⛅ Weather Forecast App – Project Report

Student Name: Divyansh Chawla
Student ID: GH1031116
GitHub Repository: https://github.com/divyanshchawlaa/WeatherForecastApp.git
Video Demonstration: https://youtu.be/M6053_FMLQE

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1. Introduction

The **Weather Forecast App** is a Java-based application designed to fetch and display **hourly and daily weather information** for any city worldwide. The project demonstrates practical **Object-Oriented Programming (OOP) principles**, API integration, and GUI development using **Java Swing**.

Objectives:

- Build a functional GUI-based weather app.
- Apply OOP principles such as encapsulation, abstraction, and polymorphism.
- Integrate a third-party API (Open-Meteo) for real-time weather data.
- Implement user-friendly features like hover-colored tables, condition icons, clothing suggestions, and alerts.

Problem Domain:
Weather forecasting is critical for daily planning, travel, and safety. This application provides a simple, interactive interface to access accurate weather data quickly.

Significance:
The app demonstrates **real-world application of Java OOP concepts** while providing a functional tool that enhances the user experience with intuitive visuals and information.

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2. System Architecture

Overview:
The app is structured around **multiple classes**, each responsible for a specific component:

- `WeatherAppGUI` – Main GUI window and event handling.
- `APIWeatherProvider` – Fetches weather data from Open-Meteo API.
- `Geocoder` – Converts city names into latitude and longitude.
- `HourlyWeatherData` – Model for hourly weather (time, temperature, condition, clothing, alert, score).

- `DailyWeatherData` – Model for daily weather (date, min/max temperature, condition).

Diagram:

```
WeatherAppGUI
    ├── APIWeatherProvider
    │       └── fetchWeather(city, days)
    ├── Geocoder
    │       └── geocode(city)
    ├── HourlyWeatherData
    └── DailyWeatherData
```

Key Features:

- GUI-based tables with hover-color effects.
- Icons for weather conditions.
- Clothing suggestions and alerts based on temperature and weather code.
- City search history.

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3. Implementation

Development Steps:

1. **Setup project structure** with `/src` folder containing all Java classes.
2. Created **data models**: `HourlyWeatherData` and `DailyWeatherData`.
3. Developed **API integration** via `APIWeatherProvider` using Open-Meteo API.
4. Built **GUI** using Java Swing:
   - JTabbedPane for Hourly/Daily forecasts.
   - JTable for displaying weather data.
   - Custom cell renderers for icons and hover-color effect.
5. Added **functionality**:
   - Fetch weather using Enter key or button click.
   - Hover-only row coloring based on temperature.
   - Clothing suggestions, alerts, and score calculation.
   - History of searched cities.

OOP Concepts Applied:

- **Encapsulation:** Private fields with getters/setters in data models.
- **Abstraction:** API provider hides the details of HTTP requests.
- **Polymorphism:** Table renderers for different cell types.

