Introduction to Generative AI

Learning Objectives
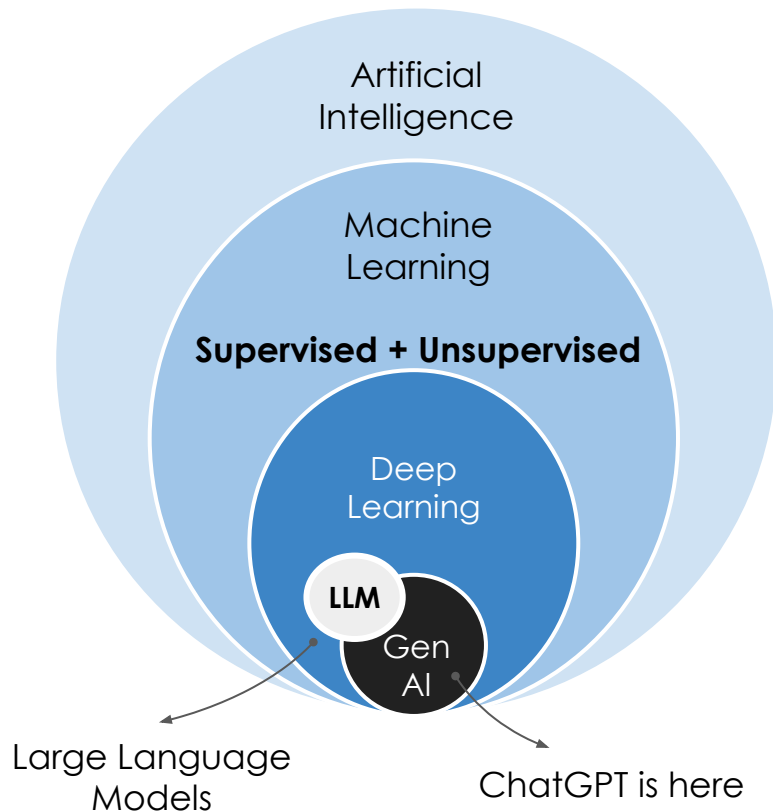
Upon completion of this module, you should be able to:

- Define AI Fundamentals and Generative Models.

- Deconstruct Large Language Models (LLMs)
  a. Analyze the behavior of LLMs and their understanding, completion, and prediction of text.
  b. Investigate the phenomenon of hallucinations in LLMs and its underlying causes.

- Identify the diverse applications of ML, DL, and Generative AI in business, retail, health, and technology sectors.

- Gain practical experience by working with ChatGPT for text and Code generation

Agenda

Here, we will cover:

- Defining AI, ML, DL, LLM and Generative Models via Venn diagram

- Learning supervised and unsupervised ML tasks

- Understanding Generative and Discriminative AI

- A brief timeline of Generative AI

- A peek into generative models

- Deconstructing the behaviour of a large language models

- ML, DL and GenAI applications in business

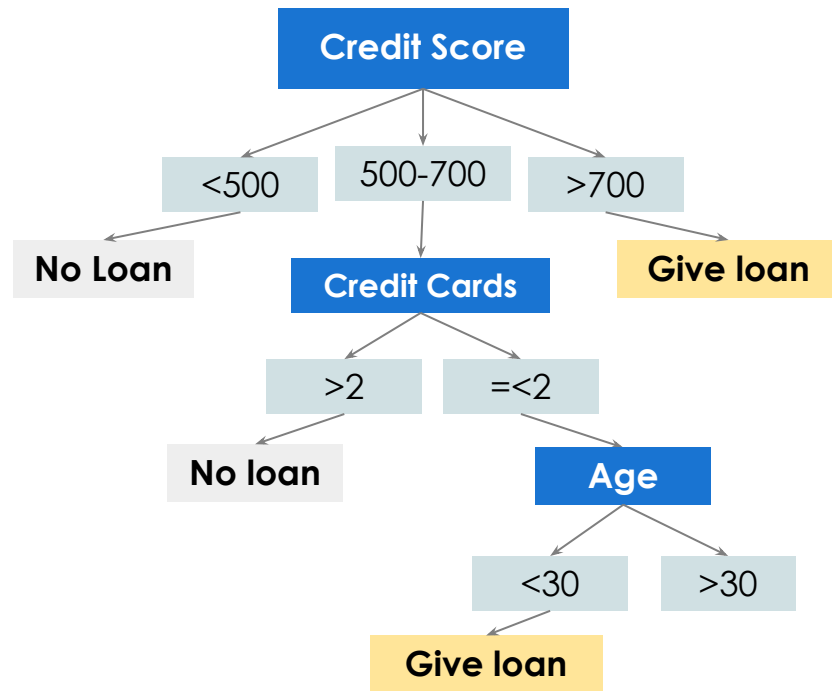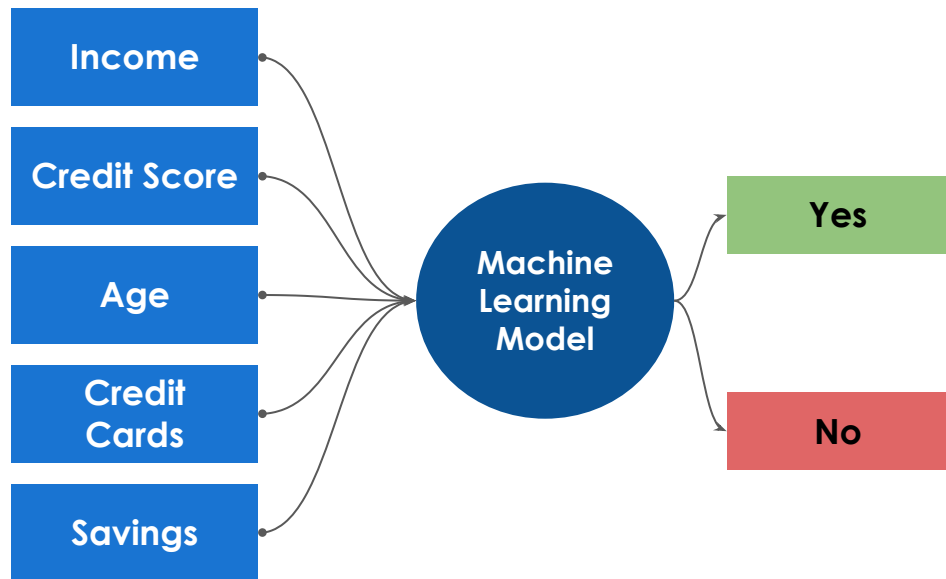- Hands-on demonstration of ChatGPT for text and code generation

