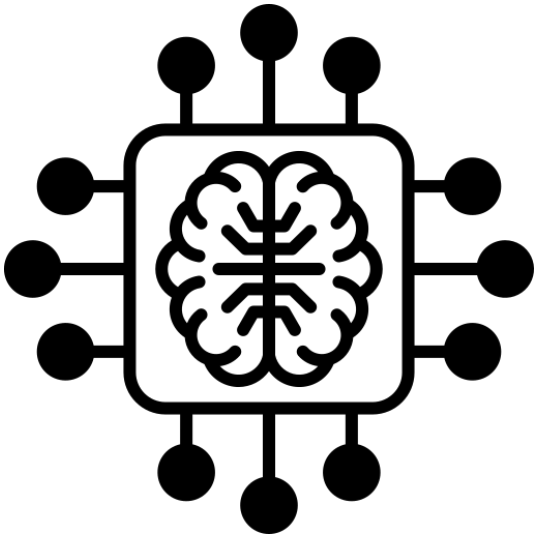
SBS4115 Fundamentals of AI & Data Analytics



Final Project Presentations and Review

Lecturer: Ir Dr Kelvin K. W. Siu
email: kelvinsiu@thei.edu.hk

高科院 Thei

Department of Construction, Environment and Engineering

Intended Learning Outcomes

- By the end of this lecture, you will have revised on the following topics:
  1. Supervised learning and unsupervised learning.
  2. Application of computer vision and natural language processing (NLP).

Machine Learning Paradigms

- Machine learning is categorized into paradigms based on the nature of the data and learning objectives:

- Supervised Learning: Trains on labeled datasets to make predictions.
- Unsupervised Learning: Identifies patterns and relationships in unlabeled data.

Supervised Learning

- Definition:

Supervised learning involves training a model on a labeled dataset.

The goal is to predict outcomes for new, unseen data.

Supervised Learning Techniques

- Techniques in Supervised Learning:

Linear Regression: Predicts numerical outcomes by fitting a straight line to the data.

Logistic Regression: Used for binary classification tasks.

Supervised Learning Techniques

- Techniques in Supervised Learning:

Support Vector Machines (SVM): Finds the optimal boundary between data classes.

Neural Networks: Handles complex, non-linear relationships in data.

- Evaluation:

Metrics include accuracy, precision, recall, and F1-score.

Unsupervised Learning

- Definition:

Unsupervised learning finds hidden patterns or structures in unlabeled data.

Focuses on exploring data without predefined outcomes.

Unsupervised Learning

- Key Characteristics:

No labeled data is required.

Models seek to cluster data or reduce dimensionality.

- Applications:

Clustering (e.g., customer segmentation, anomaly detection).

Dimensionality Reduction (e.g., Principal Component Analysis, t-SNE).

Comparison: Supervised vs. Unsupervised Learning

Supervised Learning:

Requires labeled datasets.

Focuses on prediction tasks.

Example: Predicting whether an email is spam or not.

Comparison: Supervised vs. Unsupervised Learning

Unsupervised Learning:

Works with unlabeled data.

Focuses on pattern recognition and grouping.

Example: Grouping customers by purchasing behavior.

Introduction to AI Applications

- Artificial Intelligence (AI) powers many modern systems, transforming how we interact with technology.

- Focus Areas:

Image Recognition: Interpreting and classifying visual data.

Face Recognition: Identifying individuals using facial features.

Natural Language Processing (NLP): Understanding and processing human language.

Image Recognition: Dataset Collection

1. Dataset Collection:

A large, diverse dataset ensures robustness across conditions.

Labeled images are crucial for supervised learning.

Image Recognition: Preprocessing

- **2. Preprocessing:**

Aims to standardize the dataset for improved performance.

Image Recognition: Model Selection

- **3. Model Selection:**

Convolutional Neural Networks (CNNs) are the backbone of image recognition.

Image Recognition: Training and Evaluation

- **4. Model Training:**

Use labeled datasets to teach the model.

- **5. Model Evaluation:**

Metrics: Accuracy, Precision, Recall, Error Rates.

Face Recognition: Overview

Identify and verify individuals based on unique facial features.

Features analyzed: distance between eyes, nose shape, jawline.

Outputs a digital template representing the individual.

Face Recognition: Applications

- Key Applications:

Security Systems:

- Airports: Match faces with ID photos for verification.
- Enhances security while reducing processing time.

Mobile Authentication:

- Unlock devices using facial recognition.
- Combines convenience and security.

Face Recognition: Advancements

- Advancements and Benefits:

AI algorithms distinguish subtle facial differences.

Reliable under varied conditions (lighting, angles).

- Real-Time Processing:

Ensures seamless experiences.

Reduces waiting times in applications like security checks.

Natural Language Processing (NLP): Rule-Based Systems

- 1. Rule-Based NLP Systems:

Relies on predefined rules for language processing.

Techniques:

- - Pattern Matching: Identifies keywords or phrases.
- - Grammar Rules: Parses sentences using syntax structures.

Natural Language Processing (NLP): Machine Learning

- 2. Machine Learning in NLP:

Uses labeled datasets to recognize patterns in text.

Techniques:

Logistic Regression, Naive Bayes, Support Vector Machines (SVM).

Applications:

Sentiment Analysis: Monitor public opinion by classifying text as positive, negative, or neutral.

Named Entity Recognition: Identify specific entities (names, dates).

Natural Language Processing (NLP): Deep Learning

- 3. Deep Learning in NLP:

- Advanced techniques for complex language tasks.

Methods:

- Recurrent Neural Networks (RNNs): Process sequential data.
- Transformers (e.g., BERT, GPT): Handle long-range dependencies.

Applications:

- Machine Translation, Text Summarization, Question Answering.

Checklist

- Can you:
  1. Describe supervised learning and unsupervised learning.
  2. Describe applications of computer vision and natural language processing (NLP).