

Coordination of a Multi-Agent System for Emergency Response

Team 05

January 12, 2025

Overview

- Task 1 focused on environment and agent design
- Task 2 explored coordination mechanisms
- Now, we integrate these into a practical implementation
- Implementation utilizes **CrewAI** and **Ollama**
- In this presentation, we will cover:
 - Agents and their tasks
 - Crews module and data models
 - Database and tools
 - Scripts
 - Testing
 - Integration in `main.py` and `data/` folder

Agents and Tasks

- For each crew, we define agents and tasks using `.yaml` files.
- Each crew is represented as a Python class, with agents and tasks defined as methods within the class.
- Agents are instantiated with configuration settings, and tasks are created by linking them with specific tools and data models.

medical_services/agents.yaml

```
hospital_coordinator:
  role: Hospital Coordinator
  goal: >
    ...
  backstory: >
    ...
  allow_delegation: false
  verbose: true
  llm: ollama/llama3.1
  temperature: 0.4
  max_tokens: 800
```

medical_services/tasks.yaml

```
rank_hospitals:
  description: >
    ...
  expected_output: >
    ...
  agent: hospital_coordinator
  context:
    - fetch_hospital_information
```

src/emergency_planner/data_models/

shared.py

```
FireType = Literal["ordinary", ..., "other"]
FireSeverity = Literal["low", "medium", "high"]
...
def add_schema_to_task_config(task_config, schema):
    ...
    return task_config
```

public_communication.py

```
from pydantic import BaseModel
from .shared import FireSeverity, FireType
from .medical_services import MedicalResponseReport
...
class EmergencyReport(BaseModel):
    medical_response_report: MedicalResponseReport
    fire_type: FireType
    fire_severity: FireSeverity
    ...
```

- ▼ src
 - > database
 - ▼ emergency_planner
 - > crews
 - ▼ data_models
 - 🔗 __init__.py
 - 🔗 emergency_services.py
 - 🔗 firefighters.py
 - 🔗 medical_services.py
 - 🔗 public_communication.py
 - 🔗 shared.py

src/emergency_planner/crews/

```

v src
  > database
  v emergency_planner
    v crews
      > emergency_services
      > firefighters
      v medical_services
        v config
          ! agents.yaml
          ! tasks.yaml
          + medical_services.py
        > public_communication
        > data_models

```

medical_services.py

```

@CrewBase
class MedicalServicesCrew:
    """Medical Services Crew"""
    @agent
    def medical_services_operator(self) -> Agent:
        return Agent(config=self.agents_config["
            medical_services_operator"])
    ...
    @task
    def fetch_hospital_information(self) -> Task:
        config = add_schema_to_task_config(
            self.tasks_config["
                fetch_hospital_information"],
            HospitalsInformation.model_json_schema(),
        )
        return Task(config=config, tools=[
            hospital_reader_tool])

```

Scripts

Map Analysis

```
places = ["Barcelona, Spain",
          "Seville, Spain",
          "Salamanca, Spain",
          "Tossa de Mar, Spain",
          "Lloret de Mar, Spain",
          "New York, NY, USA"]
...
columns = ["n",
           "m",
           "k_avg",
           "edge_length_total",
           "edge_length_avg",
           "streets_per_node_avg",
           "intersection_count",
           "edge_density_km",
           "street_density_km",
           "clean_intersection_density_km"]
...
df = pd.DataFrame(mapp_stats, index=
  places)
```

Database Initialization

populate_incident_table()

```
CREATE TABLE incidents (
  summary TEXT,
  timestamp TEXT,
  fire_severity TEXT,
  fire_type TEXT,
  location_x REAL,
  location_y REAL)
```

populate_hospital_table()

```
CREATE TABLE hospitals (
  hospital_id TEXT,
  location_x REAL,
  location_y REAL,
  available_beds INTEGER,
  available_ambulances INTEGER,
  available_paramedics INTEGER)
```

