Documentation

Documentation: Weather & Wine Recommendation System

Overview

This project fetches weather and wine data, merges them, stores them in a PostgreSQL database, uses OpenAI's GPT to generate wine recommendations based on current weather, and exposes the functionality through a FastAPI backend.

Modules Breakdown

`wine_fetch.py` – Fetch Wine Descriptions

- **Purpose**: Uses the Spoonacular API to fetch wine descriptions for a predefined list of wines.
- **Why**: Descriptive metadata about each wine helps the language model make more context-aware recommendations.
- **Key Features**:
    - Asynchronous API calls using `aiohttp`.
    - Saves data to `Wine_train.json`

`data_fetch.py` – Weather Data Collection

- **Purpose**: Uses the OpenWeather API to fetch **current weather data** for a predefined list of cities.
- **Why**: Weather conditions (e.g. temperature, feels-like temperature) influence wine preferences (e.g. bold reds vs. light whites). Supplying weather data helps the language model make **contextual and personalized wine recommendations**.

- **Key Features**:
  - Asynchronous weather data fetching using `aiohttp` for efficient parallel API calls.
  - Extracts relevant metrics such as temperature and feels-like temperature in both Celsius and Fahrenheit.
  - Saves:
    - Raw weather data to `Weather_train.json`
    - Cleaned and structured data to `weather_cleaned.json`

`merge_data.py` – Merge Weather and Wine Data

- **Purpose**: Merges weather data and wine descriptions into a single JSON file (`merged_data.json`).
- **Why**: Centralizing the data allows the LLM module to access and reason over a unified structure.
- **Key Features**:
  - Asynchronous file I/O using `aiofiles`.
  - Structure ensures the merged output includes keys `"weather"` and `"wine"` for easy parsing downstream.

`Database.py` – Store Merged Data in PostgreSQL

- **Purpose**: Inserts the content of `merged_data.json` into a PostgreSQL table (`merged_data`).
- **Why**: Persistent storage ensures data availability across sessions and scales better than keeping everything in memory.
- **Key Features**:
  - Auto-creates table if it doesn’t exist.
  - Stores entire JSON blob for flexibility in future querying or auditing.

`llm.py` – Generate LLM-Based Wine Recommendations

- **Purpose**: Uses OpenAI's GPT to generate summaries that recommend a wine based on a user's weather-based query.
- **Why**: The power of LLMs allows for rich, contextual wine recommendations by interpreting temperature and wine features.
- **Key Features**:
  - Extracts the city from the query.
  - Looks up the weather for that city.
  - Constructs a natural-language prompt to GPT-4.
  - Stores unique summaries in the `analysis_summaries` table in PostgreSQL.
  - Avoids duplicate entries using a pre-check.

`main.py` – FastAPI Web Server

- **Purpose**: Hosts three API endpoints to interact with the system.
- **Why**: Provides an interface for external clients to use the system programmatically.
- **Endpoints**:
  - `POST /fetch_and_process`: Accepts a query like *"What's the weather in Paris and what wine suits it?"* Calls the LLM and stores result.
  - `GET /results`: Returns all LLM-generated recommendations, optionally filtered by city.
  - `GET /analysis`: Returns only the latest summary (or latest per city).

Data Flow Overview

1. `wine_fetch.py` + (external weather data source): Generate base JSONs.

2. `merge_data.py`: Combines both datasets into `merged_data.json`.
3. `Database.py`: Saves this merged data to the PostgreSQL database.
4. `llm.py`: Reads from the merged file, calls GPT, and stores summaries.
5. `main.py`: API interface to query the system and access summaries.

Files Summary

File	Role
`wine_fetch.py`	Fetch wine data from Spoonacular API
`merge_data.py`	Merge wine + weather JSON into unified format
`merged_data.json`	Output file from merge step (used throughout the system)
`Database.py`	Push merged data into PostgreSQL
`llm.py`	GPT logic to generate and store recommendations
`main.py`	FastAPI backend for querying and managing data
`.env`	Secure storage of API keys and DB credentials (not shared here)

Why Use GPT/LLM?