Getting the Definitions Right

Artificial Intelligence

Machine Learning

Supervised + Unsupervised

Deep Learning

LLM

Gen AI

Large Language Models

ChatGPT is here

Supervised Learning

Should I give loan to this customer?
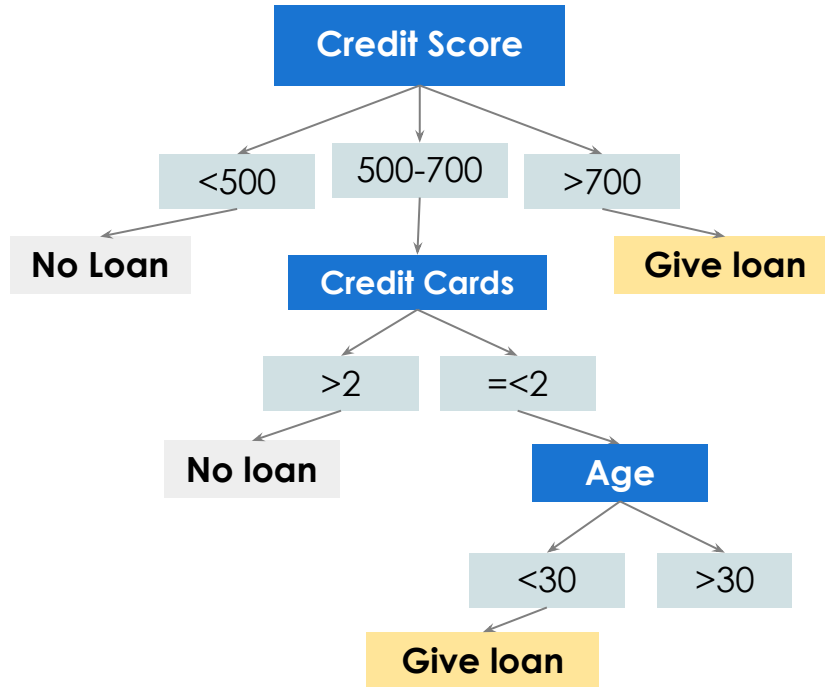
Income
Credit Score
Age
Credit Cards
Savings

→ Machine Learning Model →

Yes
No

Credit Score

<500 | 500-700 | >700

No Loan

Credit Cards

Give loan

>2 | =<2

No loan

Age

<30 | >30

Give loan

Supervised Learning

Unsupervised Learning

Which customers can I target to give loan?

