AD331 Artificial Intelligence

Week 01

Outline

Class Introduction

What is AI? Defining AI, ML, Deep Learning and Neural Network

History and Evolution of AI

Introduction to Machine Learning Paradigms

Instructor Information

- Name: BC (Byungcheon) Ko
- You can call me BC!
- Pronouns: He/Him
- Reach out to me via Slack
- Dog: Genie
- Work Experience
  - North Seattle College
  - Seattle Central College
  - Social Media Analytics
  - EdTech
  - Consumer Finance
  - Military

TA - Taylor Papke

Education

- Georgia Institute of Technology - MS in CS
- North Seattle College - App Dev

Work

- Teaching Assistant - NSC
- Technical Project Manager & Product Owner - NSC
- Instructor - Coding with Kids
- Instructor - Seattle Central College
- AI Research - Experiential AI
- Mobile UI/UX - Green Water Labs

Communication

We have a dedicated Slack channel specifically set up for this class. This platform will serve as a central hub for class announcements, resources, and discussions.

- Interaction: We strongly encourage you to use the Slack channel to ask questions, share insights, and engage in discussions with your peers. This interactive environment is designed to facilitate a collaborative learning experience.
- Support: Whether you have a quick question or need a detailed discussion on a specific topic, the Slack channel is an excellent resource. Both your instructors and classmates can provide support and feedback, fostering a community of learning.
- Real-time Communication: With Slack, you can receive immediate notifications and responses, enabling dynamic and timely interactions.

Introduce Yourselves

Name

Pronouns

Favorite Movies/Shows/Anime/Games

What did you do during the break?

Hybrid Flex/ HyFlex Modality

“students are given choice in how they participate in the course and engage with material in the mode that works best for them over the course and from session to session.”

In HyFlex courses, students can choose from one of three participation paths:

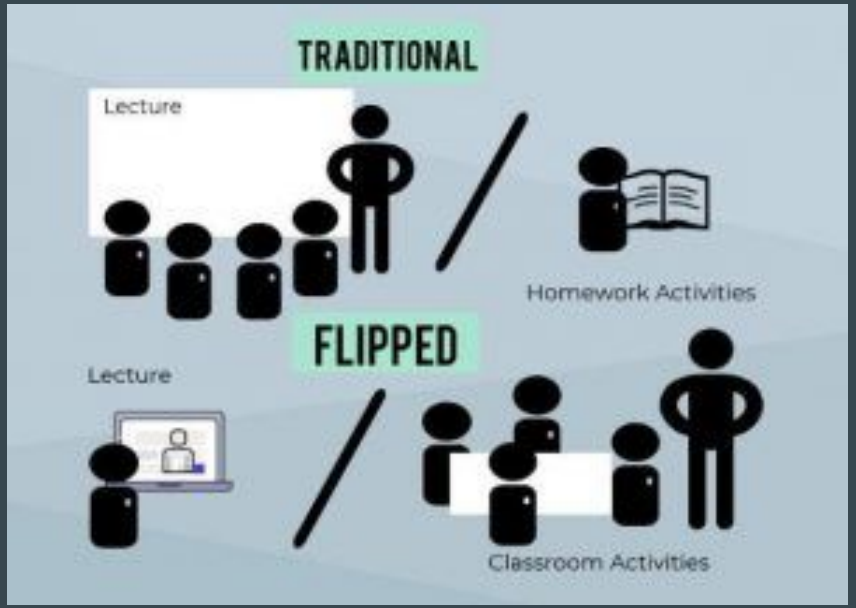
- Participate in face-to-face synchronous class sessions in-person (in a classroom)
- Participate in face-to-face class sessions via video conference (e.g., Zoom)
- Participate fully asynchronously

https://ctl.columbia.edu/resources-and-technology/teaching-with-technology/teaching-online/hyflex/

Flipped Classroom Model

Lecture or direct instruction is not the best use of class time.

Students encounter information before class (Pre-recorded lectures and assignments), freeing class time for questions



Assignments

Hands on Assignments

Discussions

Technical Interview Prep

Certification Prep - AWS Academy

Hands- on Project

AI Tools - Can we use them?

ChatGPT, Gemini, Claude

Grading

Assignments are due at 11:59 PM Pacific Time

Daily Deduction: For each day an assignment is submitted after the deadline, 1% will be deducted from the total grade of the assignment. This deduction applies immediately following the due date and time.

Maximum Penalty: The maximum penalty for late submissions is 15%. This limit is reached when an assignment is 15 days late. Beyond this point, no further deductions will be applied for additional lateness.

