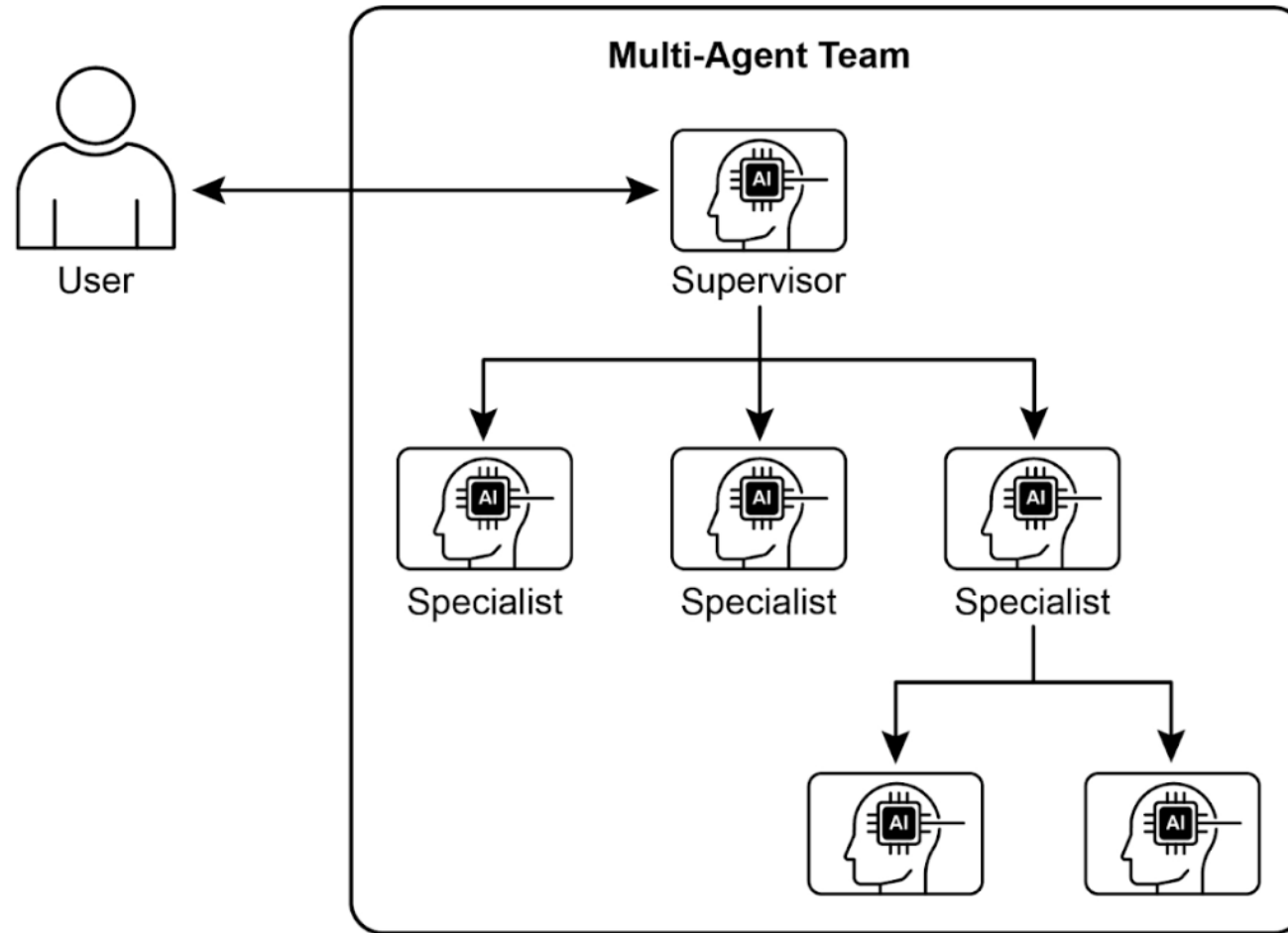
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7) Multi-Agent Collaboration

- Multiple independent or semi-independent agents work together to achieve a common goal.
- Interaction and synergy between agents.
- Each agent has a defined role, specific goals, and access to different tools or knowledge bases.

