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CSAI 422: Laboratory Assignment 4 Report

Building Conversational Agents with Tool Use and Reasoning Techniques

Overview

This assignment builds a conversational agent capable of answering weather-related queries and performing calculations. The agent uses external tools (WeatherAPI for weather data and a calculator for mathematical operations) and supports three reasoning strategies:

1. **Basic Tool Calling**: The agent uses tools to fetch weather data or perform calculations without explicit reasoning steps.

2. **Chain of Thought (CoT)**: The agent breaks down complex problems into smaller steps, explains its reasoning, and uses tools as needed.

3. **ReAct (Reasoning and Acting)**: The agent follows a structured reasoning process (Thought , Action , Observation) to respond to queries.

1.Basic Tool Calling

The following is an example of a conversation with the basic agent:


```
Weather Assistant: Goodbye! Have a great day!
(venv) PS C:\Users\LENOVO\Desktop\spring semester '25\Applied Data Mining\lab4> python conversational_agent.py
Choose an agent type (1: Basic, 2: Chain of Thought, 3: ReAct): 1
Weather Assistant: Hello! I can help you with weather information. Ask me about the weather anywhere!
(Type 'exit' to end the conversation)

You: what is the weather in cairo

Weather Assistant: The weather in Cairo is clear with a temperature of 20.3°C (68.5°F), humidity at 68%, and a wind speed of 27.4 km/h.
```

2.Chain of Thought(CoT)

The following is an example of a conversation with the chain of thought agent:


```
Weather Assistant: Goodbye! Have a great day!
(venv) PS C:\Users\LENOVO\Desktop\spring semester '25\Applied Data Mining\lab4> python conversational_agent.py
Choose an agent type (1: Basic, 2: Chain of Thought, 3: ReAct): 2
Weather Assistant: Hello! I can help you with weather information. Ask me about the weather anywhere!
(Type 'exit' to end the conversation)

You: what is the weather in cairo

Weather Assistant: According to the weather update for Cairo:
- The temperature is currently 20.3°C (68.5°F).
- Skies are clear with conditions being mild.
- Humidity levels are at 68%.
- There is a slight breeze blowing at a speed of 27.4 km/h.

It should be a nice day in Cairo to go outdoors!
```

3.ReAct Agent

The following is an example of a conversation with the ReAct agent:

```
(venv) PS C:\Users\LENOVO\Desktop\spring semester '25\Applied Data Mining\lab4> python conversational_agent.py
Choose an agent type (1: Basic, 2: Chain of Thought, 3: ReAct): 3
Weather Assistant: Hello! I can help you with weather information. Ask me about the weather anywhere!
(Type 'exit' to end the conversation)

You: what is the weather in cairo

Weather Assistant: Thought: I now have the current weather conditions in Cairo. The tool provided temperature, condition, humidity, and wind speed information.

Action: No further action is needed as I have all the required information.

Observation: The current weather in Cairo is:
- Temperature: 20.3°C (68.5°F)
- Condition: Clear
- Humidity: 68%
- Wind Speed: 27.4 kph

Final Answer: The weather in Cairo is clear with a temperature of 20.3°C and is blowing at a wind speed of 27.4 kph. The humidity level is 68%.

You: what is the weather in cairo for the next 5 days

Weather Assistant: Thought: I now have the five-day weather forecast for Cairo. The tool provided detailed information for each day including temperature ranges and condition.

Action: No further action is needed as I have all the required information.

Observation: Here is the five-day weather forecast in Cairo:
- 2025-03-18: Sunny, Max Temperature: 29.9°C, Min Temperature: 16.8°C
- 2025-03-19: Sunny, Max Temperature: 25.8°C, Min Temperature: 14.0°C
- 2025-03-20: Sunny, Max Temperature: 20.4°C, Min Temperature: 11.8°C
- 2025-03-21: Partly Cloudy, Max Temperature: 18.4°C, Min Temperature: 11.8°C
- 2025-03-22: Partly Cloudy, Max Temperature: 21.2°C, Min Temperature: 13.3°C

Final Answer: The weather forecast for Cairo over the next 5 days shows mainly sunny conditions with varying temperatures ranging from the mid-10s to low 30s Celsius. There is minimal chance of rain throughout these days.

You: |
```

Analysis of Different Reasoning Strategies

The three reasoning strategies—**Basic**, **Chain of Thought (CoT)**, and **ReAct**—each influence the quality of responses differently.

The **Basic Agent** provides fast and simple responses, making it useful for straightforward queries like retrieving weather information. However, it lacks reasoning ability and struggles with complex multi-step questions.

The **Chain of Thought (CoT) Agent** improves accuracy by breaking down complex queries into logical steps. This structured approach ensures a more detailed and well-reasoned response, especially when multiple pieces of information are needed. However, it can be slightly slower than the basic agent due to the additional processing steps.

The **ReAct Agent** is the most intelligent and flexible, as it combines reasoning with action. Instead of blindly retrieving information, it first thinks about the best approach, selects the right tools, observes the results, and then refines its answer. This makes it the most capable of handling complex or ambiguous queries. However, its performance comes at the cost of additional processing time due to multiple tool calls and iterative reasoning steps.

Challenges and Solutions

1. **Tool Execution**:

   - **Challenge**: The assistant initially returned raw function calls
     (e.g., <function=get_current_weather{"location": "Ottawa"}</function>) instead
     of executing the tools.

   - **Solution**: Fixed the process_messages function to properly extract function names
     and arguments, execute the tools, and append the results to the conversation.

2. **Ambiguous Locations**:

   - **Challenge**: When the user asked for the weather in "Canada," the assistant
     provided a general overview instead of asking for a specific city.

   - **Solution**: Added logic to handle ambiguous locations by prompting the user to
     specify a city or region.

GitHub Repo: https://github.com/ShahdTarek4/Conversational-Agent