DSC2103 - Computer Science
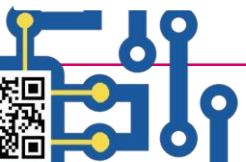
Chapter 11

Artificial Intelligence and Machine learning

Immaculate Kamusiime,

Department of Computing and Technology
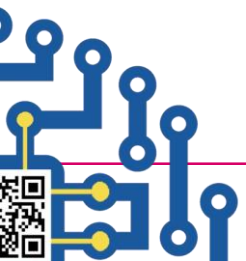
Advent Semester 2024

Artificial Intelligence and Machine learning

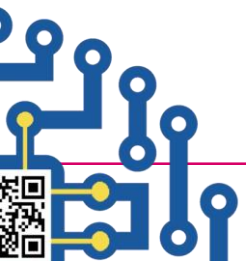- **Differentiate between Artificial Intelligence and Machine learning**

In class group discussion:
Please illustrate, use examples
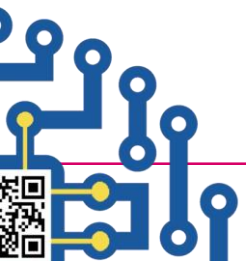
Lecture Outline

- Introduction

- AI Fact and Fiction

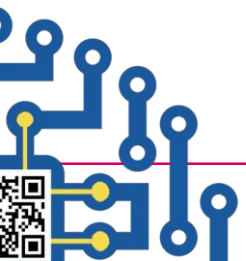- Big Data and Machine Learning

Lecture Objectives & Learning Outcomes

✓ In this module, you will be introduced to artificial intelligence and machine learning and how these revolutionary technologies are being utilized across the world today.

✓ Analyze the concepts of AI and ML

Artificial Intelligence(AI)

AI Fact and Fiction

AI fact refers to the **real** and **true** capabilities and accomplishments of Artificial Intelligence (AI) systems.

There fore, AI fact refers to what AI can really do,

AI fiction refers to the **exaggerated**, hypothetical, or unrealistic portrayals of AI in movies, books, and media.

Thus, AI fiction is the imaginative and sometimes exaggerated ideas about AI that may not be accurate.
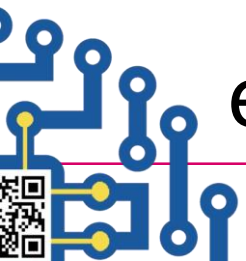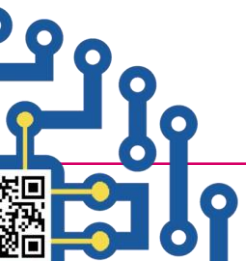
AI all around Us

How AI is changing our day-to-day activities.

1. Entertainment

Classification algorithms can help viewers find videos they will like. Based on a customer's profile, their video rental behavior, and the video rental behavior of other customers with similar demographics, the algorithm predicts which videos a customer is likely to enjoy and makes recommendations to the customer.
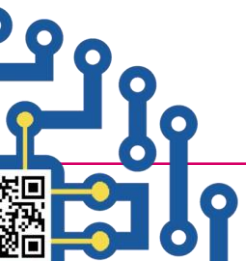
AI all around Us

2. Agriculture

Farmers use cell phones to provide researchers with images of plant diseases. These images are used in image recognition systems to diagnose plant diseases. Combined with environmental data regression, algorithms predict future disease outbreaks.
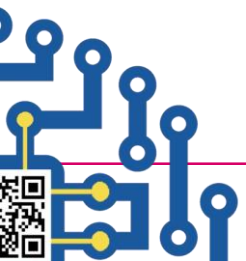
3. Fitness

The fitness app on your smartphone, or fitness tracker, collects data fed into an application that can provide you with valuable health information. Apps must build a model of your movements to identify what constitutes taking a step and the distance you cover with each one! Some fitness trackers are even using self-learning AI software that can recognize and adapt to a wide variety of movements and can learn new fitness activities based on repetitive, cyclical patterns.

