TEELLAB
Technology for Effective and Efficient Learning

Carnegie Mellon University

AI User: AI Literacy for Community Colleges

1. Overview

Title: AI User
Pre-requisites: Students must be familiar with using computers (laptop/desktop) connected to the Internet. Students must be able to engage with interactive software running in an Internet browser.
Hardware / Software requirements: A laptop/desktop computer connected to the Internet with an Internet browser.

2. Course Description

In this course, learners develop their knowledge and skills to become informed users of modern artificial intelligence (AI) and machine learning (ML) based systems. They gain knowledge and insight into AI/ML domains, AI/ML application capabilities, how AI/ML applications achieve their objectives, and potential AI/ML limitations. Learners engage with concepts and practice hands-on skills to operate various AI/ML-powered systems in relevant application areas. Learners will be able to identify long-term growing trends in the deployment of AI/ML-enabled automation, current capabilities / limitations, and typical sources of error. Additional topics include the role data plays in AI/ML-powered applications, how to validate and troubleshoot such applications, how to identify when an AI/ML system fails, how to identify inherent security issues within AI systems and mitigate their effects during decision-making, as well as the impact of computing devices and environments AI/ML systems run on.

3. Course Goals

In this course, students gain hands-on experience solving real-world problems by completing interactive projects focused on AI systems, their inputs, and outputs. Each interactive project is based on a real-world scenario, where each unit is structured as: a pre-unit quiz, instructional content with links to interactive demonstrations, an introductory motivation task, three interactive tasks of increasing difficulty, and a post-unit quiz. For each interactive task, students solve problems by manipulating items or example data to see and evaluate the outcomes and changes in outcomes produced by AI/ML systems. Students do not program models. Rather, they assess plausible outputs and metrics that models would produce and explore ways to improve performance. It is our intent that students develop the skills needed to become capable users of AI systems. Specifically, students are exposed to real-world data and scenarios to learn how to:

1) Interact with different types of AI systems and recognize their capabilities and limitations.
2) Explain the effects of data quality, quantity, and representativeness on the performance of ML systems.
3) Inspect, validate, and critically assess the outputs of AI systems.
4) Discuss the advantages and disadvantages of different computing devices and environments for the deployment of AI systems.

5) Analyze AI system inputs and outputs from computer vision applications.
6) Analyze AI system inputs and outputs from language technologies, including LLMs.
7) Analyze interpretable and explainable AI applications for decision making.
8) Explain security practices in AI, promoting informed and conscientious use of AI technology.

4. Units

In this interactive project-based course, we have 8 units:

#	Unit
1	AI Capabilities and Non-Capabilities
2	The Role of Data
3	Model Evaluation and Troubleshooting
4	Hardware Requirements
5	Language Technologies and LLMs
6	Computer Vision
7	Decision Support
8	Responsible AI

5. Unit Structure & Assessment

Each unit contains three parts:

Pre-Quiz:

- Attempt the pre-unit quiz to the best of your ability. This initial assessment is designed to gauge your prior knowledge. Make your best guess on each question as you will receive full points for completion of the quiz. You will not receive feedback on your performance on the quiz, as you will learn about the question topics by completing the unit.

Interactive Project:

- Each project contains:
    - Instructional content and links to interactive demonstrations:
        - Instructional content includes text and image-based introductions to key terms and overviews of the interactive tasks you will complete. Read through the instructional content before completing the interactive tasks.
        - Inside each of the instructional content, there are links to interactive demos which enable students to explore the ideas discussed in more detail before the interactive tasks.
    - 4 Interactive tasks:
        - Motivation task: A visual narrative set in a real-world scenario.
        - 3 interactive no-code tasks to learn concepts through hands-on practice

- Your score for the project will be based on the completion of the 4 tasks. Ensure you complete all parts of each task to receive full points.

Post-Quiz:

- After completing the project, take the post-unit quiz. Answer the question to the best of your ability as your score will be based on accurately answering the quiz questions. You will receive feedback on your performance to help you understand the material better.

Unit

The units are geared towards providing interactive experiences based on real-world scenarios.

Unit 1: AI Capabilities and Non-Capabilities

Scenario: The student is a research assistant at a college mental health center, who labels and analyzes students' social media posts and explores the capabilities and limitations of different models that perform the same task.

- Explain the significance and potential impact of what AI can and cannot do in real-world scenarios.
- Perform an ML task manually, such as classifying data points or text sentiment given a simple task definition.
- Distinguish cases where it may be difficult or impossible for a human to accurately label a data point from the cases where this is easy.
- Compare the evaluative outputs of humans to the outputs of several ML systems.
- Compare the accuracy of predictions of multiple ML systems.
- Identify use cases where current ML capabilities are sufficient and cases where current ML capabilities are not sufficient to perform a necessary task.