Credit Score

Debt

Income source

Profession

Savings

Machine learning Model

Credit Worthy

High credit score
Low Debt
Stable income
High Savings

Credit Builders

Moderate credit score
Moderate Debt
Stable income
Moderate Savings

Credit Strained

Low credit score
High Debt
Unstable income
No Savings
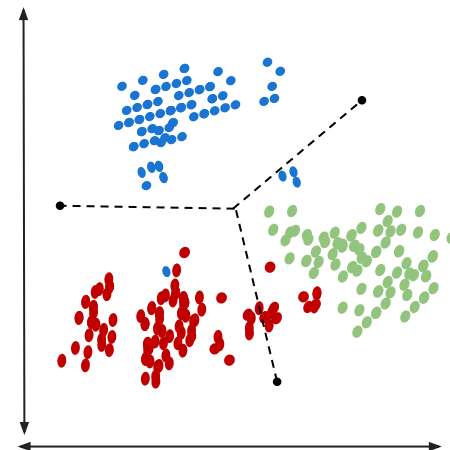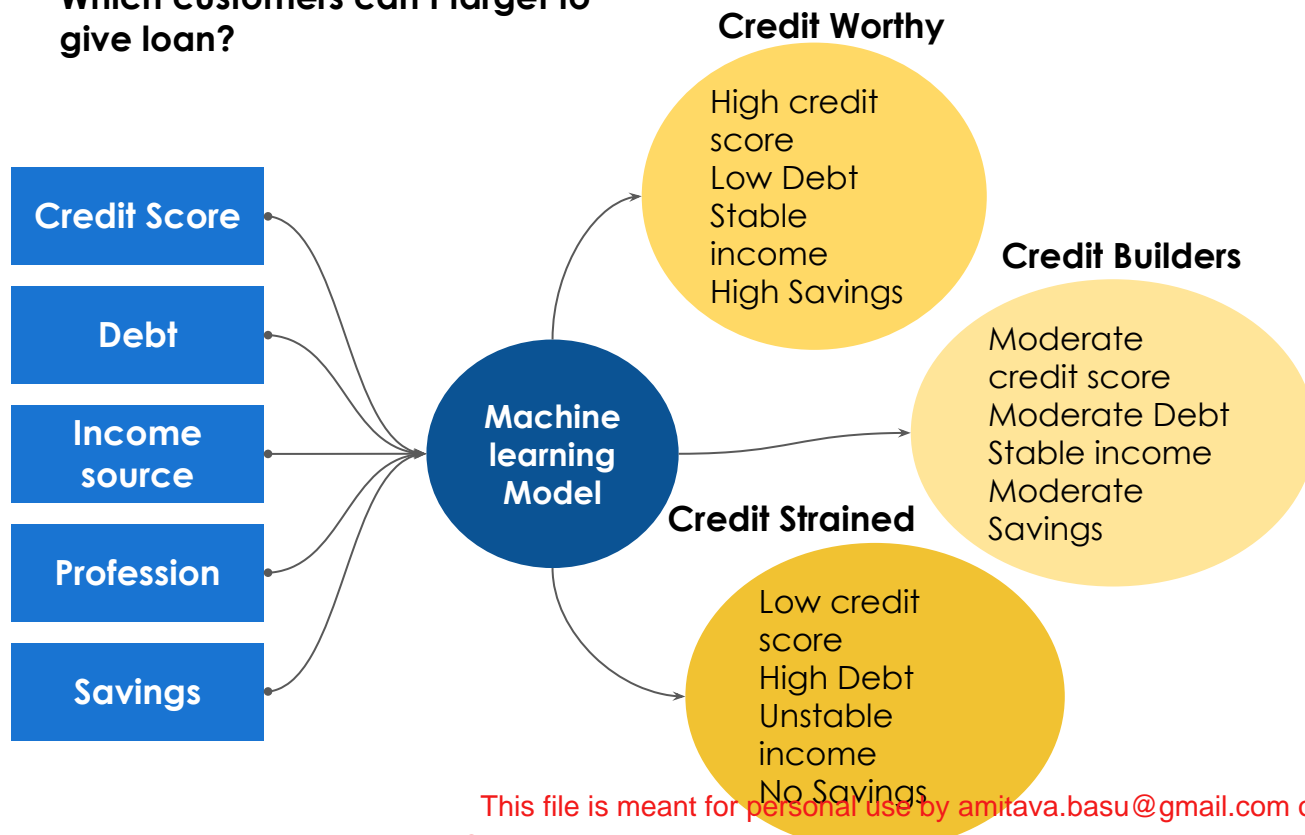
Discriminative AI vs. Generative AI

Train → **Model**
Learns from relationship between **labels** and data
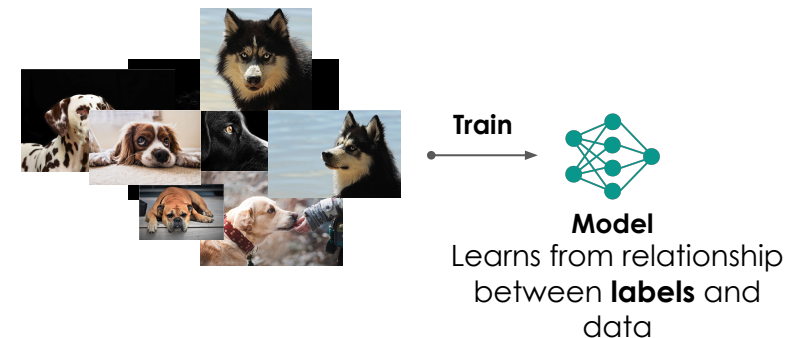
Could this be a dog?