Resubmission

You are allowed to resubmit

- Why
- Number of times

Percentage to GPA Conversion Chart

If you go to Grades, you should be able to see your percentage total and GPA

Options

- Calculate based only on graded assignments

Percentage-to-GPA Conversion Chart

Name:	Range:
4.0	100 % to 95.0%
3.9	< 95.0 % to 94.0%
3.8	< 94.0 % to 93.0%
3.7	< 93.0 % to 92.0%
3.6	< 92.0 % to 91.0%
3.5	< 91.0 % to 90.0%
3.4	< 90.0 % to 89.0%
3.3	< 89.0 % to 88.0%
3.2	< 88.0 % to 87.0%
3.1	< 87.0 % to 86.0%
3.0	< 86.0 % to 85.0%
2.9	< 85.0 % to 84.0%
2.8	< 84.0 % to 83.0%
2.7	< 83.0 % to 82.0%
2.6	< 82.0 % to 81.0%

Syllabus & Course Structure Questions?

Slack Channel Setup

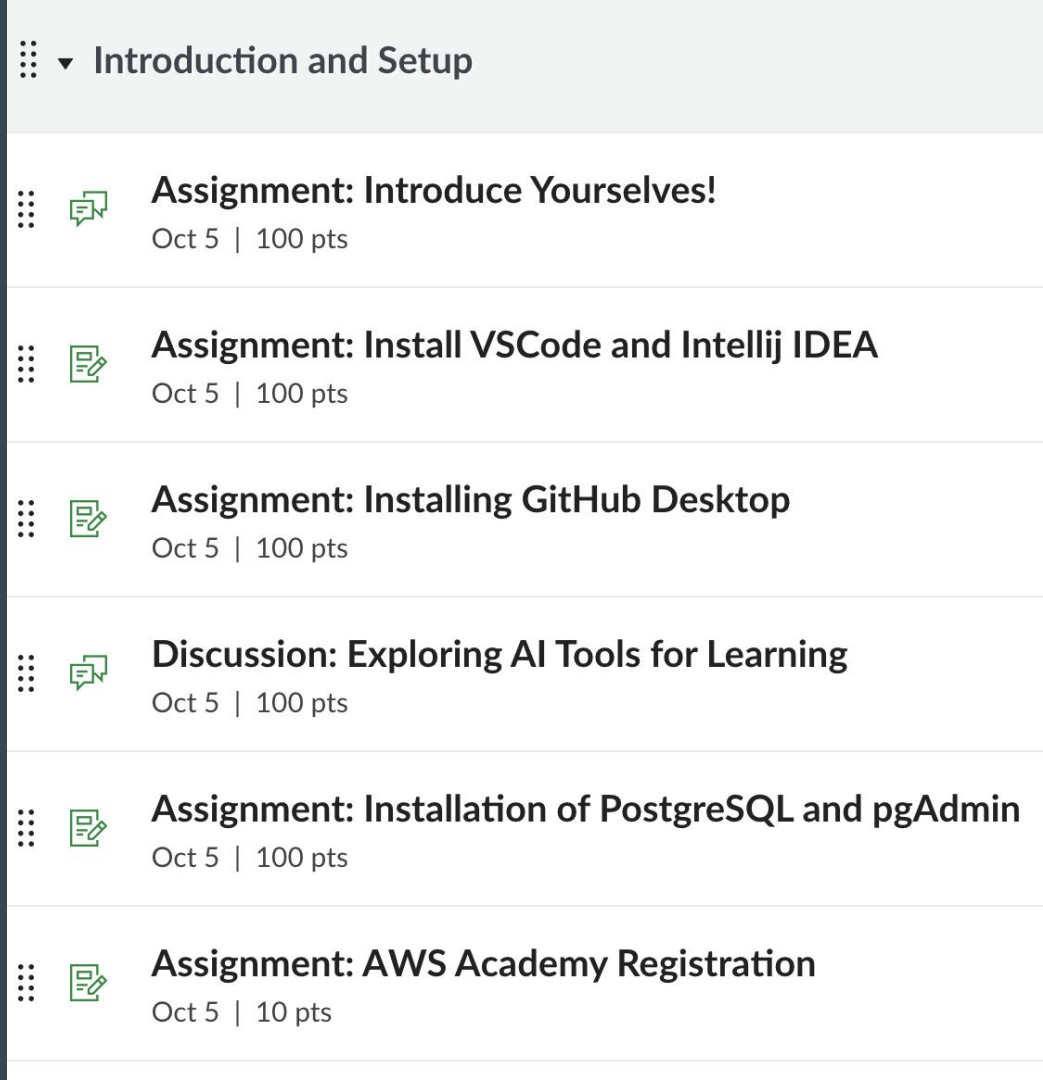
AD331-Artificial Intelligence

AWS Academy setup

Topical Outline

- 1. Introduction to AI and Machine Learning
- 2. Machine Learning Fundamentals and the ML Lifecycle
- 3. Deep Learning and Neural Networks
- 4. Introduction to Generative AI
- 5. Applications of Foundation Models 1
- 6. Applications of Foundation Models 2
- 7. Training and Fine-tuning Foundation Models
- 8. Evaluating Foundation Model Performance
- 9. Responsible AI - Bias and Fairness
- 10. Responsible AI - Transparency and Explainability
- 11. Security, Compliance, and Governance for AI Solutions

Setup


Introduction and Setup
Assignment: Introduce Yourselves!
Oct 5 | 100 pts
Assignment: Install VSCode and Intellij IDEA
Oct 5 | 100 pts
Assignment: Installing GitHub Desktop
Oct 5 | 100 pts
Discussion: Exploring AI Tools for Learning
Oct 5 | 100 pts
Assignment: Installation of PostgreSQL and pgAdmin
Oct 5 | 100 pts
Assignment: AWS Academy Registration
Oct 5 | 10 pts

What is AI? Defining AI, ML, Deep Learning, and Neural Networks

What is AI? A Framework

- Artificial Intelligence (AI): The broad concept of creating machines that mimic human cognitive functions.
- Two main types: Strong AI (human-level general intelligence) and Weak/Narrow AI (task-specific intelligence).
- AI's Goal: To allow machines to perceive, reason, act, and adapt.
- The Big Picture: AI is the umbrella term.

Machine Learning (ML): The Engine of AI

- Machine Learning (ML): A subset of AI.

- The core idea: Giving computers the ability to learn from data without being explicitly programmed.