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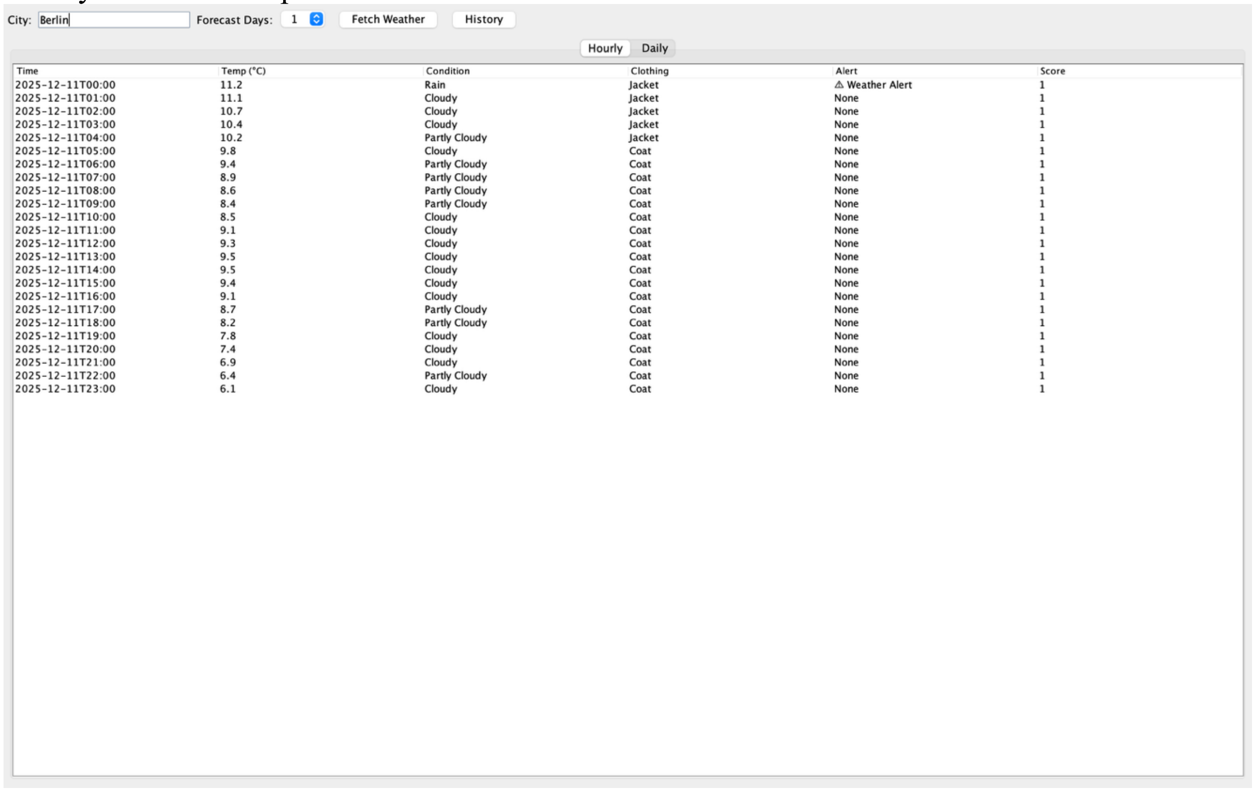
4. Results

The application successfully fetches and displays weather data:

- **Hourly Forecast Table:**
