

WEEK 2 / DAY 9

Multi-Agent Systems



By,

Shikha Tyagi

Founder - AI JAMIC (AI Research and Consulting)

Education: IIT Delhi (M.Tech.)

Today's Agenda

Part 1: The Multi-Agent Thesis

Why one agent isn't enough.

Part 2: CrewAI Fundamentals

Roles, Tasks, and Crews.

Part 3: Orchestration

How agents talk to each other.

Part 4: Hands-On Lab

Building a Newsletter Writing Crew.

Break:

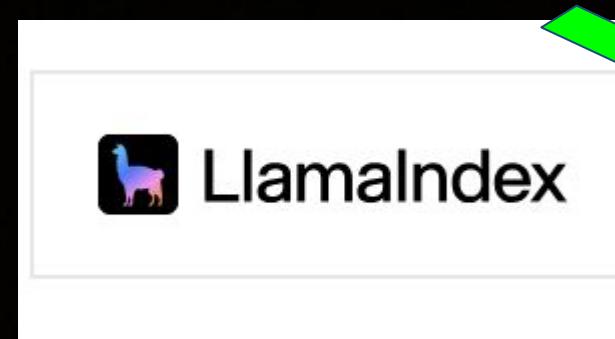
15 min break around 10:30AM

Week 2 - Working with Frameworks

Day 6 & Day 7



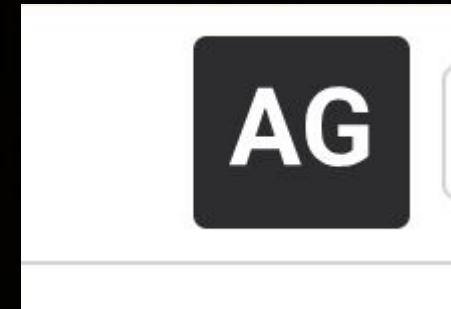
Day 8



Day 9



Day 10



Quiz

Which scenario would be a better fit for LangChain compared to LlamaIndex?

- A. You want to connect API tools, SQL queries, and reasoning in a sequence
- B. You only need to load documents and embed them
- C. Your dataset contains only PDFs and you only need retrieval
- D. You don't need tool execution logic

Quiz

Which LlamalIndex component is typically responsible for storing and retrieving document chunks?

- A. QueryRouter
- B. VectorStoreIndex
- C. MemoryNode
- D. PromptTemplate

Quiz

HyDE is associated with?

- A. Reranking
- B. Query transformation

Quiz

Which is faster?

- A. Bi-encoder
- B. Cross encoder

Quiz

Which technique has higher precision?

- A. Bi-encoder
- B. Cross encoder

Is Single Agent Enough?

Till now we built single agents trying to do everything:

Context Limit

One prompt can't hold all the rules for Research, Writing, AND Coding.

Confusion

Asking one LLM to be a "Creative Writer" and a "Strict Auditor" simultaneously confuses it.

Bottleneck

Sequential processing slows down complex workflows.

The Solution: Specialization

Instead of one "Super Agent", we create a **Crew** of specialized agents.

- **Agent A:** Researcher (Good at search, dry personality).
- **Agent B:** Writer (Good at prose, creative personality).
- **Agent C:** Editor (Good at critique, strict personality).



CrewAI

CrewAI is a framework designed to orchestrate role-playing autonomous AI agents.

<https://docs.crewai.com/en/introduction>



Role-Playing

Agents adopt specific personas (Backstories).



