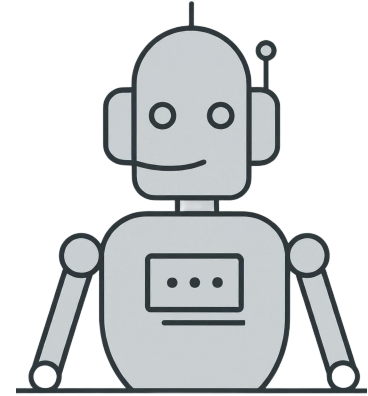# Multi-Agent Collaboration

AI = Intelligent computer programs that can perceive, reason, learn, and act in complex environments (Russell & Norvig, 2022)

Agenda

In this session, we will discuss:

- Overview of Collaborative Agent Frameworks

- Task-oriented Framework: `Crew`
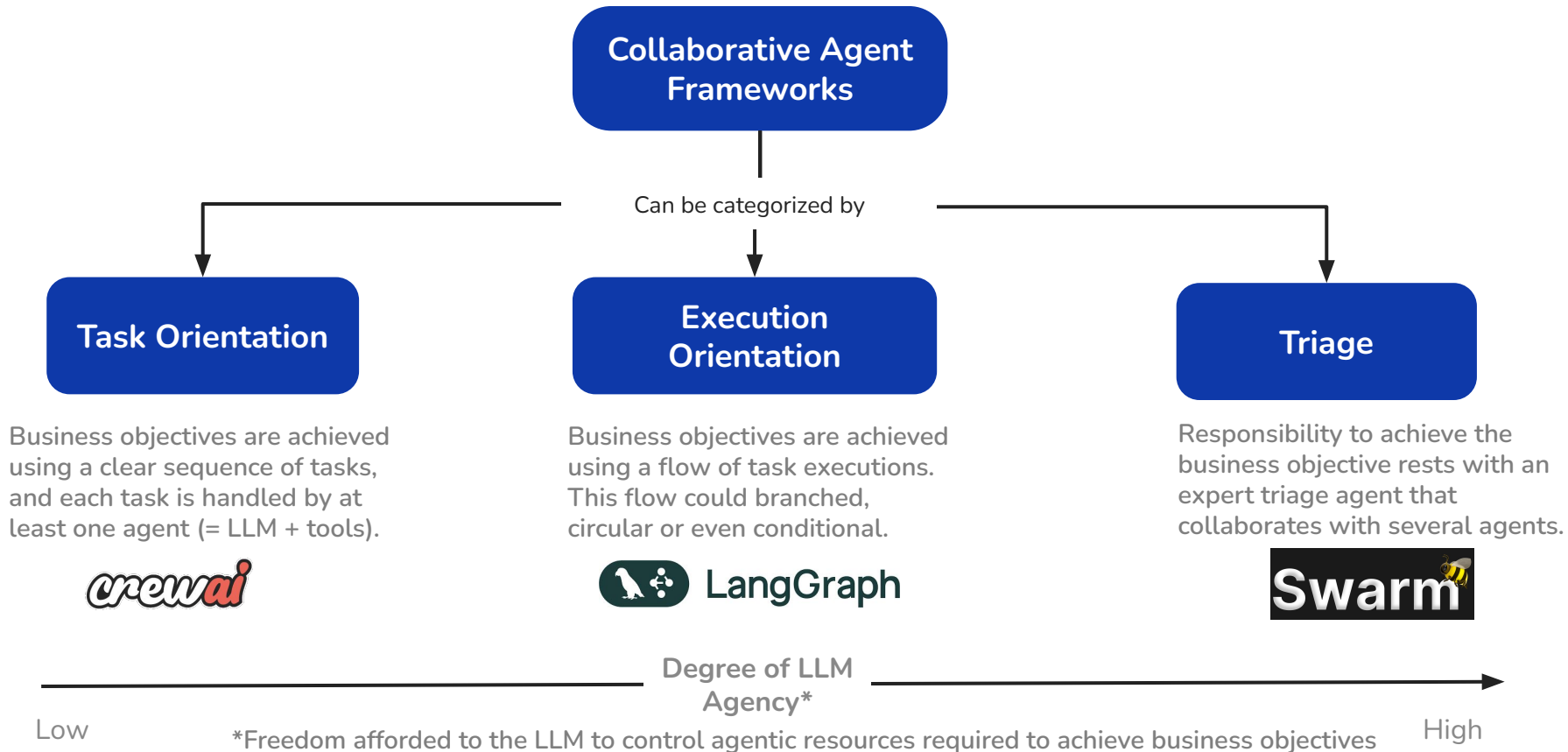
- Graph-based: `LangGraph`

- Triage Framework: `Swarm`

Multi-Agent Collaboration

Collaborative Agent Frameworks

Can be categorized by

Task Orientation

Execution Orientation

Triage

Business objectives are achieved using a clear sequence of tasks, and each task is handled by at least one agent (= LLM + tools).

