

## Machine Learning Project Report – Coding Week 2025

**Submitted by:** *Krishang Vyas*

**Institute:** IIT Guwahati

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### Task 1: CampusPulse – Student Data Exploration & Prediction

#### Objective

To analyze anonymized student survey data and uncover key patterns in academic, social, and lifestyle behavior. The goal was to clean the data, generate insights, and predict the likelihood of a student being in a romantic relationship.

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#### Approach & Experimentation

##### Level 1 – Variable Identification

- Used histograms, scatter plots, and correlation heatmaps to explore three anonymized features.
- Guessed their identities based on statistical associations with known columns.
- Documented reasoning using visual evidence and logic.

##### Level 2 – Data Cleaning

- Detected missing values and inconsistent responses.
- Applied appropriate imputation:
  - Mode for categorical
  - Median/mean for numerical values
- Justified the strategy for each cleaned feature.

##### Level 3 – Exploratory Data Analysis

- Framed insightful questions like:
  - Does screen time correlate with academic performance?
  - How do students in relationships differ in habits?
- Used violin plots, boxplots, and bar charts to reveal meaningful trends.

## Level 4 – Predictive Modeling

- Trained classification models (Logistic Regression, Random Forest, SVM).
  - Evaluated using accuracy, F1-score, and confusion matrix.
  - Random Forest achieved the best balance between precision and recall.
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## Results

- Successful identification of hidden features.
  - Meaningful insights into student life and behavior.
  - EDA strengthened the trust and interpretability of predictions.
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## Task 2: The Rise of the WeatherMind – Intelligent AI Assistant

### Objective

To build an agent-based, tool-augmented AI system using LangGraph and LLMs that can interpret prompts, use APIs, reason over tasks, and remember user context.

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## Approach & Implementation

### Level 1 – Core Activation

- Built a chatbot node powered by Gemini or an open LLM.
- Integrated a calculator tool to handle BODMAS arithmetic.
- Rendered the basic LangGraph structure.

### Level 2 – External Perception

- Added tools:
  - **Fashion Recommender** – provides trending styles by location
  - **Weather Extractor** – fetches live weather using API queries

### Level 3 – Intent Routing & Memory

- Enabled routing logic to direct queries to appropriate agents or tools.

- Added memory so the chatbot could respond to follow-ups contextually.

#### Level 4 – Multi-Agent System Design

Defined 3 specialized agents:

- **Decision\_Maker Agent**
  - Parsed the user query and determined whether to call fashion, weather, or send it for general processing.
- **Analysis Agent**
  - Handled arithmetic/BODMAS queries using the calculator tool.
- **Researcher Agent**
  - Answered general Gemini-based prompts (e.g., "Tell me about black holes") using the base LLM.

Custom routing logic allowed seamless agent-to-agent transitions, graceful fallback, and accurate tool execution.

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#### Results

- Built a modular, multi-agent AI capable of:
  - Arithmetic, contextual reasoning, and tool-based responses
  - Interpreting diverse prompts with intent detection
  - Conversational memory for a coherent user experience
- The agent architecture was flexible, clear, and successfully handled chained tasks like:

“What’s the weather in Tokyo and what should I wear?”

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#### Conclusion

This project covered the spectrum from classical ML modeling to modern AI agents. It combined:

- Data understanding and predictive modeling (Task 1)
- Tool-enhanced AI systems with real-world integration (Task 2)

The journey emphasized reasoning, exploration, and clear communication of insights—hallmarks of practical machine learning.