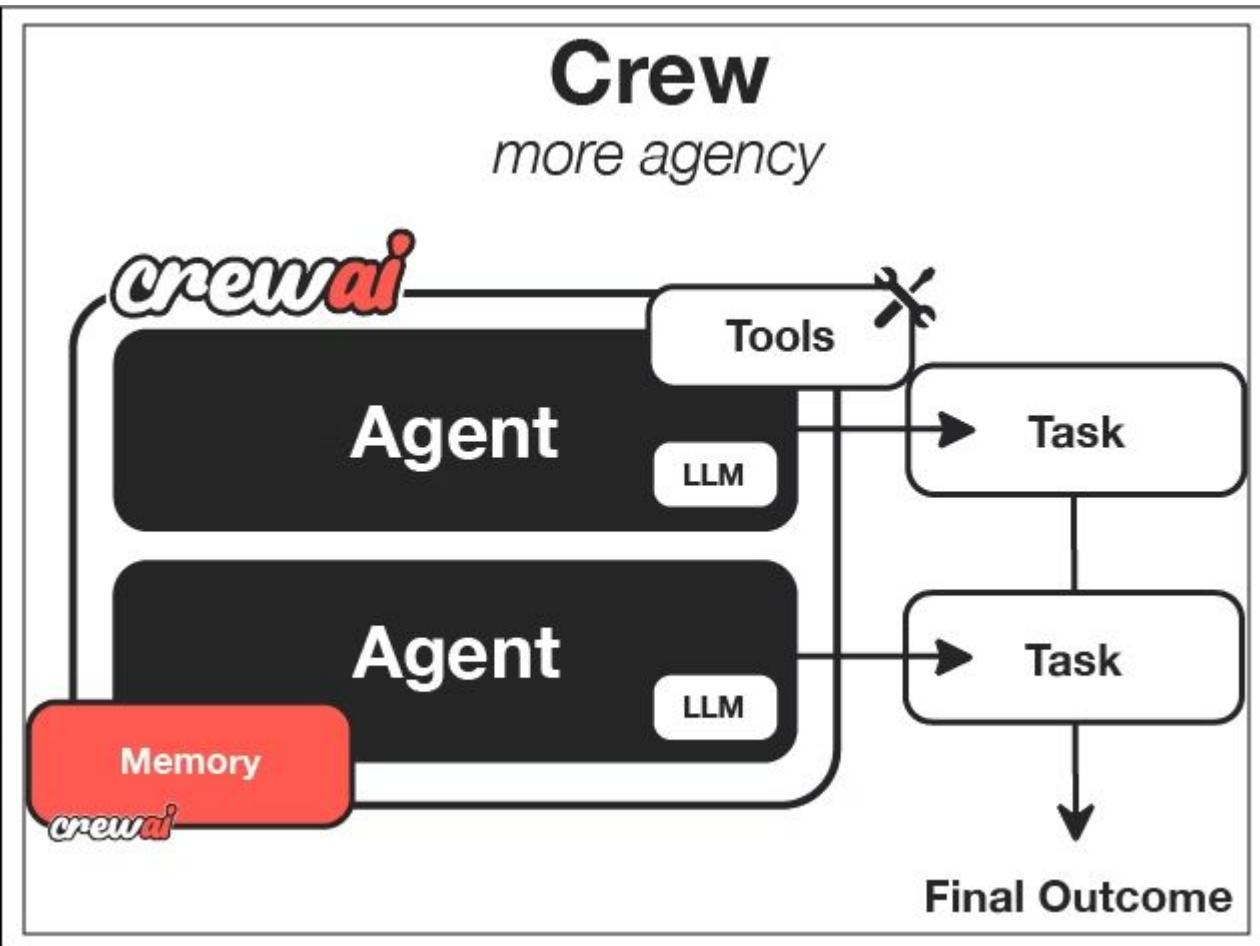
Collaboration

Agents can delegate tasks and share outputs.



Tool Integration

Compatible with LangChain tools.



Taken from : <https://docs.crewai.com/en/introduction>

1. The Agent

<https://docs.crewai.com/en/concepts/agents>

An Agent in CrewAI is primarily defined by three things:

- **Role:** Job Title (e.g., "Senior Researcher").
- **Goal:** What they want to achieve.
- **Backstory:** Context that gives them personality and constraints.

Quick Check

What is System Prompt?

The Power of Backstory

The backstory acts as a **System Prompt** that persists throughout the task.

Without Backstory

"Here is the data about AI trends."

With Backstory

"As a skeptic, I found these AI trends, but I must warn you that the data is preliminary..."

In CrewAI, what is the primary purpose of the "Backstory"?

- A. To compress the history of the chat.
- B. To give the agent context, personality, and constraints.
- C. To define the list of tools available.
- D. To store the API keys.

