**Project Title**

Total Marks 50

**Deadline 25/10/2024**

**A Responsible Generative AI Approach to AI-driven Medical Diagnostic Systems Based on Design Thinking Principles**

**Objective of the Project**

In an era where Machine Learning and Deep Learning are advancing rapidly, it is crucial to apply this knowledge to real-world challenges that significantly impact healthcare. This project aims to develop a Medical Diagnostic System using Generative AI and Design Thinking principles to create innovative, user-centered, and ethical solutions for disease diagnosis.

The project will focus on two key disease-diagnosis objectives using a dataset containing 132 symptoms and 42 disease outcomes. The system will be designed using the Design Thinking framework—Empathize, Define, Ideate, Prototype, and Test—with Generative AI integrated at every stage. The dataset consists of training and testing data in two CSV files, each containing 133 columns: 132 symptoms and one prognosis (disease outcome).

The final deliverable will be a user-centric diagnostic tool that combines technical accuracy with practical usability. By leveraging Generative AI at each stage, students will enhance their ability to creatively solve complex medical challenges and optimize system performance through iterative feedback loops**.**

**Project Components and Requirements (Follow Design Thinking +Generative AI Approach and not the Traditional Approach)**

1. **Data Sourcing and Ingesting**
   * Traditional Approach: Dataset with above details is given.
   * **Design Thinking + Generative AI Approach:** Use empathetic techniques to understand the needs of the end-users (e.g., physicians, patients) and ideate potential data sources. Collaborate with stakeholders to identify diverse data sources that address different diagnostic perspectives. Use Generative AI tools to brainstorm new data gathering strategies, enrich datasets, and ensure comprehensive coverage of symptoms and diseases.
2. **Exploratory Data Analysis (EDA)**
   * **Traditional Approach**: Perform data cleaning, aggregation, and visualization to explore the dataset. Identify trends and relationships between symptoms and diseases. Use graphs, tables, and charts to explain the findings.
   * **Design Thinking + Generative AI Approach:** Conduct user interviews with medical professionals to understand what insights would be valuable for improving diagnosis. Use Generative AI to prototype initial visualizations based on user needs and gather feedback. AI-powered tools can also help automate data cleaning, detect anomalies, and suggest innovative ways to present diagnostic insights for better user understanding.
3. **Predictive Model Development**
   * **Traditional Approach:** Build two or more predictive models using machine learning techniques (e.g., ensemble or gradient boosting) to predict diseases based on symptoms. Use appropriate evaluation metrics and visualize the model performance.
   * **Design Thinking + Generative AI Approach:** Use Generative AI to assist in the model selection process, ensuring that the models chosen align with user priorities such as interpretability, explainability, and diagnostic accuracy. AI tools can help generate model alternatives, run simulations, and present refined outputs to healthcare professionals. User feedback on model usability should be gathered and integrated into the final model development, ensuring alignment between AI-driven predictions and the needs of end-users.
4. **Ethical Considerations and Responsible AI Use**
   * Throughout the project, reflect on the ethical implications of using AI for medical diagnostics, such as ethical issues and biases. Document these reflections at every stage**.**

**Report Requirements**

The final report should reflect a systematic application of Generative AI and Design Thinking principles, alongside traditional machine learning methodologies. It must include:

1. **Executive Summary/Abstract**Provide an overview of your project’s objectives, methods, key findings, and conclusions.
2. **Introduction**
   * Define the hypotheses you aim to test using the dataset.
   * Discuss the motivation for incorporating Generative AI and Design Thinking into a medical diagnostic system.
3. **Dataset Description**Briefly describe the dataset, including the approach taken to ingest and explore it. Highlight any Generative AI tools used during data preparation (if any).
4. **Design Thinking Stages**Document how you applied Generative AI at each stage of the Design Thinking process:
   * Stage 1: Empathize
     + Explain how you used **Generative AI to facilitate user empathy.** Did you use AI to simulate diagnostic scenarios, or explore patient perspectives? Document how you gathered insights from users using Generative AI (e.g., doctors or patients) and incorporated them into your project**.**
   * **Stage 2: Define**
     + Describe the problem definition process. How did AI tools assist in refining the problem statement or identifying key areas of focus for diagnosis? Discuss how this feedback was integrated to address real-world challenges.
   * **Stage 3: Ideate**
     + Brainstorm potential solutions and models using Generative AI to suggest approaches and simulate possible outcomes. How did AI facilitate innovative model choices or lead to new ideas for improving diagnostic accuracy?
   * **Stage 4: Prototype**
     + Detail how Generative AI helped prototype and refine models. Document the steps taken to clean and prepare the data, using samples of intermediate data. Include how AI tools were used to improve the efficiency of preprocessing, model development, or visualization. Describe the tools used and their justification.
   * **Stage 5: Test**
     + Explain how the final model was tested. How did Generative AI support the testing phase (e.g., by simulating test cases, running multiple validation scenarios, or providing real-time feedback)? Document any feedback from Generative AI and how it was integrated into the model. Include performance metrics and insights from usability testing.
5. **Ethical Reflection**Reflect on the ethical challenges encountered in the project, particularly the use of Generative AI in medical diagnosis. Discuss how potential biases or privacy concerns were addressed, and what safeguards were implemented. (**Add a dedicated section for this)**
6. **Conclusion and Future Work**Summarize your findings and the project’s impact on developing an AI-driven diagnostic system. Discuss how Generative AI will continue to evolve in future work and how the system could be further improved.
7. **References**List all sources used in the project, including academic papers, datasets, and AI tools.

**Grading Criteria (Total Marks: 50)**

**1. Completeness and Coverage (10 marks)**

* Project covers all stages of the Design Thinking process, integrated with Generative AI.
* All required deliverables are provided, including analysis, models, and ethical considerations.

**2. Use of Advanced Predictive Models (8 marks)**

* Advanced models are used, incorporating Generative AI suggestions for model refinement.
* Justifications for model selection are clearly documented.

**3. Integration of Design Thinking and Generative AI (8 marks)**

* Demonstrated use of Generative AI at each stage of the Design Thinking process.
* User feedback and AI-driven insights are incorporated into every phase.

**4. Full Pipeline Implementation (6 marks)**

* A complete pipeline is implemented, from data preprocessing to model evaluation.
* The use of Generative AI tools is documented in the preprocessing, modeling, and validation phases.

**5. Quality of Analysis and Visualization (8 marks)**

* Visualizations are insightful, well-presented, and aligned with user needs.
* AI-powered visualization tools are used to enhance interpretability.

**6. Ethical Considerations (5 marks)**

* Thoughtful reflection on ethical issues, especially regarding the use of Generative AI.
* Consideration of potential AI biases, privacy concerns, and explainability.

**7. Report Quality and Presentation (5 marks)**

* The report is well-written and clearly formatted, with no grammatical errors.
* Figures, tables, and visualizations are clear and support the analysis.

**Deficiency Criteria**

Marks may be lost for the following reasons:

* Instructions not followed or missing sections.
* Lack of integration of Generative AI into the Design Thinking stages.
* Poor quality writing, presentation, or visualizations.
* Incomplete implementation of the pipeline or model validation.
* Lack of consideration for ethical issues.

**Submission Requirements**

1. Source Code: Submit a zipped folder containing all source code (ipynb) and a README file that includes documentation of how Generative AI was used in each stage of design thinking. Please note that usage recording for the Generative AI is compulsory.
2. Technical Report: Submit a .pdf file on Turnitin (second check).