- The use of GPT enables **natural language interpretation** and **contextual wine pairing** that would be difficult to hardcode.
- By combining weather details (e.g., *"feels like 34°C"*) with nuanced wine descriptions, GPT provides thoughtful and dynamic recommendations.

Environment Variables

The system relies on a `.env` file with:

```
POSTGRES_DB_URL=your_postgres_connection_url
```

```
OPENAI_API_KEY=your_openai_api_key
SPOONACULAR_API_KEY=your_spoonacular_api_key
```

Kindly use own api-keys

Open-Weather = “”

spoonacular= ” ”

Open_API_key = “”

PostgressSQL = “”

Why This Architecture?

- **Separation of concerns**: Each script handles one task (data fetching, merging, storing, generating, serving).
- **Scalability**: Modular design allows replacing components (e.g., new wine API or weather provider).
- **Efficiency**: Async operations for fetching and merging improve performance.
- **Reliability**: PostgreSQL provides durable storage, while LLM ensures rich content generation.

LLM Integration Overview

This is a visual representation of how the **LLM (Large Language Model)** integrates the weather and wine data:

- The **weather API** provides city-specific temperature and climate data.
- The **wine API** offers descriptive profiles of various wines.
- When a user asks, for example, *“What wine should I have in Paris?”*, the system:
    1. Looks up the **current weather** in Paris.
    2. Uses GPT to interpret both the **weather** and the **wine dataset**.
    3. Generates a personalized **wine recommendation**.

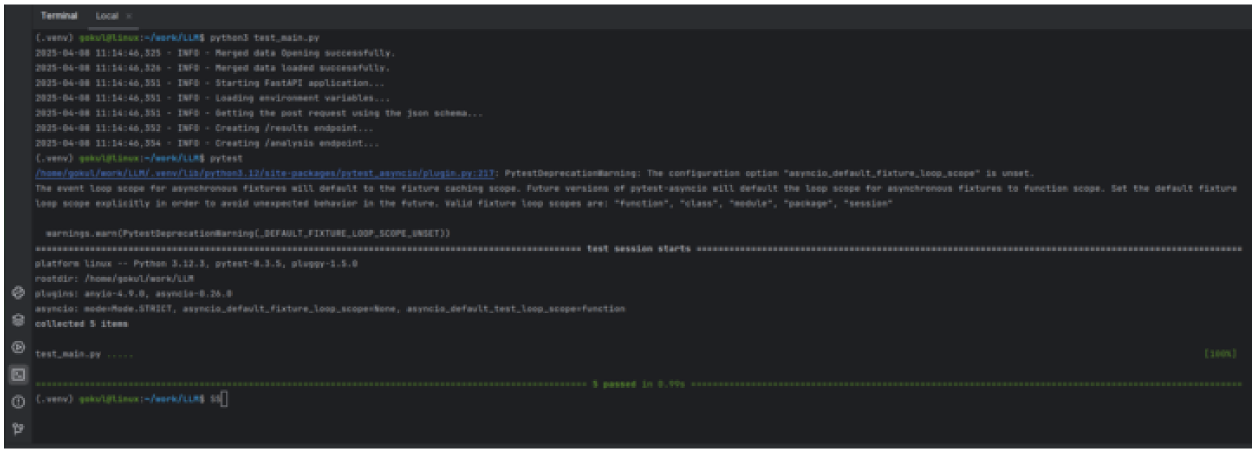
Adaptive Recommendations

The output varies based on city and weather. For example:

- In **Paris** with warm weather, it may suggest a light, crisp white wine like **Riesling**.
- In **Berlin** on a cooler day, it might recommend a bold red like **Cabernet Sauvignon**.

