CIS 678 Machine Learning

Introduction to ML

Week 1 Plan

- **Get to know each other (networking)**
- Set up our course objective, guidelines, and evaluation procedure.
- Introduction to ML
- Set up our programming development environment(s), more specifically,
  - Google Colab(oratory) on your Google drive,
  - HPC cluster account (introduction)
- Basics of Math, Statistics, and Probability (Part 1)

ML introduction

What *is* Machine Learning?

Machine Learning (ML) is when a computer learns patterns from data and improves its performance **without being explicitly programmed** for every task.

What *is NOT* Machine Learning?

These are programs that follow **explicit instructions** or rules written by a human, without adapting or learning from data.

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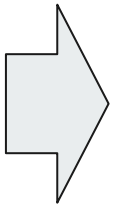
Example Applications



1. **Calculator App:**
   - Follows strict math rules coded by a programmer.
   - It doesn't "learn" how to calculate—it just executes instructions.
1. Digital Alarm Clock:
   - Goes off at a set time programmed by the user.
   - No learning—just performs based on what you set.
1. Static Website:
   - Displays fixed content to all users.
   - Doesn't adapt or learn from user behavior.
1. Microwave Oven Timer:
   - Follows direct input commands (e.g., heat for 2 minutes).
   - Doesn't learn what type of food you usually heat or adjust automatically.

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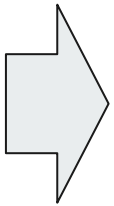

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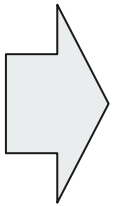

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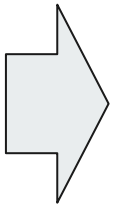

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   - Over time, it gets better at predicting which emails are spam—even if it's never seen that exact message before.
2. Netflix Recommendations:
   - Learns fro… …atched.
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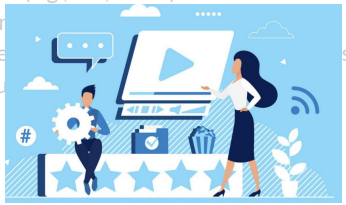

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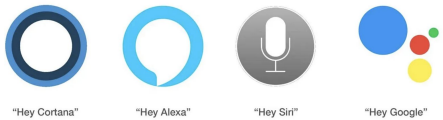

2. Netflix R
   - Learns from what you and others have watched.
   - Suggests new movies/shows based on patterns in viewing behavior.
3. **Voice Assistants (e.g., Siri, Alexa):**
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Example Applications

4. **Self-Driving Cars:**
    - Learn to detect pedestrians, read signs, and respond to traffic using data from cameras, radar, etc.

5. Conversational Age
    - Learns fr
    - Improve

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5. **Conversational Agent (ChatGPT)**
    - Learns from massive text data
    - Improves using human feedback.

Let's Check with our Understanding!

Q. What was the average daytime temperature in Grand Rapids in August 2024?

Is it a ML problem?

Let's Check with our Understanding!

Q. What was the average daytime temperature in Grand Rapids in August 2024?

Clue: This information is already known.

Is it a ML problem?

Let's Check with our Understanding!

Q. What will be the average daytime temperature in Grand Rapids in August 2026?

Is it a ML problem?

Let's Check with our Understanding!

Q. What will be the average daytime temperature in Grand Rapids in August 2026?

Clue: This information is unknown and involves uncertainty.

Is it a ML problem?

QA

k-NN (1D)

Distance Metric

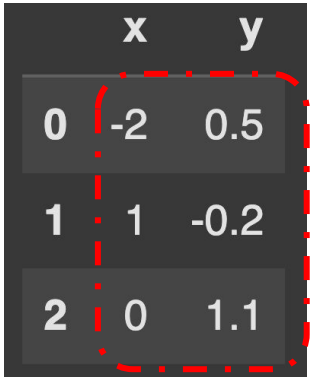
k-NN (First ML Model)

Go To Math (Linear Algebra)

Next slides to be planed in another PPTx

Practice (ML introduction)

- Given a set of 2D data points, can you find the closest pair using,
  - L1/Manhattan distance
  - L2 distance,
  - Cosine distance



	x	y
0	-2	0.5
1	1	-0.2
2	0	1.1

Practice (ML introduction)

- Find the independent pairs of vectors, if there are any.

	x	y	z
0	-2	10	0
1	1	1	0
2	0	0	10

Practice (ML introduction)

- You have two **ML engineer** friends with their **years of experience** and **salaries** are as follows

	profession	years-of-experience	salary
0	ML engineer	2	120000
1	ML engineer	5	160000

Practice (ML introduction)

- You have two **ML engineer** friends with their **years of experience** and **salaries** are as follows
- What you expect the salary would be for two other ML engineers
    - With no experience
    - With 3 years of experience?

	profession	years-of-experience	salary
0	ML engineer	2	120000
1	ML engineer	5	160000
2	ML engineer	0	?
3	ML engineer	3	?

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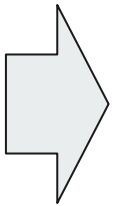

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1. Bank Fraud Detection:
    - Learns what normal spending looks like.
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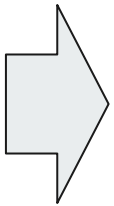

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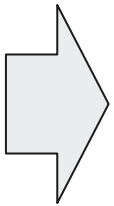

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Outline

- What is ML and what isn’t
- Distance metrics
- Vector orthogonality
- Linear equation test

Outline

- What is ML and what isn’t
- k -Nearest Neighbors (kNN) Model