  - Time | Temperature | Condition (with icon) | Clothing | Alert | Score
  - Hover over rows to see **color-coded temperatures**.
- **Daily Forecast Table:**
  - Date | Min Temp | Max Temp | Condition (with icon)

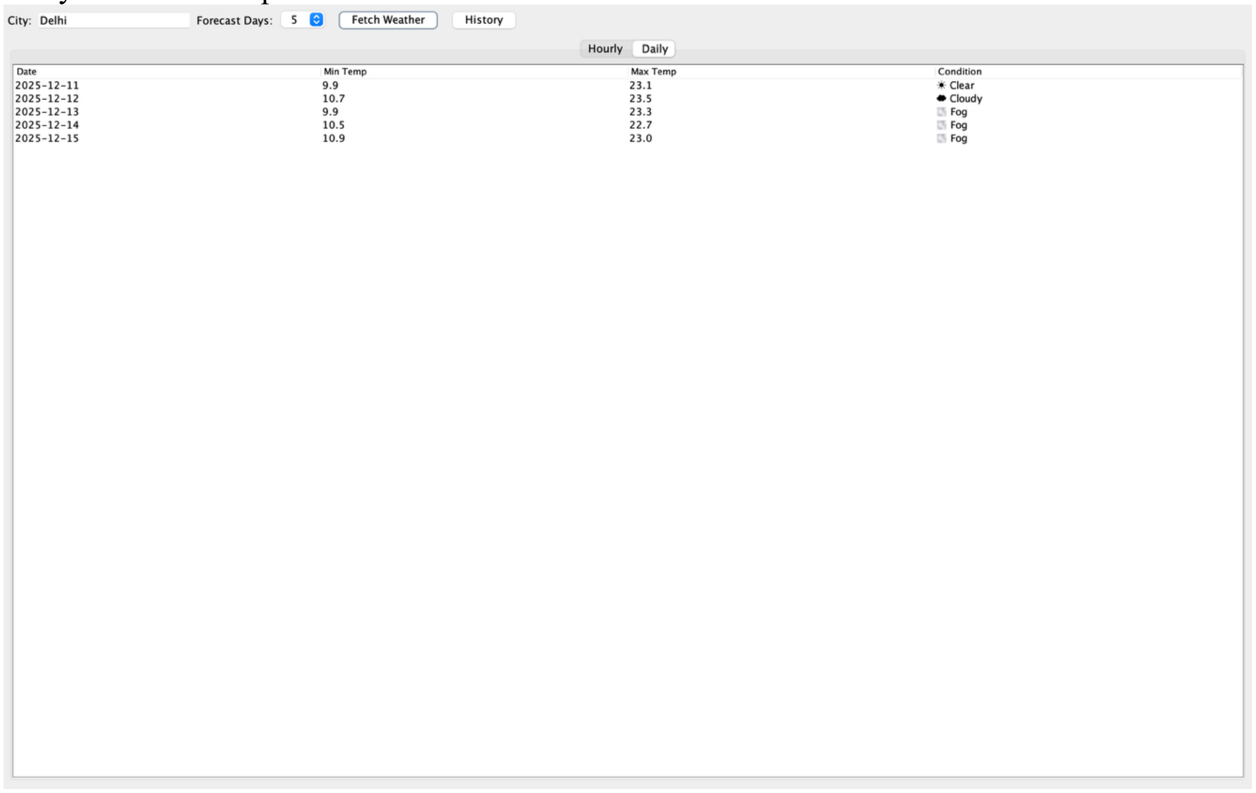
Screenshots:

1. Hourly forecast example



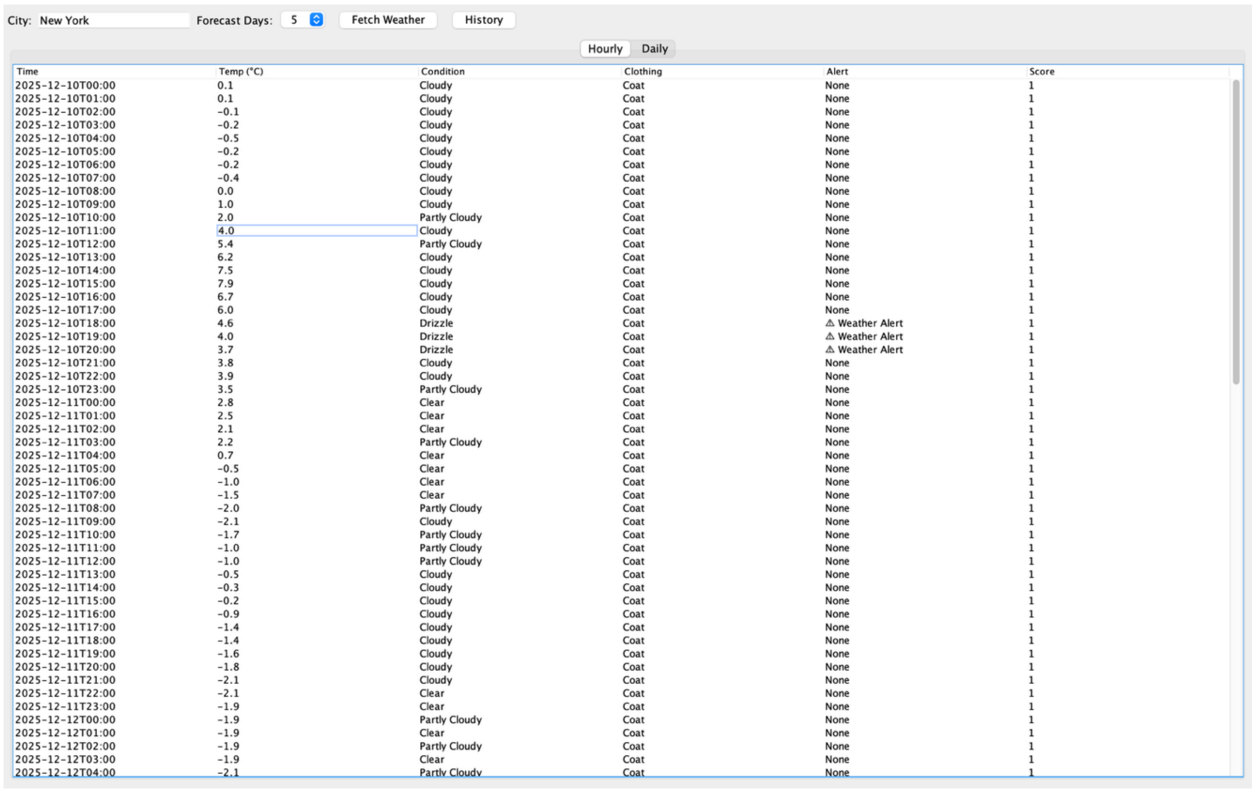
Time	Temp (°C)	Condition	Clothing	Alert	Score
2025-12-11T00:00	11.2	Rain	Jacket	⚠ Weather Alert	1
2025-12-11T01:00	11.1	Cloudy	Jacket	None	1
2025-12-11T02:00	10.7	Cloudy	Jacket	None	1
2025-12-11T03:00	10.4	Cloudy	Jacket	None	1
2025-12-11T04:00	10.2	Partly Cloudy	Jacket	None	1
2025-12-11T05:00	9.8	Cloudy	Coat	None	1
2025-12-11T06:00	9.4	Partly Cloudy	Coat	None	1
2025-12-11T07:00	8.9	Partly Cloudy	Coat	None	1
2025-12-11T08:00	8.6	Partly Cloudy	Coat	None	1
2025-12-11T09:00	8.4	Partly Cloudy	Coat	None	1
2025-12-11T10:00	8.5	Cloudy	Coat	None	1
2025-12-11T11:00	9.1	Cloudy	Coat	None	1
2025-12-11T12:00	9.3	Cloudy	Coat	None	1
2025-12-11T13:00	9.5	Cloudy	Coat	None	1
2025-12-11T14:00	9.5	Cloudy	Coat	None	1
2025-12-11T15:00	9.4	Cloudy	Coat	None	1
2025-12-11T16:00	9.1	Cloudy	Coat	None	1
2025-12-11T17:00	8.7	Partly Cloudy	Coat	None	1
2025-12-11T18:00	8.2	Partly Cloudy	Coat	None	1
2025-12-11T19:00	7.8	Cloudy	Coat	None	1
2025-12-11T20:00	7.4	Cloudy	Coat	None	1
2025-12-11T21:00	6.9	Cloudy	Coat	None	1
2025-12-11T22:00	6.4	Partly Cloudy	Coat	None	1
2025-12-11T23:00	6.1	Cloudy	Coat	None	1