Business objectives are achieved using a flow of task executions. This flow could branched, circular or even conditional.

Responsibility to achieve the business objective rests with an expert triage agent that collaborates with several agents.

crewai

LangGraph

Swarm

Degree of LLM Agency*

Low

*Freedom afforded to the LLM to control agentic resources required to achieve business objectives

High

Multi-Agent Collaboration

Note:

So far, we have seen one agent formulating a detailed plan involving tool calls to achieve a business objective. However, an even more profitable direction, especially when the objectives are complex is to use multiple specialized agents in a collaborative manner. The key here is to decide how the collaboration could be designed. On one end, there is a pure task orientation where the solution to the business objective is broken down into a defined sequence of tasks and each task is executed by an agent with access to one or more tools. This is the crew of agents approach. When the solution is more of a set of task executions that are not necessarily sequential or might be repetitive, then defining the execution as a graph would be a more beneficial approach. Finally, when the collaboration is hierarchical where a supervisor agent plans a solution and delegates the execution to multiple agents (i.e., there is a clear hierarchy) the triage approach works better. All these frameworks though are still in active development and show serious promise. Crew of agents as implemented by Crew AI is particularly popular due to its simplicity. LangGraph allows the composition of arbitrary execution graphs and can potentially handle any situation but at the cost of the technical burden imposed by the graph orientation.
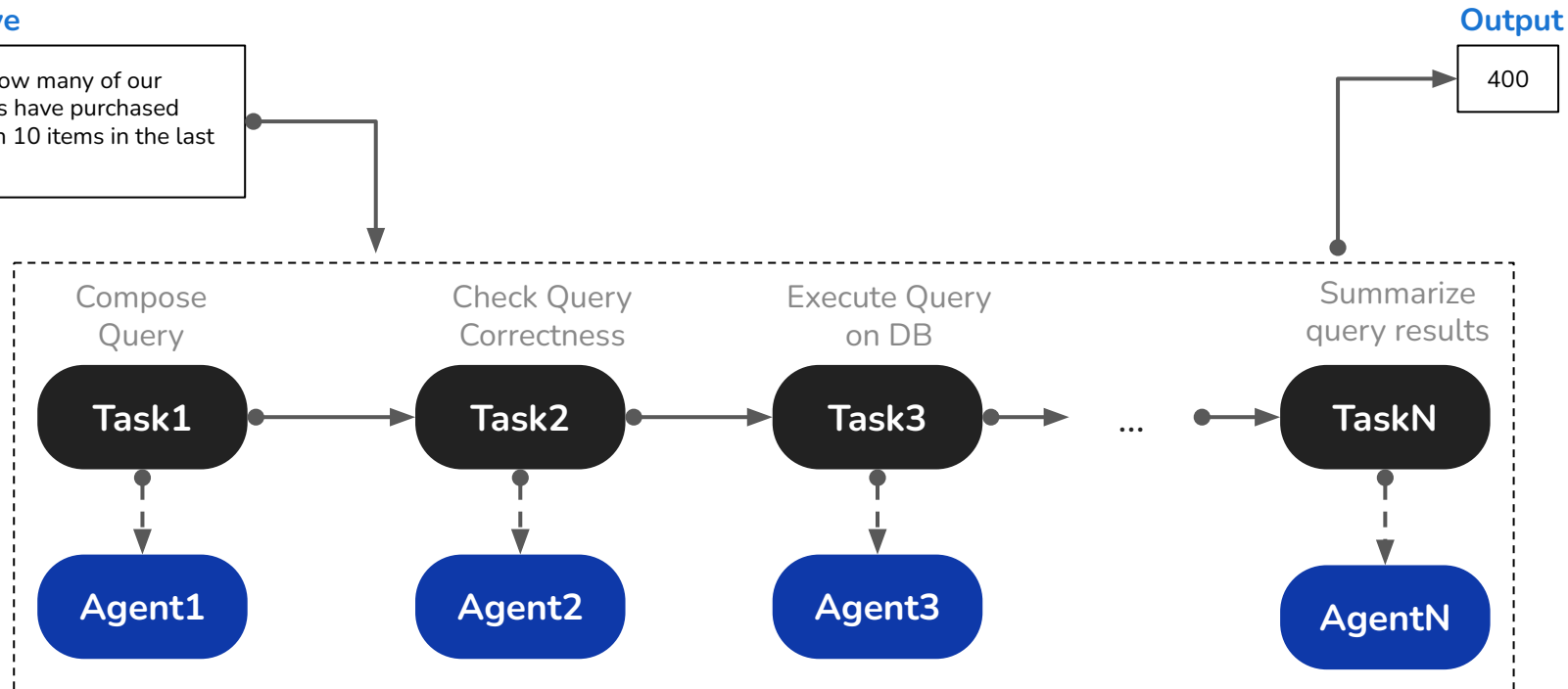
Task-Oriented Collaboration