Classify

YES

Discriminative AI

Train → **Model**
Learns from patterns in large amounts of unstructured data

+

Other images on the internet
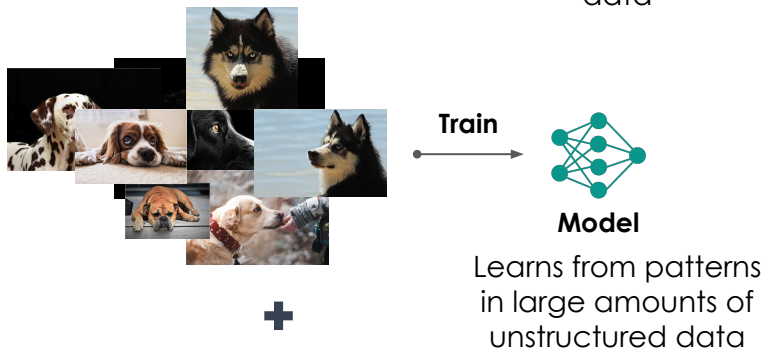
Create an image of dog, having fun in a party, wearing a black tuxedo with wine in one hand

Generate
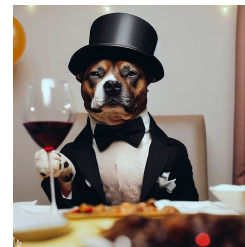
Generative AI

A Brief History of Generative AI

2014 — Generated realistic images - GANs - Ian Goodfellow

2017 — Breakthrough in NLP - Transformer Models

2018 — Advent of large language models - BERT, GPT

2019 — Advanced GANs - style GANs

2020 — OpenAI released GPT-3 - this was state-of-the-art

2021 — Vision Transformers - CLIP, DALL-E

2022 — OpenAI released ChatGPT (GPT-3.5), DALL-E 2

2023 — GPT-4, Stable Diffusion Model - market is flooded with GenAI apps

A Peek into Generative AI Models

Data	Pre-Training	Fine Tuning	Tasks

Text

Images

Speech

Video

Structured Data