AI all around Us

4. Retail

Artificial intelligence solutions in some retail stores improve customer engagement through interactive chat programs or Chatbots. Chatbots can be an effective way to communicate with customers. They can answer frequently asked questions, recommend products, address grievances, collect valuable customer data, and divert calls to a human telesales executive if needed. They can also be programmed to self-learn from past data to keep refining and personalize subsequent customer interactions.
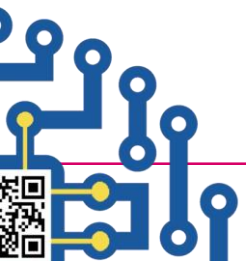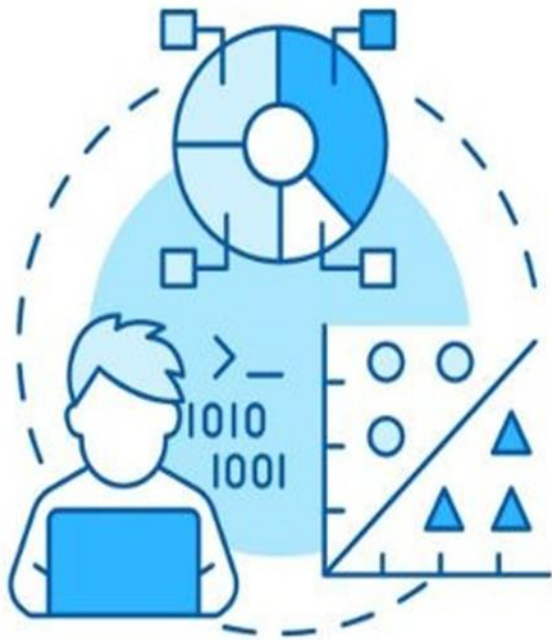
What is Machine Learning
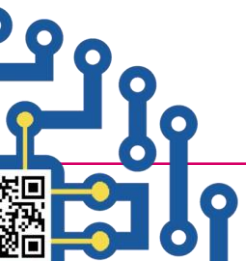
What is Machine Learning

Machine Learning(ML) is a subset of Artificial Intelligence that focuses on the development of algorithms and models that enable computers to learn from and make predictions or decisions based on data.

Types of machine Learning analysis

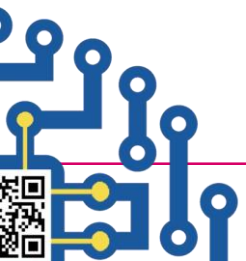Supervised

Unsupervised

Reinforcement

Supervised machine learning Algorithms

1. **Supervised machine learning algorithms** are the most commonly used for <u>predictive analytics</u>.

   These require human interaction to label data ready for accurate supervised learning. In supervised learning, the model is taught by example using input and output data sets processed by human experts, usually data scientists.

   The model learns the relationships between input and output data and then uses that information to formulate <u>predictions</u> based on new datasets.

Supervised machine learning Algorithms

For example; a classification model can learn to identify plants after being trained on a dataset of properly labeled images with the plant species and other identifying characteristics.

Supervised machine learning Algorithms commonly solve Classification and regression problems.

a). Classification problems consist of a discrete unknown variable. Typically, the issue involves estimating which specific sample belongs to a set of pre-defined classes. Examples of classification are filtering email into spam or non-spam, diagnosing pathologies from medical tests, or identifying faces in a picture.
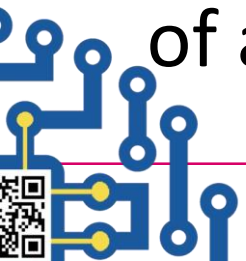
Supervised machine learning Algorithms

b). Regression problems involve estimating the mathematical relationship(s) between a continuous variable and one or more other variables.

This mathematical relationship can then compute the values of one unknown variable given the known values of the others.

Examples of problems that use regression include estimating a car's position and speed using GPS, predicting the trajectory of a tornado using weather data, or predicting the future value of a stock using historical and other data.

Unsupervised machine Learning algorithms

2.Unsupervised machine learning algorithms do not require human experts but autonomously discover patterns in data. Unsupervised learning mainly deals with unlabeled data.

- The model must work on its own to find patterns and information. Examples of problems solved with unsupervised methods are clustering and association.

Unsupervised machine Learning algorithms

a) **Clustering methods** - Clustering is the grouping of data that have similar characteristics. It helps segment data into groups and analyzes each to find patterns. For example, clustering algorithms identify groups of users based on their online purchasing history and then send each member targeted ads.

b) **Association methods** - Association consists of discovering groups of items frequently observed together. Online retailers use associations to suggest additional purchases to a user based on the content of their shopping cart.
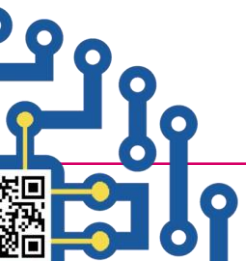
Reinforcement machine learning

3.Reinforcement learning teaches the machine through **trial** and **error** using feedback from its actions and experiences, also known as learning from mistakes.