- How it works: An algorithm finds patterns and relationships in massive datasets.

- Key ML Types: Supervised Learning (labeled data), Unsupervised Learning (unlabeled data), Reinforcement Learning (learning through trial and error/rewards).

Deep Learning (DL): ML with Sophistication

- Deep Learning (DL): A subset of ML that uses deep, multi-layered Neural Networks. - Power: The ability to automatically learn hierarchical features from raw data.

- "Deep" refers to: The number of layers in the network. Shallow networks have one or two, Deep networks have many (dozens or even hundreds).

- Primary Applications: Image recognition, natural language processing (NLP), speech translation, and autonomous vehicles.

Neural Networks: The Brains of Deep Learning

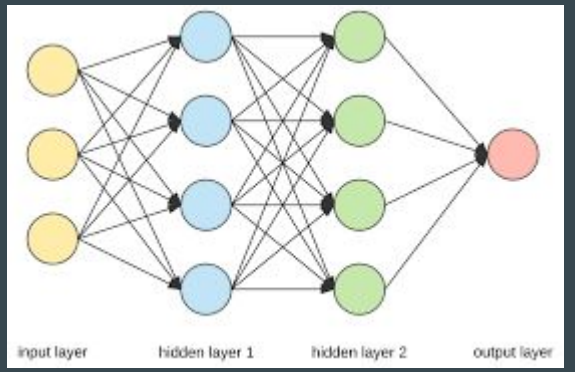
- Neural Networks (NNs): The core computational model underlying DL.

- Structure: Inspired by the human brain’s network of neurons.

- Components: Input Layer (receives data), Hidden Layers (perform complex computations), and Output Layer (provides the result/prediction).

- The 'Neuron' (Node): A mathematical function that takes input, applies weights, adds a bias, and passes the result through an activation function.

- Learning: Occurs by adjusting the weights and biases between the nodes via a process called backpropagation.



The Complete AI Framework

- AI is the Parent: The pursuit of building intelligent machines.

- ML is the Method: The technique that allows machines to learn from data without explicit programming.

- DL is the Advanced Tool: A sophisticated form of ML using multi-layered Neural Networks.

- NNs are the Architecture: The specific computational structure (layers of neurons) that powers DL.

- Key Takeaway: All Deep Learning is Machine Learning, and all Machine Learning is Artificial Intelligence.

Technical Interview Prep - Week 01 part 1

Explain the difference between AI, Machine Learning, and Deep Learning.

History and Evolution of AI

Introduction

What is AI? The simulation of human intelligence processes by machines.

Goals: Reasoning, learning, problem-solving, perception, language use.

Early Conceptual Roots: Mythology, automata, and philosophical queries about mind and mechanism.