Python Testing

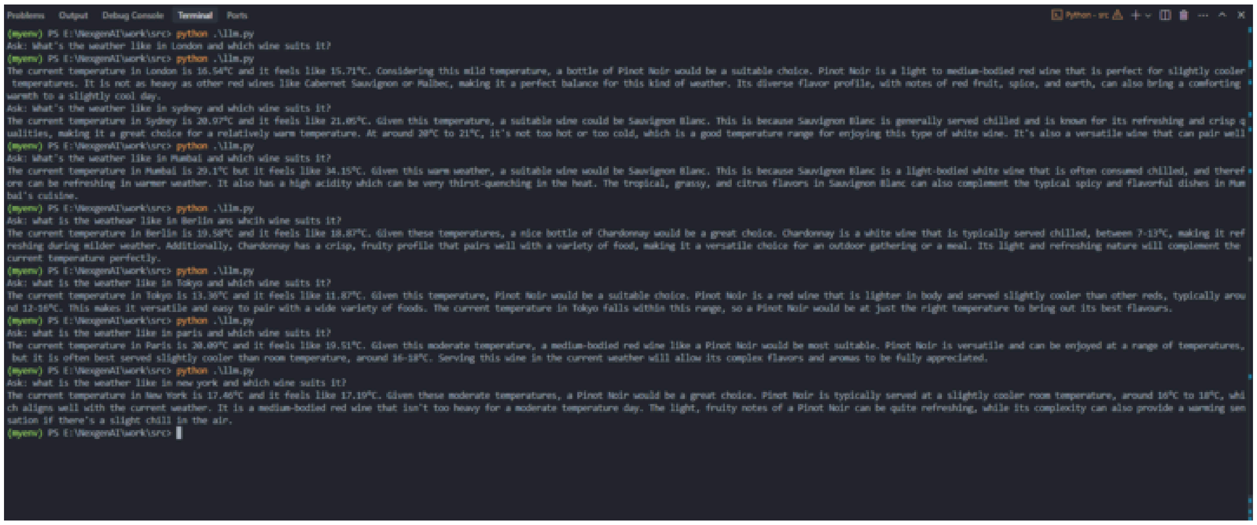
- Catch Bugs Early - You can find issues before they make it to production (like broken routes, DB errors, or incorrect logic).
- Ensure Code Quality - Tests enforce a contract—if someone changes the logic in main.py, your tests can immediately catch regressions.
- Enable Confident Refactoring - Want to change something in your code? Run the tests afterward to confirm nothing broke.
- Automate Validation - Manually checking each endpoint or function is tedious. With pytest, you can validate all endpoints with a single command