Generative Models

Large Language Models

Question Answering

Sentiment Analysis

Information Extraction

Object Recognition

Image Captioning
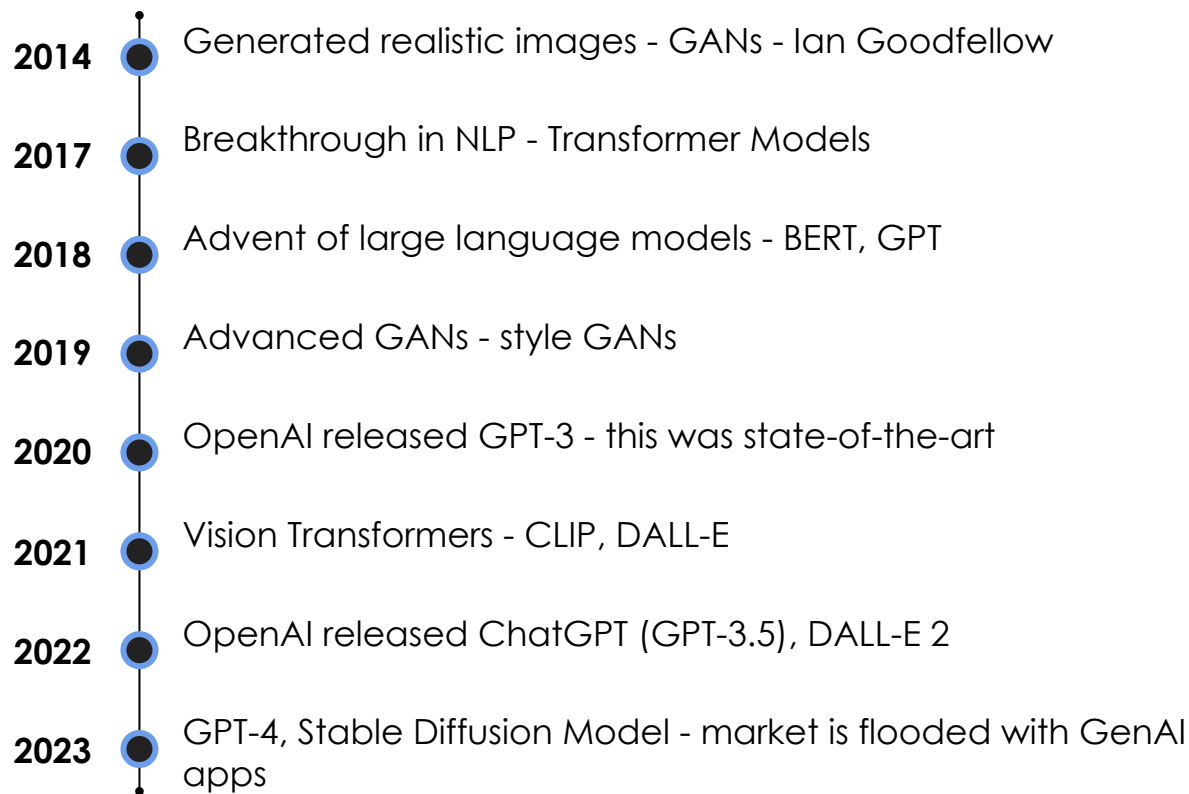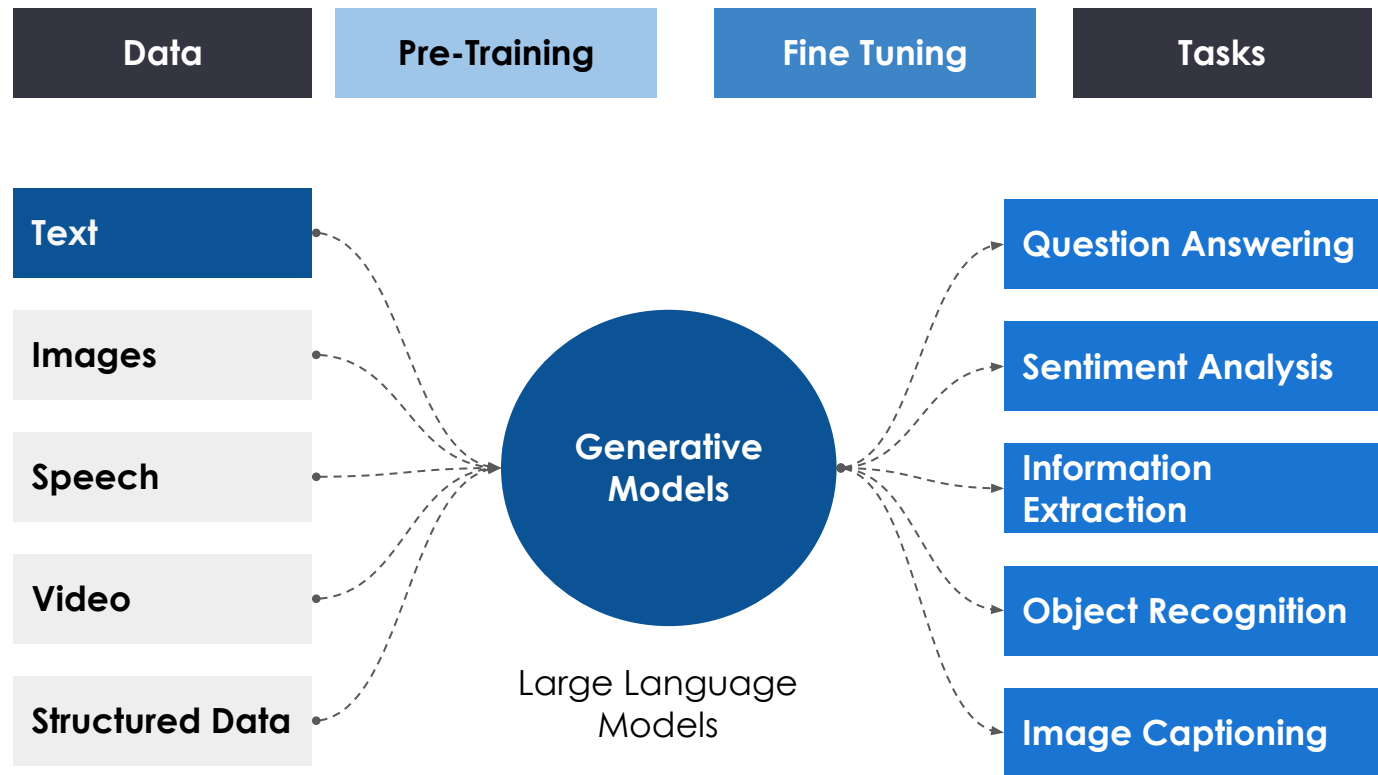
Large Language Models (LLMs)

- **Large**, because 2 things:
  1. trained on **large amounts of data**
  2. **billions** of trainable **parameters**

- **Language**, because it deals with text data (takes **input** in text and generates **output** in **text**).

- **Model**, because it **predicts** the next **word**/sentence/token.

- So **LLMs** are **language models consisting of a neural network with billions of parameters**, trained on large quantities of unlabeled text using self-supervised learning.

Interacting with Generative AI Models

Hands-on: **Introducing ChatGPT**

How does the Model understand text?

Is there a numeric way to represent association between text or words?