- It involves assigning positive values to desired outcomes and negative values to undesired effects.

- The result is optimal solutions hence the system learns to avoid adverse outcomes and seek the positive. Practical applications of reinforcement learning include building ratification intelligence for playing video games and robotics and industrial automation.
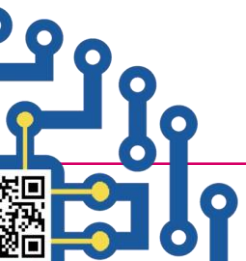
The machine learning process

- **Step 1. Data preparation** - Perform data cleaning procedures such as transformation into a structured format and removing missing data and noisy/corrupted observations.

- **Step 2a. Learning data** - Create a learning data set used to train the model.

- **Step 2b. Testing data** - Create a test dataset used to evaluate the model performance. Only perform this step in the case of supervised learning.

- **Step 3. Learning Process Loop - Selection**. An algorithm is chosen based on the problem. Depending on the selected algorithm, additional pre-processing steps might be necessary.
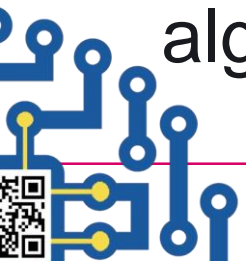
The machine learning process

- **Step 4. Learning Process Loop - Evaluation**. This selected algorithm's performance is evaluated on the learning data. If the algorithm and the model reach an acceptable performance on learning data, the solution validates the test data. Otherwise, repeat the learning process with a proposed new model and algorithm.

- **Step 5. Model evaluation** - Test the solution on the test data. The performances on learning data are not necessarily transferrable to test data. The more complex and fine-tuned the model is, the higher the chances are that the model will become prone to overfitting, which means it cannot perform accurately against unseen data. Overfitting can result in going back to the model learning process.

The machine learning process

- **Step 6. Model implementation** - After the model achieves satisfactory performance on test data, implement the model. Implementing the model means performing the necessary tasks to scale the machine learning solution to big data.
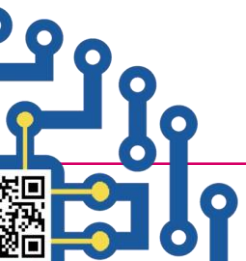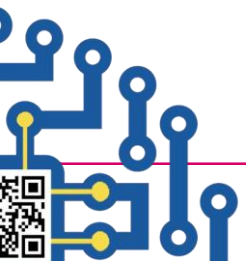
Training machines to recognize patterns

Machine learning has many valuable applications in the field of data analytics. One critical application is **pattern recognition**.