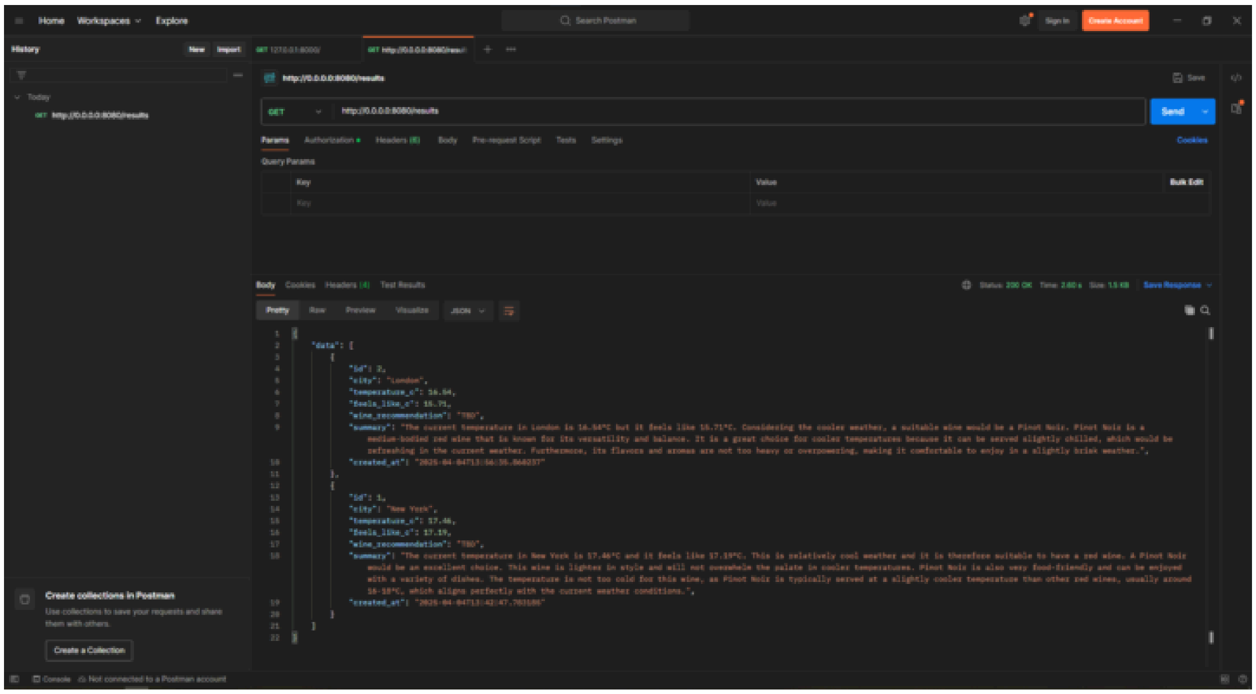
```
(.venv) gokul@linux:~/work/LLM$ python3 test_main.py
2025-04-08 11:14:46,325 - INFO - Merged data Opening successfully.
2025-04-08 11:14:46,326 - INFO - Merged data loaded successfully.
2025-04-08 11:14:46,351 - INFO - Starting FastAPI application...
2025-04-08 11:14:46,351 - INFO - Loading environment variables...
2025-04-08 11:14:46,351 - INFO - Getting the post request using the json schema...
2025-04-08 11:14:46,352 - INFO - Creating /results endpoint...
2025-04-08 11:14:46,354 - INFO - Creating /analysis endpoint...
(.venv) gokul@linux:~/work/LLM$ pytest
/home/gokul/work/LLM/.venv/lib/python3.12/site-packages/pytest_asyncio/plugin.py:217: PytestDeprecationWarning: The configuration option "asyncio_default_fixture_loop_scope" is unset.
The event loop scope for asynchronous fixtures will default to the fixture caching scope. Future versions of pytest-asyncio will default the loop scope for asynchronous fixtures to function scope. Set the default fixture
loop scope explicitly in order to avoid unexpected behavior in the future. Valid fixture loop scopes are: "function", "class", "module", "package", "session"

  warnings.warn(PytestDeprecationWarning(_DEFAULT_FIXTURE_LOOP_SCOPE_UNSET))
============================================================================================= test session starts ==============================================================================================
platform linux -- Python 3.12.3, pytest-8.3.5, pluggy-1.5.0
rootdir: /home/gokul/work/LLM
plugins: anyio-4.9.0, asyncio-0.26.0
asyncio: mode=Mode.STRICT, asyncio_default_fixture_loop_scope=None, asyncio_default_test_loop_scope=function
collected 5 items

test_main.py .....                                                                                                                                                                                       [100%]

============================================================================================== 5 passed in 0.99s ===============================================================================================
(.venv) gokul@linux:~/work/LLM$ $
```

Illustration

This diagram shows the flow of data and logic between the components:

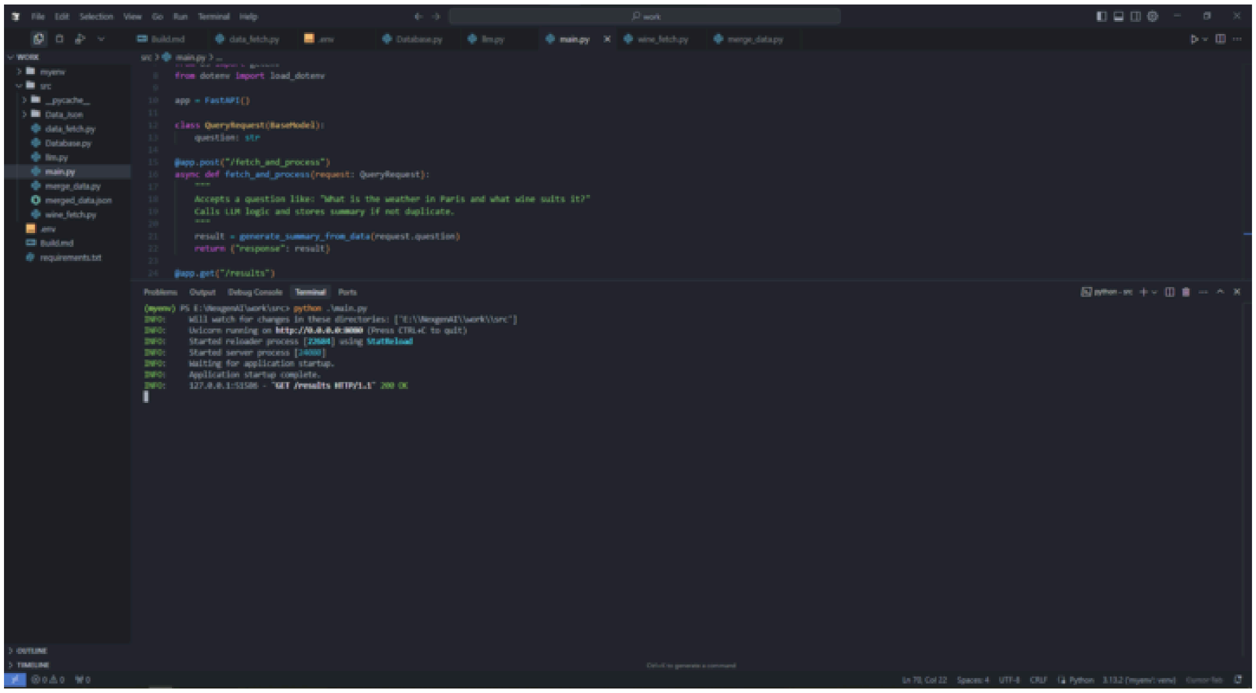


```
(myenv) PS E:\NexgenAI\work\src> python .\llm.py
Ask: What's the weather like in London and which wine suits it?
(myenv) PS E:\NexgenAI\work\src> python .\llm.py
The current temperature in London is 16.54°C and it feels like 15.71°C. Considering this mild temperature, a bottle of Pinot Noir would be a suitable choice. Pinot Noir is a light to medium-bodied red wine that is perfect for slightly cooler
 temperatures. It is not as heavy as other red wines like Cabernet Sauvignon or Malbec, making it a perfect balance for this kind of weather. Its diverse flavor profile, with notes of red fruit, spice, and earth, can also bring a comforting
warmth to a slightly cool day.
Ask: What's the weather like in sydney and which wine suits it?
The current temperature in Sydney is 20.97°C and it feels like 21.05°C. Given this temperature, a suitable wine could be Sauvignon Blanc. This is because Sauvignon Blanc is generally served chilled and is known for its refreshing and crisp q
ualities, making it a great choice for a relatively warm temperature. At around 20°C to 21°C, it's not too hot or too cold, which is a good temperature range for enjoying this type of white wine. It's also a versatile wine that can pair well
(myenv) PS E:\NexgenAI\work\src> python .\llm.py
Ask: What's the weather like in Mumbai and which wine suits it?
The current temperature in Mumbai is 29.1°C but it feels like 34.15°C. Given this warm weather, a suitable wine would be Sauvignon Blanc. This is because Sauvignon Blanc is a light-bodied white wine that is often consumed chilled, and theref
ore can be refreshing in warmer weather. It also has a high acidity which can be very thirst-quenching in the heat. The tropical, grassy, and citrus flavors in Sauvignon Blanc can also complement the typical spicy and flavorful dishes in Mum
bai's cuisine.
(myenv) PS E:\NexgenAI\work\src> python .\llm.py
Ask: what is the weathear like in Berlin ans whcih wine suits it?
The current temperature in Berlin is 19.58°C and it feels like 18.87°C. Given these temperatures, a nice bottle of Chardonnay would be a great choice. Chardonnay is a white wine that is typically served chilled, between 7-13°C, making it ref
reshing during milder weather. Additionally, Chardonnay has a crisp, fruity profile that pairs well with a variety of food, making it a versatile choice for an outdoor gathering or a meal. Its light and refreshing nature will complement the
current temperature perfectly.
(myenv) PS E:\NexgenAI\work\src> python .\llm.py
Ask: what is the weather like in Tokyo and which wine suits it?
The current temperature in Tokyo is 13.36°C and it feels like 11.87°C. Given this temperature, Pinot Noir would be a suitable choice. Pinot Noir is a red wine that is lighter in body and served slightly cooler than other reds, typically arou
nd 12-16°C. This makes it versatile and easy to pair with a wide variety of foods. The current temperature in Tokyo falls within this range, so a Pinot Noir would be at just the right temperature to bring out its best flavours.
(myenv) PS E:\NexgenAI\work\src> python .\llm.py
Ask: what is the weather like in paris and which wine suits it?
The current temperature in Paris is 20.09°C and it feels like 19.51°C. Given this moderate temperature, a medium-bodied red wine like a Pinot Noir would be most suitable. Pinot Noir is versatile and can be enjoyed at a range of temperatures,
 but it is often best served slightly cooler than room temperature, around 16-18°C. Serving this wine in the current weather will allow its complex flavors and aromas to be fully appreciated.
(myenv) PS E:\NexgenAI\work\src> python .\llm.py
Ask: what is the weather like in new york and which wine suits it?
The current temperature in New York is 17.46°C and it feels like 17.19°C. Given these moderate temperatures, a Pinot Noir would be a great choice. Pinot Noir is typically served at a slightly cooler room temperature, around 16°C to 18°C, whi
ch aligns well with the current weather. It is a medium-bodied red wine that isn't too heavy for a moderate temperature day. The light, fruity notes of a Pinot Noir can be quite refreshing, while its complexity can also provide a warming sen
sation if there's a slight chill in the air.
(myenv) PS E:\NexgenAI\work\src>
```