Examples

<https://docs.crewai.com/en/concepts/agents>

2. The Task

A **Task** is a specific assignment given to an Agent.

- **Description:** Clear instructions.
- **Expected Output:** What the result should look like.
- **Agent:** Who is responsible.

| Task Execute in sequence they are defined



Output of one task can be accessed by another via
“context” parameter

Examples

<https://docs.crewai.com/en/concepts/tasks>

3. The Tool

Agents need tools to interact with the world.

CrewAI works natively with **LangChain Tools**.

You can assign specific tools to specific agents (e.g., only the Researcher gets `GoogleSearch`, only the Coder gets `PythonREPL`).

4. The Process

How does the Crew execute tasks?

Sequential (Default)

Task A -> Task B -> Task C.

Like a waterfall model. Good for clear pipelines.

Hierarchical

A "Manager" agent decides who does what and reviews the work.

Requires a more powerful LLM (GPT-4) as the manager.

5. The Crew

The container that binds Agents and Tasks together.

```
from crewai import Crew, Process
crew = Crew( agents=[researcher, writer], tasks=[task1, task2],
process=ProcessSEQUENTIAL )
result = crew.kickoff()
```

Why might you choose a "Hierarchical" process over "Sequential"?

- A. It is faster.
- B. It requires less tokens.
- C. It allows a Manager to delegate tasks dynamically based on complexity.
- D. It works without an API key.

Examples

<https://docs.crewai.com/en/concepts/crews>

Feature	LangChain	LlamaIndex	CrewAI
Core Purpose	Build full AI workflows using chains, tools, agents	Focus on data integration, retrieval, and indexing	Build multi-agent teams that collaborate autonomously
Main Strength	Modular workflows and tools; industry-standard	Very strong document ingestion + RAG	Crew-style multi-agent collaboration and decision-making
RAG Support	Yes	Best in class	Yes, via agent tools
Agents Support	Yes (very flexible)	Basic integration	Designed for agents-team execution
Learning Curve	Medium–High	Low	Medium
Best Use-Cases	Tools chaining, functional pipelines	RAG over PDFs, DBs, APIs	Autonomous multi-agent apps
Pipes/Flows	Chains/Runnables	Query Engines/Graphs	Tasks and Roles
Typical Output	Tool execution pipelines	Query responses over custom knowledge	Multi-role task delegation execution

When to Choose Which?

Pick **LangChain** if you want

- ◆ Integrations + Tools
- ◆ Custom workflows
- ◆ Agents + structured pipelines

Pick **Llamaindex** if you want

- ◆ Conversational retrieval
- ◆ Querying structured/unstructured docs
- ◆ Simplicity

Pick **CrewAI** if you want

- ◆ Multiple agents working together
- ◆ Agents that collaborate, delegate, review
- ◆ Autonomous pipelines

Hands-On Lab

Capstone



From learning to implementation

| Track 1: E-Commerce Agent



The "Personal
Shopper"

Retail & Customer Support

Goal: Build an agent that helps users find products and track orders.

- **RAG:** Index a product catalog (PDF/CSV) to answer "What is your return policy?"

*"User: What is your contact number?"
"Agent: +136571352"*

Track 2: Academic Assistant



The "Research
Companion"

Education & EdTech

Goal: An intelligent study buddy that quizzes you on textbooks.

- **RAG:** Index a specific textbook chapter or research paper.

"User: What is photosynthesis."

"Agent: Sure! photosynthesis is"

Track 3: Legal Analyzer



The "Risk Spotter" Legal & Compliance

Goal: An agent that reviews contracts and highlights risky clauses.

- **RAG:** Index standard NDAs or Employment Contracts.

"User: Check this NDA for non-compete"

"Agent: Warning: The 'Non-Compete' duration of 5 years is unusually long."

Day 9 Summary

- **CrewAI** provides the structure for Multi-Agent Systems.
- **Roles & Backstories** act as powerful system prompts.
- **Sequential Process** allows for predictable pipelines (Research -> Write).
- This approach solves the context and complexity limits of single agents.

Looking Ahead: Day 10

Microsoft AutoGen