Word embeddings = **semantic** + **syntactic** relations in a **vector space**

similarity + **rules** = **meaning**

Let's try to understand vector space

	Living Being	Human	Gender	Royalty
Man	0.8	0.8	0.8	- 0.7
Woman	0.9	0.9	- 0.9	- 0.8
King	0.8	0.7	0.7	0.7
Queen	0.7	0.8	- 0.8	0.8
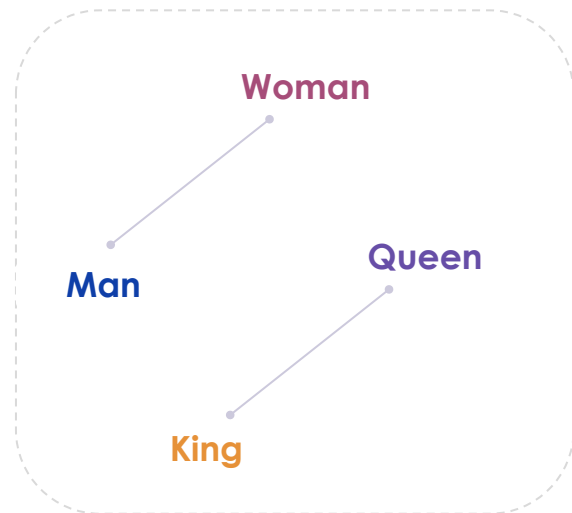
King - **Man** + **Woman** = **?**

Woman

Man

Queen

King

How does it complete text?

The robot must obey instructions given to _____

Learning from the large set of documents, the model has understood that when the word **robot** is referred to again in a sentence, words like "**it**" / "**its**" are most likely to be the completion word.
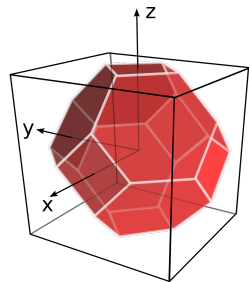
It memorized this association by knowing they are close to each other in some vector dimension that associates pronouns with words.

The robot must obey instructions given to
it

The robot must obey instructions given to
its control system or programming

The robot must obey instructions given to
its designated operator or user

How does it predict the next word?

- **Step-1**: **Word Embeddings** - Break the sentence into words and convert them to embeddings

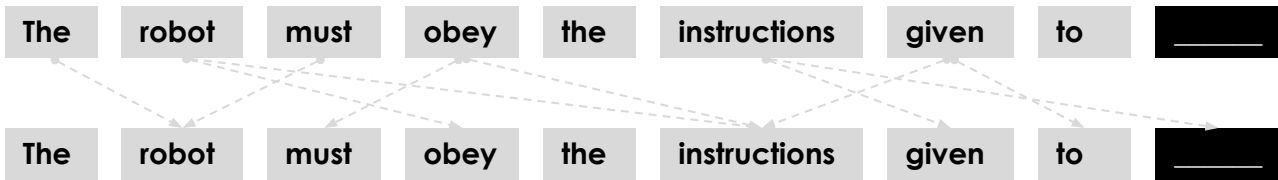| The	robot	must	obey	the	instructions	given	to	_____

- **Step-2**: **Find connections** - Understand which word is related to which word more

The	robot	must	obey	the	instructions	given	to	_____

The	robot	must	obey	the	instructions	given	to	_____

- **Step-3**: **Giving importance/attention**: Each word is assigned a score based on how important it is to other words in the sentence

The	robot	must	obey	the	instructions	given	to	_____

The	robot	must	obey	the	instructions	given	to	_____
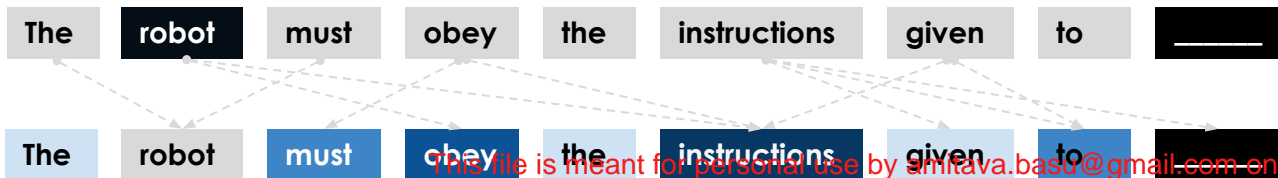
How does it predict the next word?