The Dawn of AI: The theoretical groundwork of the mid-20th century.

The Foundational Era (1940s-1970s)

Alan Turing (1950): Proposed the Turing Test (The Imitation Game) in his paper "Computing Machinery and Intelligence."

Dartmouth Workshop (1956): John McCarthy coined the term "Artificial Intelligence"; marked the official birth of the field.

Early Programs: The Logic Theorist (Newell, Simon, Shaw) and Perceptrons (Frank Rosenblatt).

Early Optimism and Limitations: The creation of the first chatbots like ELIZA (Joseph Weizenbaum).

The AI Winters (1970s & 1980s)

Initial Hype vs. Reality: Systems struggled to scale beyond "toy problems."

Lack of Computational Power: Computers lacked the memory and speed needed for complex systems.

Funding Cuts: The Lighthill Report (1973) in the UK and declining US government support led to the First AI Winter.

Brief Resurgence (1980s): Rise of Expert Systems (e.g., XCON); programs that encoded human expertise.

Second AI Winter: The eventual failure of Expert Systems and the collapse of the LISP machine market.

The Machine Learning Renaissance (1990s-2010s)

- Shift in Focus: From symbolic reasoning to data-driven approaches and Machine Learning (ML).
- Key Technological Drivers: Internet, increasing data (Big Data), and vastly improved computing power (Moore's Law).
- Major Milestones:
  - 1997: Deep Blue (IBM) defeats world chess champion Garry Kasparov.
  - Early 2000s: Growth of AI in web search, fraud detection, and recommendation systems.
  - 2011: IBM Watson wins on the TV quiz show Jeopardy!

The Deep Learning Revolution (2010s-Present)

- Key Enabler: Deep Learning—Neural Networks with many layers, enabled by powerful GPUs and massive datasets.
- Breakthrough Applications:
  - Image Recognition (2012): AlexNet drastically improved computer vision accuracy.
  - Speech Recognition: Led to the rise of virtual assistants (Siri, Alexa).
  - AlphaGo (2016): Google DeepMind's AI defeats the world Go champion, a game far more complex than chess.
- The Generative AI Era (Post-2017):
  - Transformer Architecture and Large Language Models (LLMs) like GPT.
  - Focus on generating new content: text, images, and code.

Current State and Future Trajectories

- Narrow AI Dominance: Current AI is powerful but specialized (e.g., image classifiers, LLMs).
- The Pursuit of AGI: Research is ongoing into Artificial General Intelligence (AGI)—AI with human-level cognitive ability across many tasks.
- Emerging Trends:
  - Multimodal AI: Integrating text, images, and audio seamlessly.
  - Explainable AI (XAI): Making complex models more transparent and trustworthy.
  - Autonomous Systems: Advanced robotics and self-driving technologies.
- Ethical and Societal Concerns: Bias, regulation, job displacement, and alignment with human values.