7) Multi-Agent Collaboration



7) Multi-Agent Collaboration

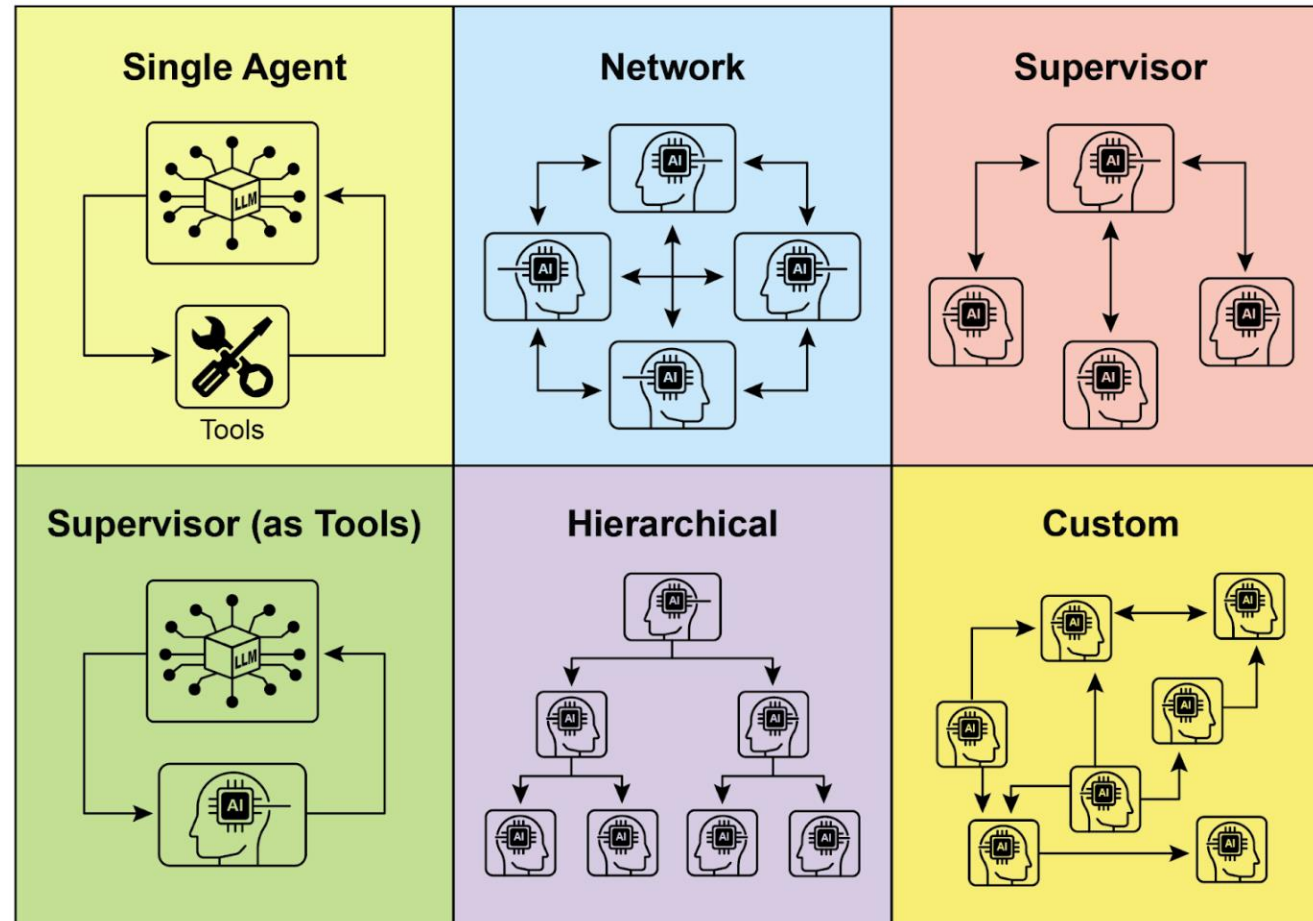


Fig. 2: Agents communicate and interact in various ways.