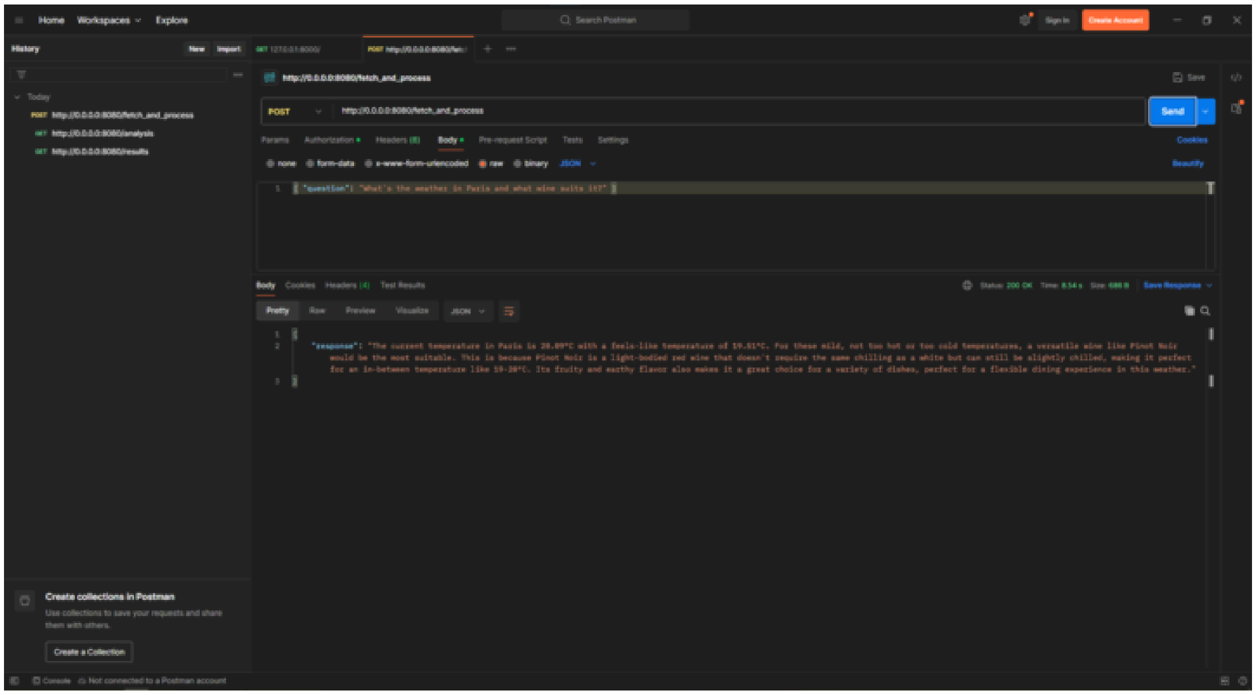
```
GET http://0.0.0.0:8080/results
```

```
{
    "data": [
        {
            "id": 2,
            "city": "London",
            "temperature_c": 16.54,
            "feels_like_c": 15.71,
            "wine_recommendation": "TBD",
            "summary": "The current temperature in London is 16.54°C but it feels like 15.71°C. Considering the cooler weather, a suitable wine would be a Pinot Noir. Pinot Noir is a
                medium-bodied red wine that is known for its versatility and balance. It is a great choice for cooler temperatures because it can be served slightly chilled, which would be
                refreshing in the current weather. Furthermore, its flavors and aromas are not too heavy or overpowering, making it comfortable to enjoy in a slightly brisk weather.",
            "created_at": "2025-04-04T13:56:35.860257"
        },
        {
            "id": 1,
            "city": "New York",
            "temperature_c": 17.46,
            "feels_like_c": 17.19,
            "wine_recommendation": "TBD",
            "summary": "The current temperature in New York is 17.46°C and it feels like 17.19°C. This is relatively cool weather and it is therefore suitable to have a red wine. A Pinot Noir
                would be an excellent choice. This wine is lighter in style and will not overwhelm the palate in cooler temperatures. Pinot Noir is also very food-friendly and can be enjoyed
                with a variety of dishes. The temperature is not too cold for this wine, as Pinot Noir is typically served at a slightly cooler temperature than other red wines, usually around
                16-18°C, which aligns perfectly with the current weather conditions.",
            "created_at": "2025-04-04T13:42:47.703186"
        }
    ]
}
```



```python
from dotenv import load_dotenv

app = FastAPI()

class QueryRequest(BaseModel):
    question: str

@app.post("/fetch_and_process")
async def fetch_and_process(request: QueryRequest):
    """
    Accepts a question like: "What is the weather in Paris and what wine suits it?"
    Calls LLM logic and stores summary if not duplicate.
    """
    result = generate_summary_from_data(request.question)
    return {"response": result}

@app.get("/results")
```

```
(myenv) PS E:\NexgenAI\work\src> python .\main.py
INFO:     Will watch for changes in these directories: ['E:\\NexgenAI\\work\\src']
INFO:     Uvicorn running on http://0.0.0.0:8080 (Press CTRL+C to quit)
INFO:     Started reloader process [22884] using StatReload
INFO:     Started server process [24080]
INFO:     Waiting for application startup.
INFO:     Application startup complete.
INFO:     127.0.0.1:51586 - "GET /results HTTP/1.1" 200 OK
```