Crew of Agents

Sequence of tasks to be followed is fixed during crew creation. Each task is handled by at least one agent. Output of one task acts as context for the next task execution.

Objective

Identify how many of our customers have purchased more than 10 items in the last one week

Output

400

Compose Query — **Task1** — Agent1

Check Query Correctness — **Task2** — Agent2

Execute Query on DB — **Task3** — Agent3

... Summarize query results — **TaskN** — AgentN

Task-Oriented Collaboration

- Crew of agents allows for a clear role-defined breakdown for complex tasks. This approach maps directly to many business processes
- This is extensible to a hierarchical execution, where one agent (manager LLM) is tasked with assigning the sequence of tasks (based on its judgement).
- This framework works best for complex, research-oriented tasks
- This approach burns through many more tokens due to planning and execution of each task.

Create a crew of agents to score leads received by a business

Collaboration as Graph Traversal

Objectives are Mapped to Execution Tasks

Each node in the computational graph are functions that encode the logic of the agent. A shared state is maintained for the entire graph and updated by each node. Edges between nodes are also functions that determine which node should be executed next.

Objective

Identify how many of our customers have purchased more than 10 items in the last one week

Output

400

Generate

Query Database

Main Function

Node1 → Node2 → Node3

Rewrite

Node4

... → NodeK
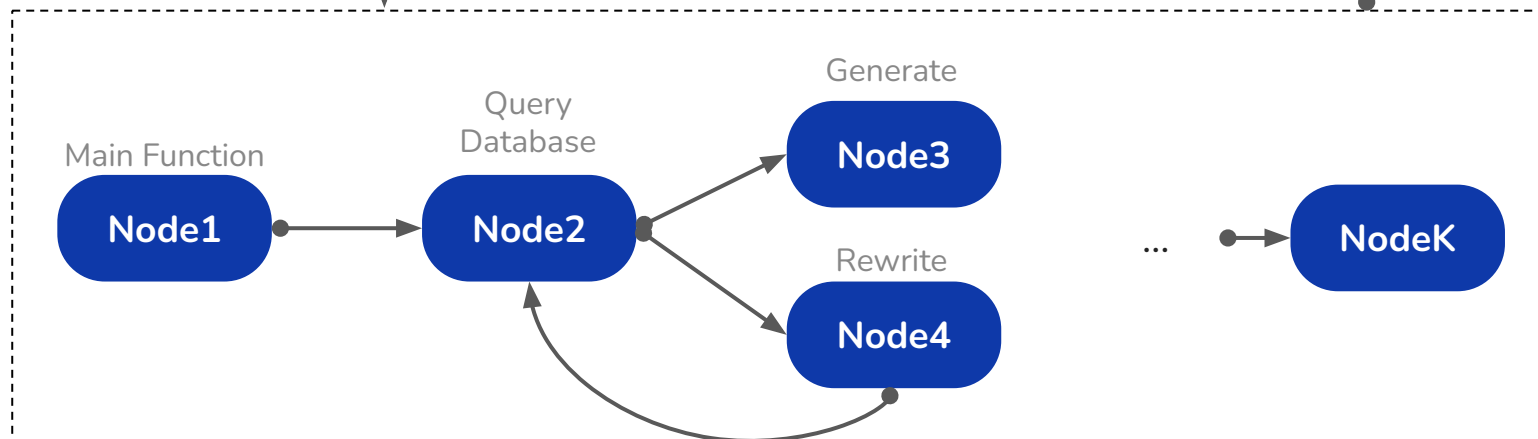
Graph-Oriented Collaboration