2. Daily forecast example



Date	Min Temp	Max Temp	Condition
2025-12-11	9.9	23.1	☀ Clear
2025-12-12	10.7	23.5	☁ Cloudy
2025-12-13	9.9	23.3	Fog
2025-12-14	10.5	22.7	Fog
2025-12-15	10.9	23.0	Fog

3.



Time	Temp (°C)	Condition	Clothing	Alert	Score
2025-12-10T00:00	0.1	Cloudy	Coat	None	1
2025-12-10T01:00	0.1	Cloudy	Coat	None	1
2025-12-10T02:00	-0.1	Cloudy	Coat	None	1
2025-12-10T03:00	-0.2	Cloudy	Coat	None	1
2025-12-10T04:00	-0.5	Cloudy	Coat	None	1
2025-12-10T05:00	-0.2	Cloudy	Coat	None	1
2025-12-10T06:00	-0.2	Cloudy	Coat	None	1
2025-12-10T07:00	-0.4	Cloudy	Coat	None	1
2025-12-10T08:00	0.0	Cloudy	Coat	None	1
2025-12-10T09:00	1.0	Cloudy	Coat	None	1
2025-12-10T10:00	2.0	Partly Cloudy	Coat	None	1
2025-12-10T11:00	4.0	Cloudy	Coat	None	1
2025-12-10T12:00	5.4	Partly Cloudy	Coat	None	1
2025-12-10T13:00	6.2	Cloudy	Coat	None	1
2025-12-10T14:00	7.5	Cloudy	Coat	None	1
2025-12-10T15:00	7.9	Cloudy	Coat	None	1
2025-12-10T16:00	6.7	Cloudy	Coat	None	1
2025-12-10T17:00	6.0	Cloudy	Coat	None	1
2025-12-10T18:00	4.6	Drizzle	Coat	⚠ Weather Alert	1
2025-12-10T19:00	4.0	Drizzle	Coat	⚠ Weather Alert	1
2025-12-10T20:00	3.7	Drizzle	Coat	⚠ Weather Alert	1
2025-12-10T21:00	3.8	Cloudy	Coat	None	1
2025-12-10T22:00	3.9	Cloudy	Coat	None	1
2025-12-10T23:00	3.5	Partly Cloudy	Coat	None	1
2025-12-11T00:00	2.8	Clear	Coat	None	1
2025-12-11T01:00	2.5	Clear	Coat	None	1
2025-12-11T02:00	2.1	Clear	Coat	None	1
2025-12-11T03:00	2.2	Partly Cloudy	Coat	None	1
2025-12-11T04:00	0.7	Clear	Coat	None	1
2025-12-11T05:00	-0.5	Clear	Coat	None	1
2025-12-11T06:00	-1.0	Clear	Coat	None	1
2025-12-11T07:00	-1.5	Clear	Coat	None	1
2025-12-11T08:00	-2.0	Partly Cloudy	Coat	None	1
2025-12-11T09:00	-2.1	Cloudy	Coat	None	1
2025-12-11T10:00	-1.7	Partly Cloudy	Coat	None	1
2025-12-11T11:00	-1.0	Partly Cloudy	Coat	None	1
2025-12-11T12:00	-1.0	Partly Cloudy	Coat	None	1
2025-12-11T13:00	-0.5	Cloudy	Coat	None	1
2025-12-11T14:00	-0.3	Cloudy	Coat	None	1
2025-12-11T15:00	-0.2	Cloudy	Coat	None	1
2025-12-11T16:00	-0.9	Cloudy	Coat	None	1
2025-12-11T17:00	-1.4	Cloudy	Coat	None	1
2025-12-11T18:00	-1.4	Cloudy	Coat	None	1
2025-12-11T19:00	-1.6	Cloudy	Coat	None	1
2025-12-11T20:00	-1.8	Cloudy	Coat	None	1
2025-12-11T21:00	-2.1	Cloudy	Coat	None	1
2025-12-11T22:00	-2.1	Clear	Coat	None	1
2025-12-11T23:00	-1.9	Clear	Coat	None	1
2025-12-12T00:00	-1.9	Partly Cloudy	Coat	None	1
2025-12-12T01:00	-1.9	Clear	Coat	None	1
2025-12-12T02:00	-1.9	Partly Cloudy	Coat	None	1
2025-12-12T03:00	-1.9	Clear	Coat	None	1
2025-12-12T04:00	-2.1	Partly Cloudy	Coat	None	1

5. Challenges and Solutions

Challenges:

1. **Mapping API data to custom data models:**
   - The Open-Meteo API returns JSON with arrays; had to align hourly time, temperature, and weather codes.
   - **Solution:** Created a parser in `APIWeatherProvider` and used loops to build `HourlyWeatherData` and `DailyWeatherData`.
2. **Hover-only row coloring in JTable:**
   - JTable doesn't provide built-in hover detection.
   - **Solution:** Used `table.getMousePosition()` inside a custom `TableCellRenderer` to apply background color only when hovering.
3. **Handling city not found errors:**
   - API returns null or empty results for invalid cities.
   - **Solution:** Added error handling and user prompts via `JOptionPane`.

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6. Conclusion and Future Work

Conclusion:
The Weather Forecast App successfully demonstrates **Java OOP principles, GUI development, and API integration**. The application is user-friendly, visually appealing, and functional.

Future Improvements:

- Implement **gradient coloring** instead of solid colors.
- Add **more weather parameters** (humidity, wind speed, UV index).
- Integrate a **database** to save search history persistently.
- Add **real-time notifications or alerts** for severe weather.
- Optimize the **UI for mobile devices** or responsive layout.

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7. References

- Open-Meteo API: https://open-meteo.com/
- JSON Library: https://mvnrepository.com/artifact/org.json/json

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