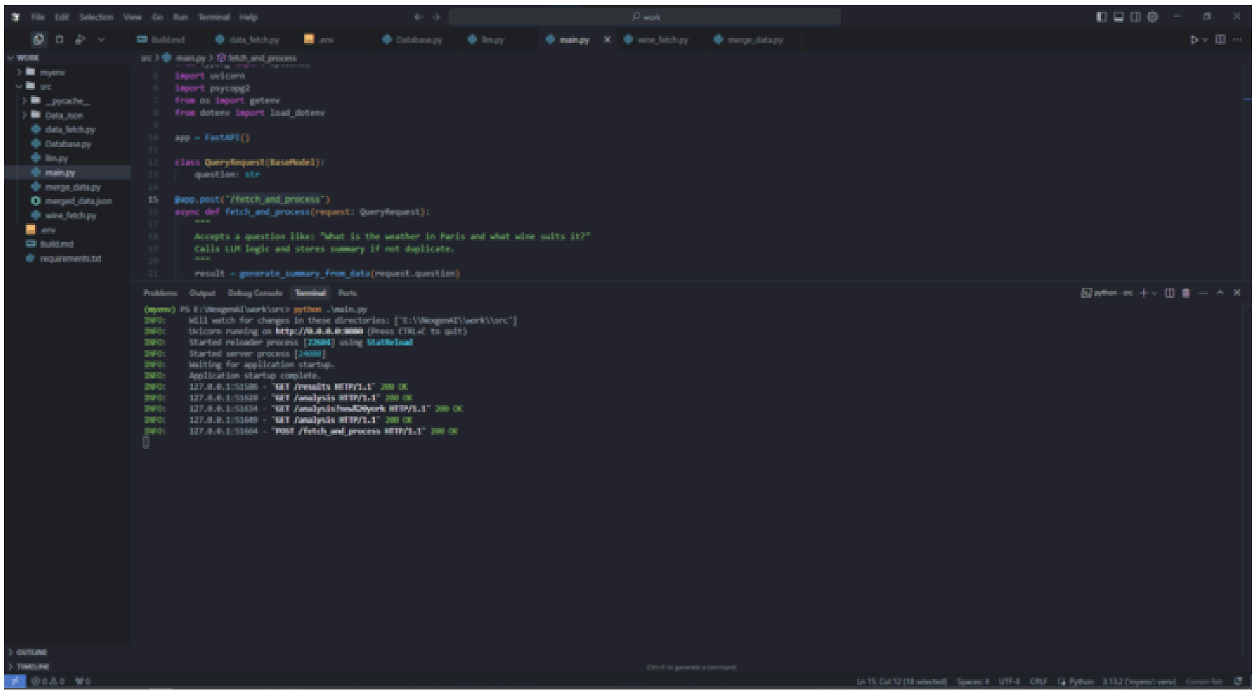
History
POST http://0.0.0.0:8080/fetch_and_process
GET http://0.0.0.0:8080/analysis
GET http://0.0.0.0:8080/results
Create collections in Postman
Use collections to save your requests and share them with others.
Create a Collection