- Complex execution flows can be defined and executed as graphs.
- Conditional execution allows for logical branches to be built into the execution logic.
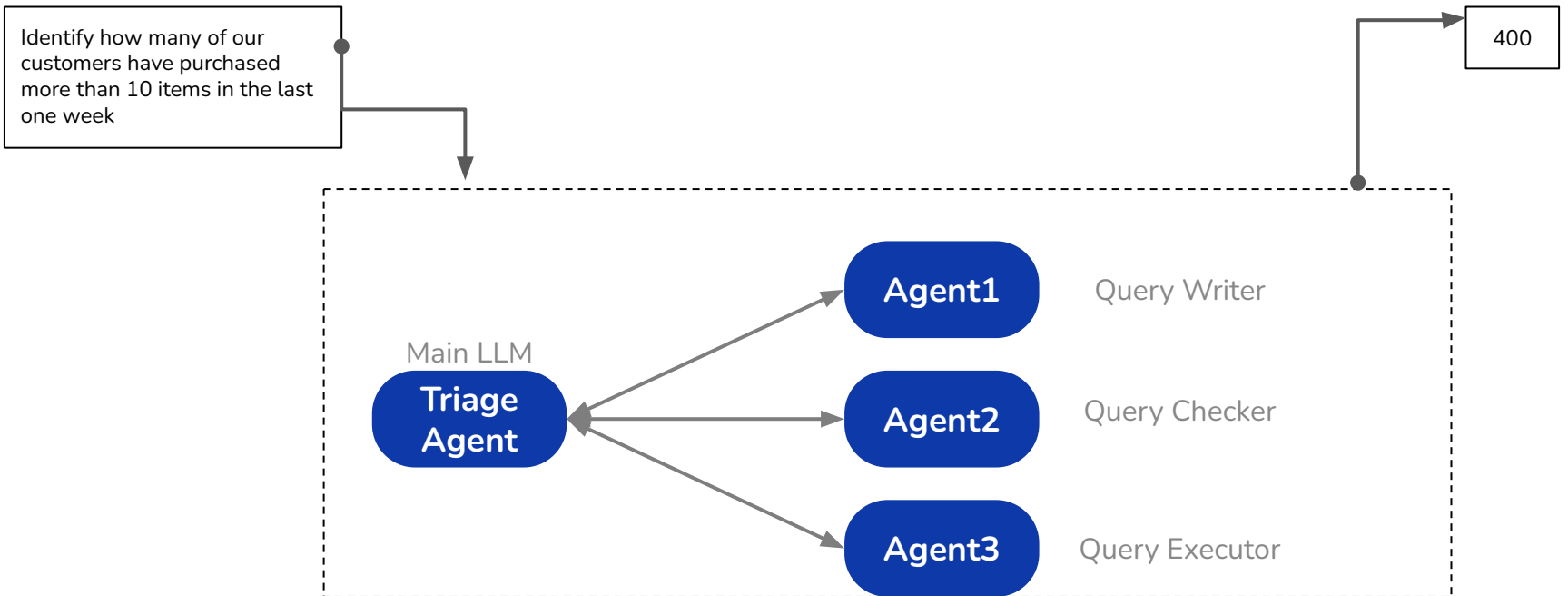- For several business processes, tasks are linear and the graph data structure is redundant

Create an agentic RAG application to answer questions

Triage-Driven Collaboration

Objectives are Mapped to Execution Tasks

A triage agent decided which agent should be invoked and in what order to achieve the business objective. Agents execute routines and handoff results to the triage agent.

Objective

Identify how many of our customers have purchased more than 10 items in the last one week

Output

400

Main LLM

Triage Agent

Agent1 — Query Writer

Agent2 — Query Checker

Agent3 — Query Executor

Triage-Driven Collaboration

- Complex execution flows can be defined and executed as graphs.
- Conditional execution allows for logical branches to be built into the execution logic.
- For several business processes, tasks are linear and the graph data structure is redundant

Create an airline booking and reservation management system

Thank You