Unit 2: The Role of Data

Scenario: The student takes the role of a junior data engineer helping with the predictive maintenance of airplanes, who must identify poor quality data, evaluate the impact of data on model performance, and perform feature selection to improve model performance.

- Explain the significance and potential impact of data in real-world AI applications.
- Differentiate among common types of data (e.g., text, images, tables, audio, video), and contrast their properties.
- Demonstrate how real-world objects or concepts can be represented as numerical features (i.e., an input to a ML model).
- Contrast inputs and outputs of various ML models and their uses.
- Explain the process of training and evaluation of ML models, focusing on the role of gold standard data.

Unit 3: Model Evaluation and Troubleshooting

Scenario: The student is an AI consultant, who must evaluate, troubleshoot, and improve the performance of a traffic sign detection model in the context of autonomous vehicles.

- Explain the importance and impact of model and data limitations in real-world AI applications, and how to troubleshoot these issues.
- Classify the accuracy of a ML model across a range of possible outcomes to discover which outcomes the model performs well or the model performs poorly.
- Evaluate inputs to an AI application in terms of their correctness, validity, and/or if they are expected.
- Evaluate outputs of an AI application in terms of whether they should be trusted.
- Analyze the variance of the accuracy of an ML model on example tasks to identify when certain tasks are beyond its capabilities.
- Compare the outputs of an ML model trained on a higher-quality labeled dataset to the outputs of a model trained on a poorly labeled dataset.
- Compare the impact on the accuracy of an ML system when the training dataset and testing dataset are from different contexts.
- Evaluate an AI application in terms of the severity of consequences resulting from an incorrect output.

Unit 4: Hardware Requirements

Scenario: Students will collaborate with clients to recommend suitable hardware solutions. They will evaluate and suggest the appropriate hardware systems capable of running machine learning models tailored to various disaster management scenarios.

- Compare multiple computing devices and environments in terms of their capabilities.
- Compare how the hardware resources impact the feasibility, accuracy, and throughput of a variety of AI applications.
- Identify appropriate computing resources given the requirements of an AI application.
- Understand the differences between the different ways AI systems need to handle load, from single and multi-stream deployments to server and offline deployments.
- Differentiate between throughput and latency when it comes to understanding an AI system.
- Evaluate how differences in hardware, AI models, and server load can change the throughput of an AI system.
- Understand appropriate use cases for large language models.
- Analyze the impact of hardware on LLM inference performance.
- Evaluate deployment options for LLMs based on technical and cost considerations, between cloud computing, self-hosting, and using an API.

Unit 5: Language Technologies and LLMs

Scenario: Students will collaborate with a project manager and data scientist to evaluate a client facing chatbot focused on providing timely support with client requests. On the background of this project students will gain experience working with and evaluating NLP applications.

- Evaluate an example NLP application in terms of its feasibility (data availability, data collection effort, potential ethical concerns).
- Decide on the input data that is appropriate to use given the functionality and expected outputs of an NLP application.
- Evaluate the quality of outputs of a large language model (LLM) such as ChatGPT.
- Identify errors and their potential sources, including context changes in NLP applications.

Unit 6: Computer Vision

Scenario: The student uses and evaluates computer vision models to identify objects (specifically wildlife) and their locations in images.

- Evaluate an example computer vision application in terms of its feasibility (data availability, data collection effort, potential ethical concerns).
- Identify errors and their potential sources, including environmental changes in computer vision applications.
- Compare and contrast the outputs of computer vision systems produced under different datasets and human/computer resource requirements.
- Decide on the input data that is appropriate to use given the functionality and expected outputs of a computer vision application.
- Analyze the outputs of a computer vision application and evaluate if they are correct based on the provided input.
- Place a computer vision component in the structure of a larger AI application and recognize the role of the component within the structure.

Unit 7: Decision Support

Scenario: The student evaluates an AI decision support system that provides input on housing assistance.

- Understand how fully-automated AI decision making can lead to issues in situations where there needs to be subjective judgements that go beyond simple objective measures.
- Identify how well-defined features can lead to mismatches between model performance and model accuracy, requiring users to use models to supplement user information.

- Recall three categories of how we can add explainability to AI decision making - examples, feature importance, and explainable models - and their pros and cons in solving your problem at hand.
- Differentiate between explanation accuracy and model accuracy for explainable decision making.

Unit 8: Responsible AI

Scenario: The student evaluates security in AI applications for a medical device company.

- Understand the importance of explainable AI systems in the AI landscape, focusing on security applications.
- Evaluate model cards to understand relevant and irrelevant uses of AI for a particular application.
- Evaluate the tradeoffs between AI models that are robust to random attacks and those that are strong on a task.
- Explain the importance and benefits of red-teaming an AI application.
- Understand the importance of auditing an AI model for security.