POST http://0.0.0.0:8080/fetch_and_process

```
{ "question": "What's the weather in Paris and what wine suits it?" }
```

Status: 200 OK Time: 8.54 s Size: 686 B

```
{
    "response": "The current temperature in Paris is 20.09°C with a feels-like temperature of 19.61°C. For these mild, not too hot or too cold temperatures, a versatile wine like Pinot Noir would be the most suitable. This is because Pinot Noir is a light-bodied red wine that doesn't require the same chilling as a white but can still be slightly chilled, making it perfect for an in-between temperature like 19-20°C. Its fruity and earthy flavor also makes it a great choice for a variety of dishes, perfect for a flexible dining experience in this weather."
}
```



```python
import uvicorn
import psycopg2
from os import getenv
from dotenv import load_dotenv

app = FastAPI()

class QueryRequest(BaseModel):
    question: str

@app.post("/fetch_and_process")
async def fetch_and_process(request: QueryRequest):
    """
    Accepts a question like: "What is the weather in Paris and what wine suits it?"
    Calls LLM logic and stores summary if not duplicate.
    """
    result = generate_summary_from_data(request.question)
```

```
(myenv) PS E:\NexgenAI\work\src> python .\main.py
INFO:     Will watch for changes in these directories: ['E:\\NexgenAI\\work\\src']
INFO:     Uvicorn running on http://0.0.0.0:8000 (Press CTRL+C to quit)
INFO:     Started reloader process [22684] using StatReload
INFO:     Started server process [24080]
INFO:     Waiting for application startup.
INFO:     Application startup complete.
INFO:     127.0.0.1:51586 - "GET /results HTTP/1.1" 200 OK
INFO:     127.0.0.1:51628 - "GET /analysis HTTP/1.1" 200 OK
INFO:     127.0.0.1:51634 - "GET /analysis?new%20york HTTP/1.1" 200 OK
INFO:     127.0.0.1:51649 - "GET /analysis HTTP/1.1" 200 OK
INFO:     127.0.0.1:51664 - "POST /fetch_and_process HTTP/1.1" 200 OK
```