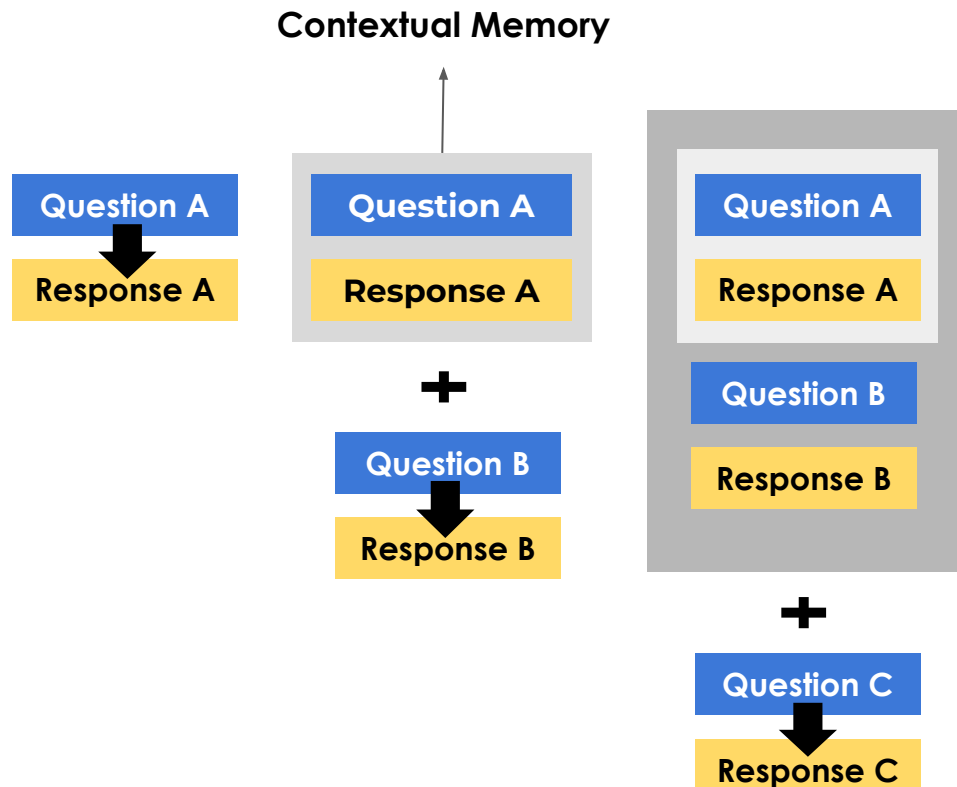- **Step-4**: **Assigning Weights** - This is for "robot" - but step-3 and 4 will be repeated for all words

The	robot	must	obey	the	instructions	given	to	_____
0.2	-	0.6	0.7	0.2	0.8	0.3	0.7	----> **Weights**

it	**0.9**
its	0.8
itself	0.85
robot	0.5

- **Step-5**: **Find Relevance** - To complete the sentence, which are the words to consider

The	robot	must	obey	the	instructions	given	to	it
0.2	0.9	0.2	0.7	0.2	0.8	0.3	0.2	

- **Step-6**: **Predict** - Get the next possible words with their probabilities and fill in or do the "chat completion" with the one that has the highest probability

How is it able to remember conversations?

Contextual Memory

Question A

Response A

Question A

Response A

+

Question B

Response B

Question A

Response A

Question B

Response B

+

Question C

Response C

Why do Language models hallucinate?

Did not understand the context or intent behind the question / prompt

Why does this happen?

Information needed to give the relevant answer was absent in the training data

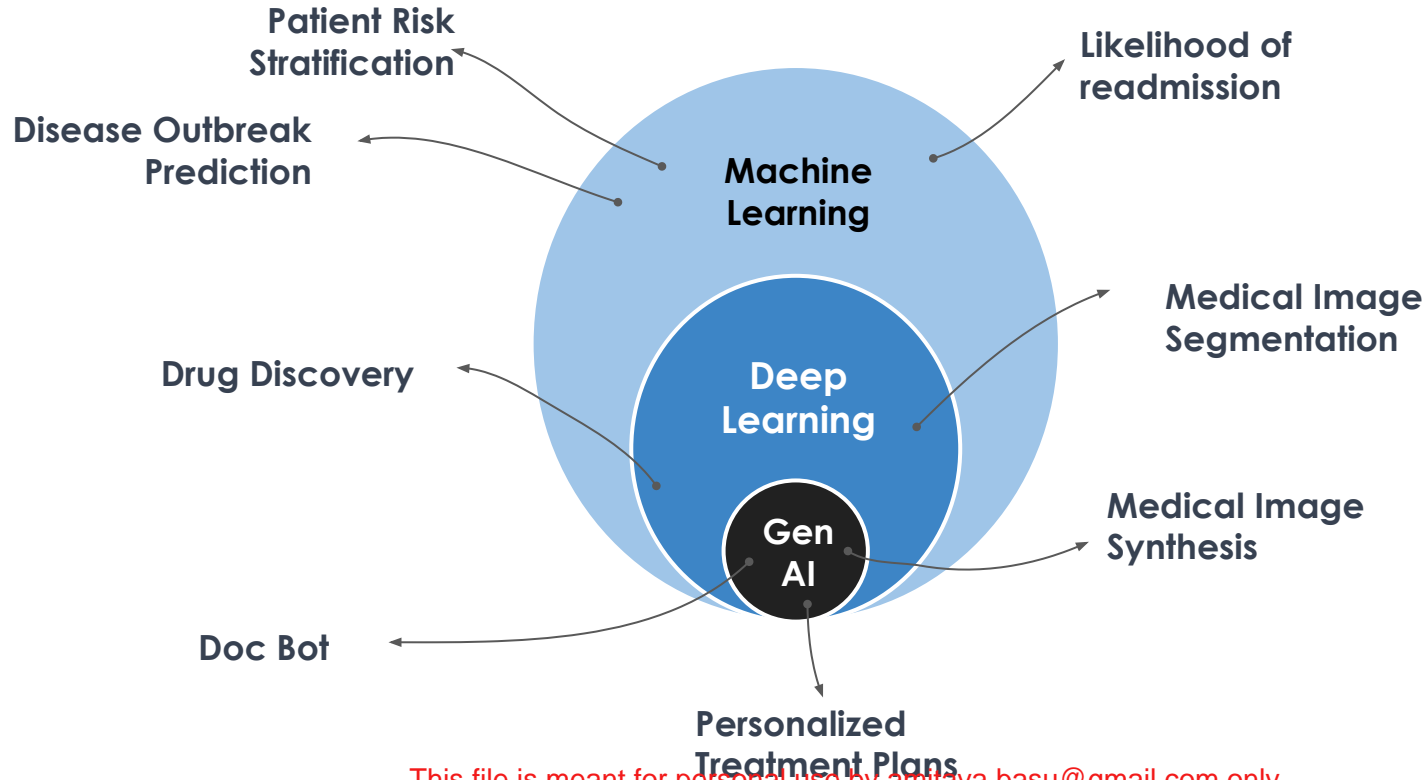**These are probabilistic models - leading to inconsistency/randomness in its outputs**