Introduction to Machine Learning Paradigms

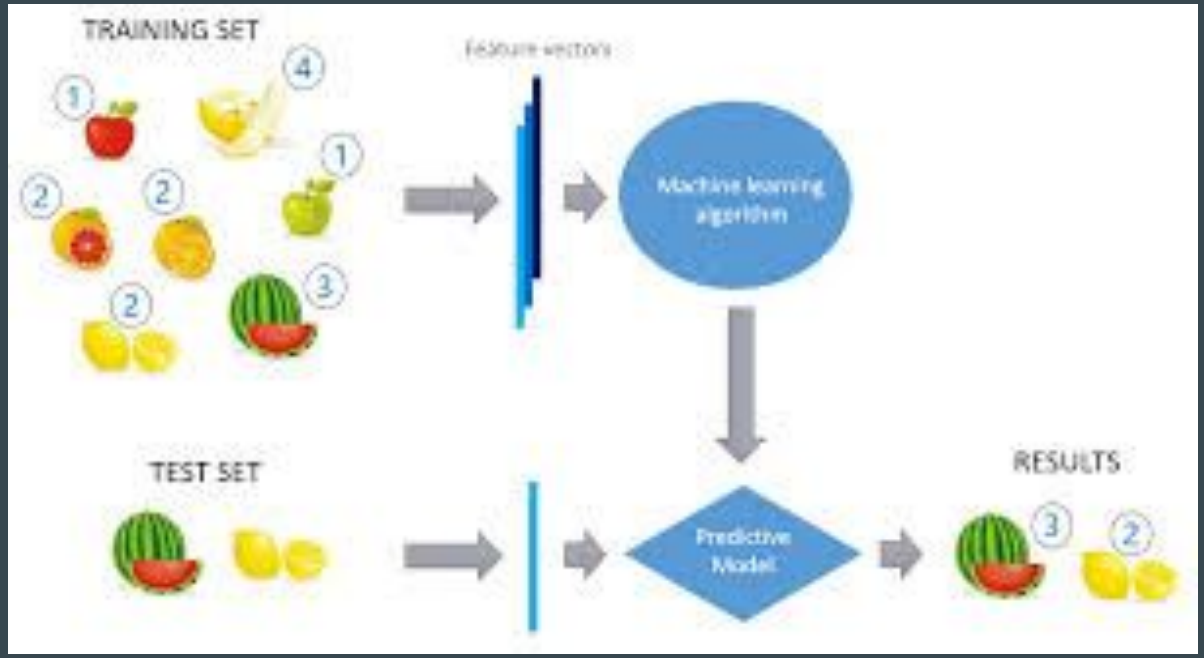
The Three Pillars of Machine Learning

Machine Learning (ML) is the field of study that gives computers the ability to learn without being explicitly programmed.

ML algorithms are broadly categorized by how they use data and feedback to learn.

Supervised Learning: Learning with a Teacher

- Definition: The model is trained on a labeled dataset.
- Mechanism: Learns a mapping function from input to output.
- Two main types: Classification (predicting a category) and Regression (predicting a continuous value).
- Examples: Spam detection, Image recognition, Predicting house prices, Sentiment analysis.



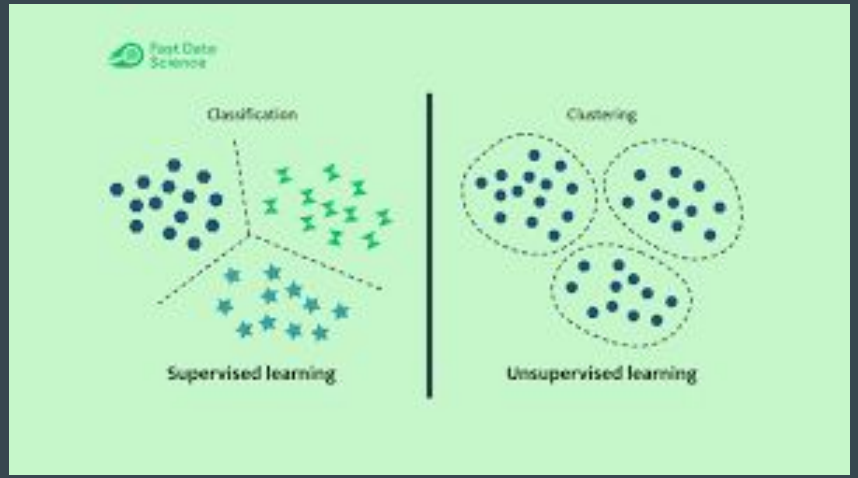
Unsupervised Learning: Discovering Hidden Patterns

Definition: The model is trained on an unlabeled dataset.

Mechanism: Finds hidden structures, patterns, or groupings within the data.

Common Tasks: Clustering (grouping similar data points) and Dimensionality Reduction (simplifying data).

Examples: Customer segmentation, Market basket analysis (association rules), Anomaly detection.



Reinforcement Learning: Learning by Trial-and-Error

Definition: An Agent learns to make a sequence of decisions in an Environment to maximize a cumulative Reward.

Mechanism: Trial-and-Error process. The Agent follows a Policy (strategy) to select actions that lead to the highest expected long-term reward.

Key Concepts: State, Action, Reward, and Policy.

Examples: Game playing (AlphaGo, Chess), Robotics control, Autonomous driving, Resource management.

Comparison

Data Type: Supervised requires Labeled Data; Unsupervised uses Unlabeled Data; Reinforcement uses a Reward signal from interaction.

Goal:

- Supervised is to Predict;
- Unsupervised is to Discover/Explore;
- Reinforcement is to Maximize Cumulative Reward.

Technical Interview Prep - Week 01 part 2

What is supervised learning?

Technical Interview Prep - Week 01 part 3

Give an example of a classification problem, and present it using the STAR method.

Assignment: Development Environment Setup and Data Exploration

Anaconda Setup

https://www.kaggle.com/code/lalitharajesh/iris-dataset-exploratory-data-analysis

https://eminebozkus.medium.com/exploring-the-iris-flower-dataset-4e000bcc266c

https://www.geeksforgeeks.org/data-analysis/exploratory-data-analysis-on-iris-dataset/