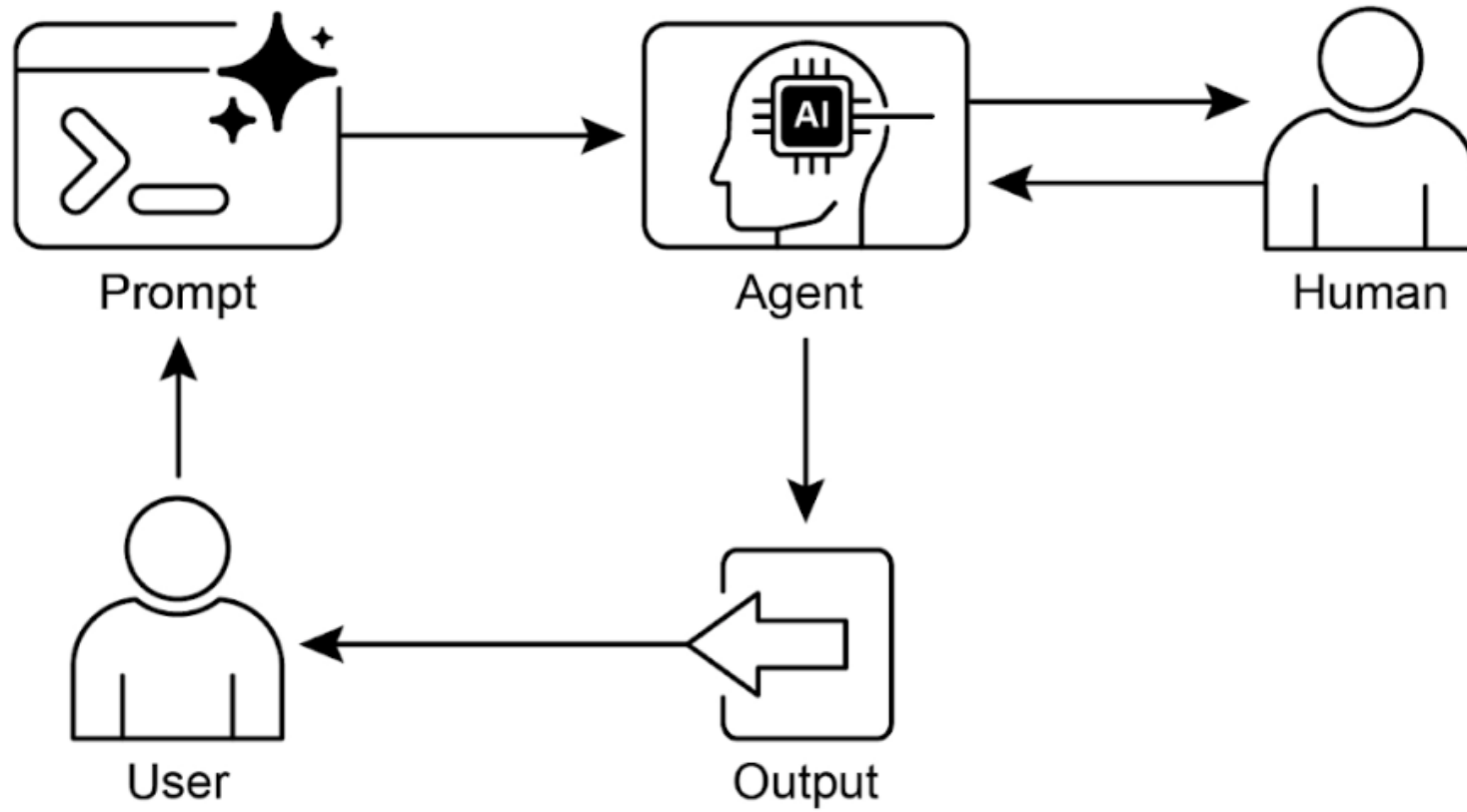
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8) Human in the Loop

- Integrates AI with human input to enhance agent capabilities.
- Optimal AI performance frequently requires human insight
 - In scenarios with high complexity or ethical considerations.
- Lack of scalability, operators cannot manage millions of tasks
- Requires a hybrid approach combining automation for scale and HITL for accuracy.
- The effectiveness is heavily dependent on the expertise of the human operators.

8) Human in the Loop



References


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3. [LangGraph Cookbook](#)
4. [LangChain Tutorials](#)
5. [Interrupt](#) – the AI Agent Conference by LangChain
6. [Prof. Ghassemi Lectures and Tutorials](#), AI Agents lectures

Thank you for your attention!

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[https://github.com/maryambrij/
langchain-langgraph-
tutorials.git](https://github.com/maryambrij/langchain-langgraph-tutorials.git)

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