

WEEK 2 / DAY 9

Multi-Agent Systems



By,

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| 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:

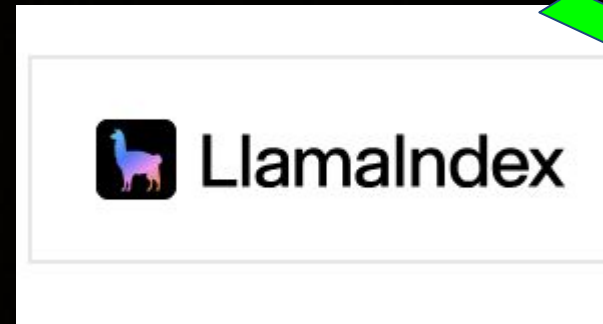
15 min break around 10:30AM

Week 2 - Working with Frameworks

Day 6 & Day 7



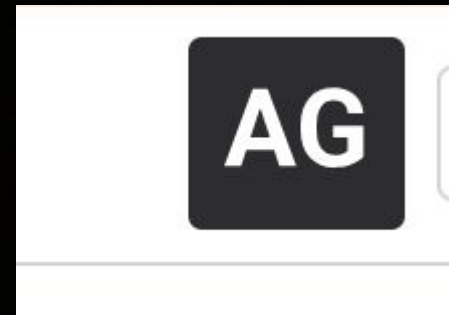
Day 8



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

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



Role-Playing

Agents adopt specific personas (Backstories).



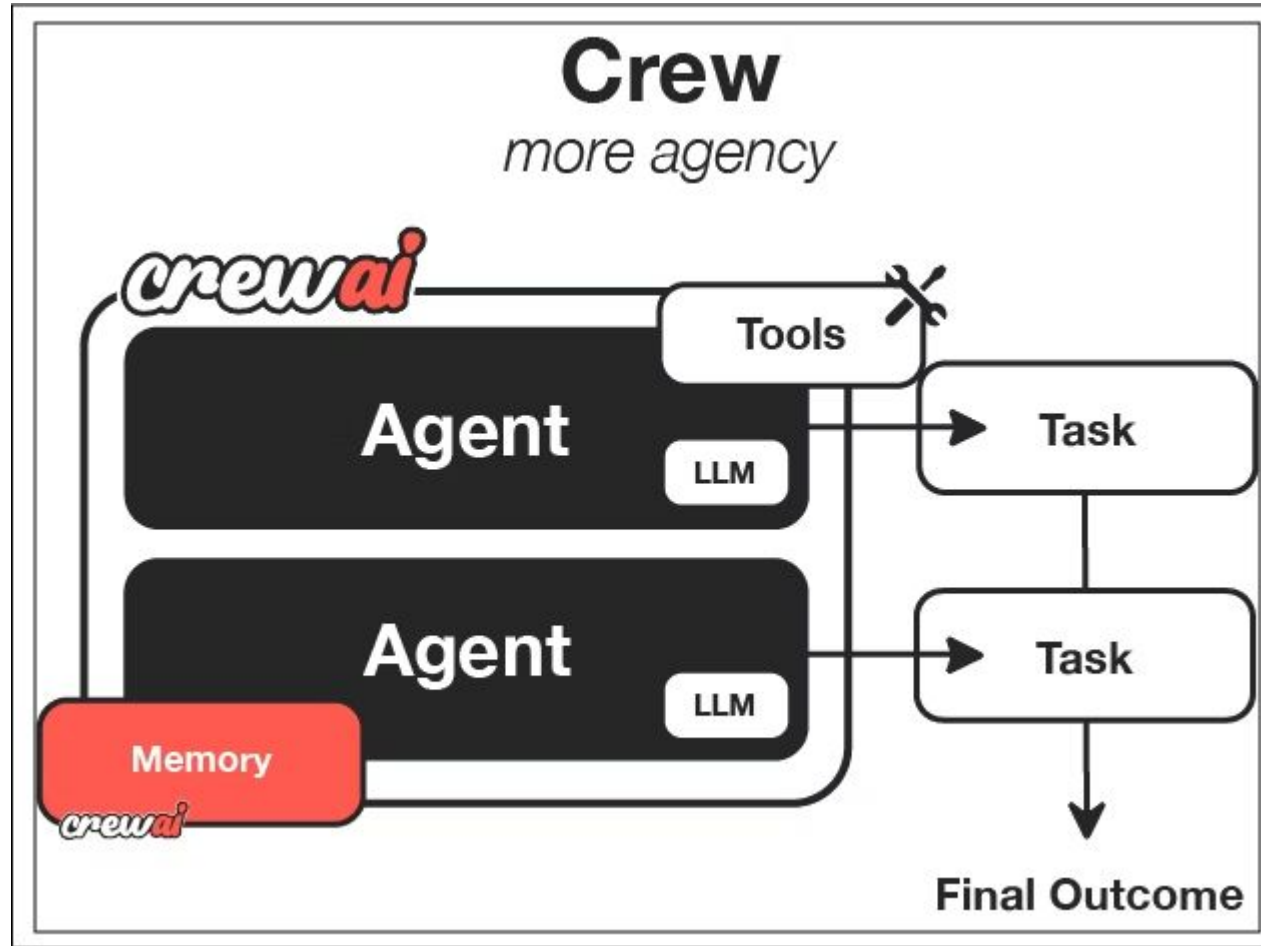
Collaboration

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=Process.sequential )
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>

LangChain		LlamaIndex	
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



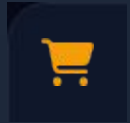
Hands-On Lab

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

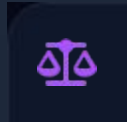
Goal: An intelligent study buddy that quizzes you on textbooks.

- **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