GPS Tool

```
from crewai.tools import BaseTool
import osmnx as ox

class RouteDistanceTool(BaseTool):
    def __init__(self, **kwargs):
        super().__init__(**kwargs)
        self.city_map = ox.load_graphml(GRAPHML_FILENAME)

    def _find_distance(self, x_origin, y_origin, x_destination, y_destination):
        origin_node = ox.distance.nearest_nodes(self.city_map, x_origin, y_origin)
        destination_node = ox.distance.nearest_nodes(self.city_map, x_destination, y_destination)
        route = ox.shortest_path(self.city_map, origin_node, destination_node, weight="travel_time")
        edge_lengths = ox.routing.route_to_gdf(self.city_map, route)["length"]

        return round(sum(edge_lengths)) / 1000
```

Database Tools

Tool	Input	Output
Hospital Reader	None	List of hospitals with their available resources
Hospital Updater	Hospital ID Beds Reserved Ambulances Dispatched Paramedics Deployed	None
Incident Retrieval	Location X Location Y Fire Severity Fire Type Summary	Related cases

src/emergency_planner/test.py

```
def process_crew_test(crew_name: str, crew_inputs: Dict[str, Any], test_index:
    int) -> None:
    ...
    crew = instantiate_crew(crew_name)
    logger.info("Agents loaded")
    for agent in crew.crew().agents:
        logger.info(f"Role: {agent.role}")
    ...
    for task in crew.crew().tasks:
        result = task.execute_sync(agent=task.agent, context=task.context, tools=
            task.tools)
    ...
    final_result = crew.crew().kickoff(inputs=crew_inputs)
    ...
def main() -> None:
    ...
    test_cases = load_test_cases(JSON_FILE)
    for i, test_case in enumerate(test_cases, start=1):
        ...
        # Input model validation
        ...
        process_crew_test(crew_name, crew_inputs, i)
    ...
```

src/emergency_planner/test/

- ✓ src
 - > database
 - ✓ emergency_planner
 - > crews
 - > data_models
 - ✓ test
 - ✓ inputs
 - { } test_crews.json
 - { } test_ES.json
 - { } test_FF.json
 - { } test_MS.json
 - { } test_PC.json
 - ✓ logs
 - ≡ test.log
 - ✓ results
 - ≡ EmergencyServicesCrew_output_1.txt
 - ≡ FirefightersCrew_output_1.txt
 - ≡ MedicalServicesCrew_output_1.txt
 - ≡ PublicCommunicationCrew_output_1.txt

test_crews.json

```
{
  "test_cases": [
    {
      "crew_to_test": "EmergencyServicesCrew",
      "crew_inputs": {
        "transcript":
          "A fire of electrical..."
      }
    }
  ]
  ...
}
```

src/emergency_planner/main.py

```
class EmergencyPlannerFlow(Flow[EmergencyPlannerState]):
    @start()
    def get_call_transcript(self): ...

    @listen(get_call_transcript)
    def emergency_services(self): ...

    @listen(emergency_services)
    def firefighters(self): ...

    @listen(emergency_services)
    def medical_services(self):
        if not self.state.call_assessment.medical_services_required:
            return
        ...

    @listen(or_(and_(firefighters, medical_services), "
        retry_public_communication"))
    def public_communication(self): ...

    @router(public_communication)
    def check_approval(self): ...
```

data/

- ▼ data
 - ▼ inputs
 - 🔍 .gitkeep
 - ≡ call_transcripts.txt
 - ≡ lloretDeMar.graphml
 - ▼ outputs
 - 🔍 .gitkeep
 - 📄 emergency_report_2.md
 - 📄 emergency_report.md
 - ≡ logs1.txt
 - ≡ logs2.txt

src/emergency_planner/main.py

```
@start()
def get_call_transcript(self):
    with open(EMERGENCY_CALL_TRANSCRIPTS_FILENAME, "r"
              ) as f:
        self.state.call_transcript = f.readlines()[
            TRANSCRIPT_INDEX]
```

```
@listen("save full emergency report")
def save_full_emergency_report(self):
    full_emergency_report = f"""
# Emergency Report

## Call Transcript
{self.state.call_transcript}
...
"""

    with open(EMERGENCY_REPORT_FILENAME, "w") as f:
        f.write(full_emergency_report)
```

Thank you!

Questions?