When training the pattern recognition system, a portion of the dataset **prepares** the system, and the remaining amount **tests** the system's accuracy.
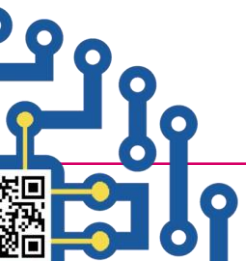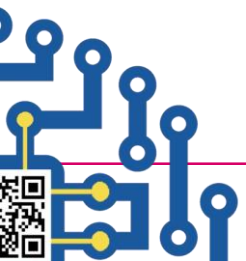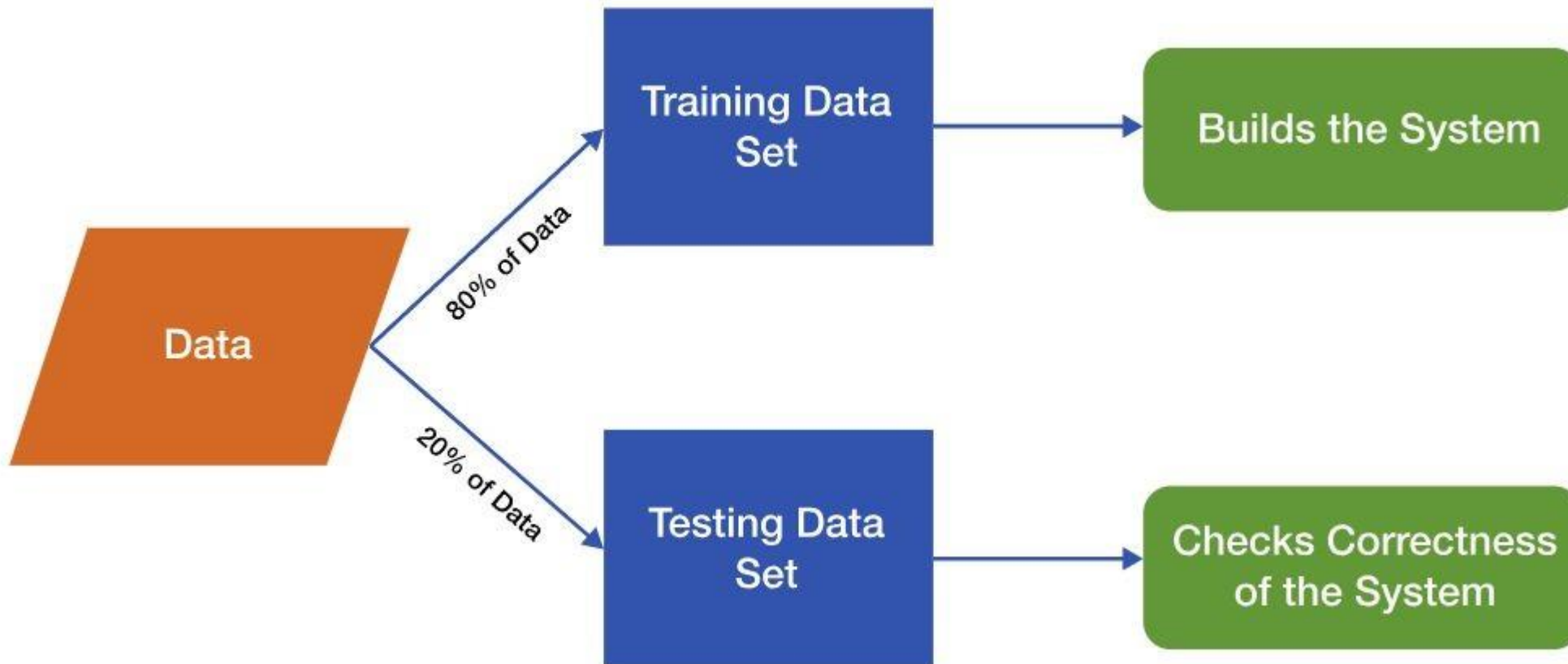
Training machines to recognize patterns

The data set divides into two groups:

i) Train the model and test the model. The training data set is used to build the model and consists of about 80% of the data. It contains the set of images used to train the system.

ii) The testing data set consists of about 20% of the data and measures the model's accuracy. For example, if the system that identifies categories of birds can correctly identify seven out of ten birds, then the system's accuracy is 70%.
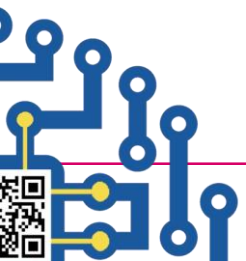
Training machines to recognize patterns

Training machines to recognize patterns

Pattern recognition algorithms can be applied to different types of digital data, including images, texts, or videos, and can be used to automate and solve complicated analytical problems fully.

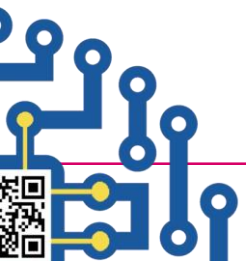The applications and use cases for pattern recognition are virtually unlimited. Some examples include:

1. Mobile Security - Identifying fingerprints or facial recognition to gain access to a smartphone.

Training machines to recognize patterns

2.Engineering - Speech recognition by digital assistant systems such as Alexa, Google Assistant, and Siri.

3.Geology - Detecting specific types of rocks and minerals and interpreting temporal patterns in seismic array recordings.

4.Biomedical - Using biometric patterns to identify tumor and cancer cells in the body.

Questions?
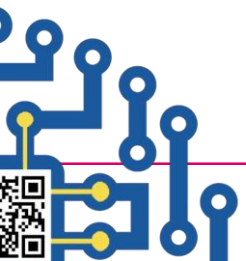
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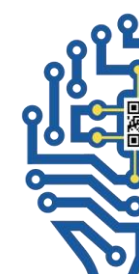
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