Business Problems solved by GenAI - Retail
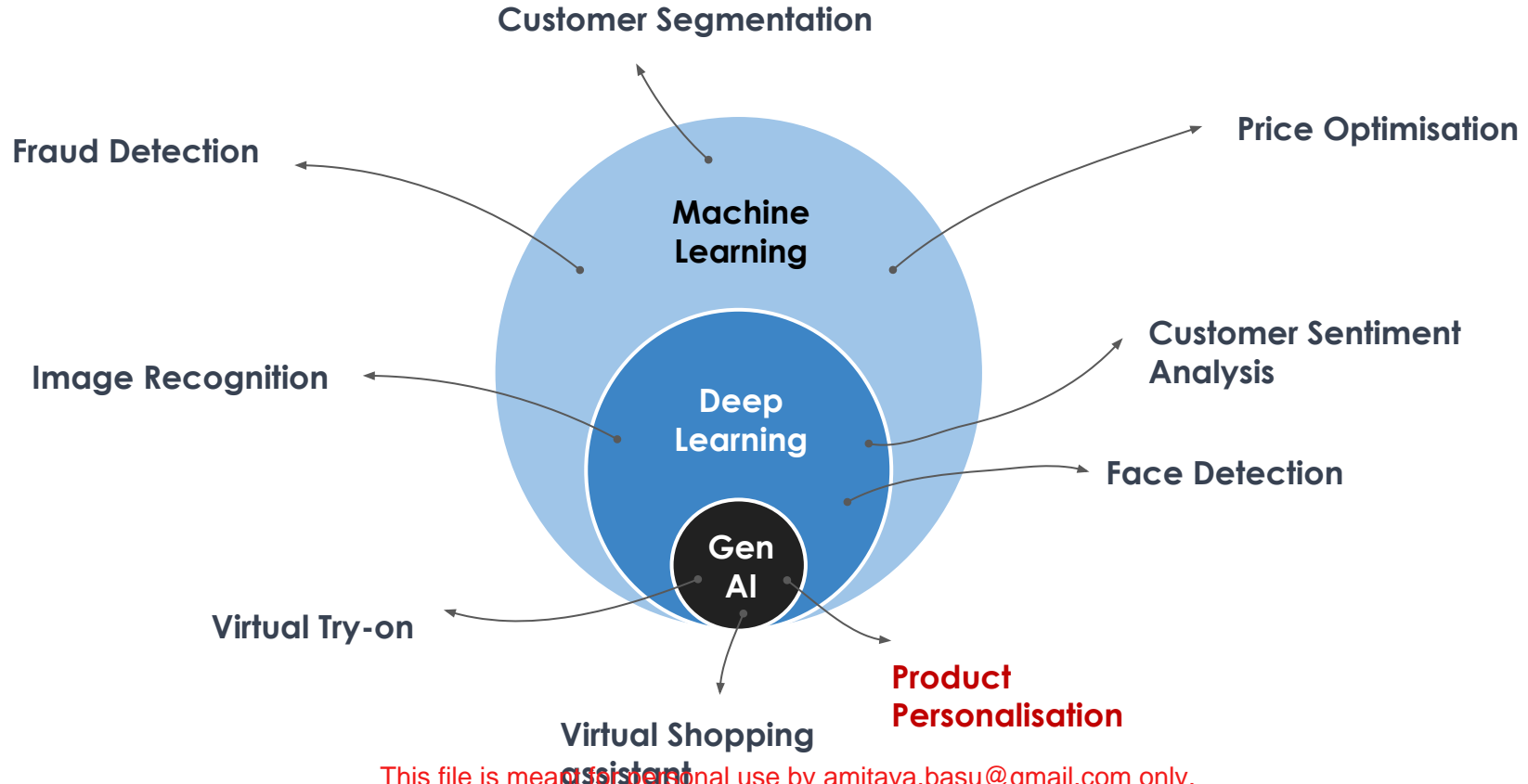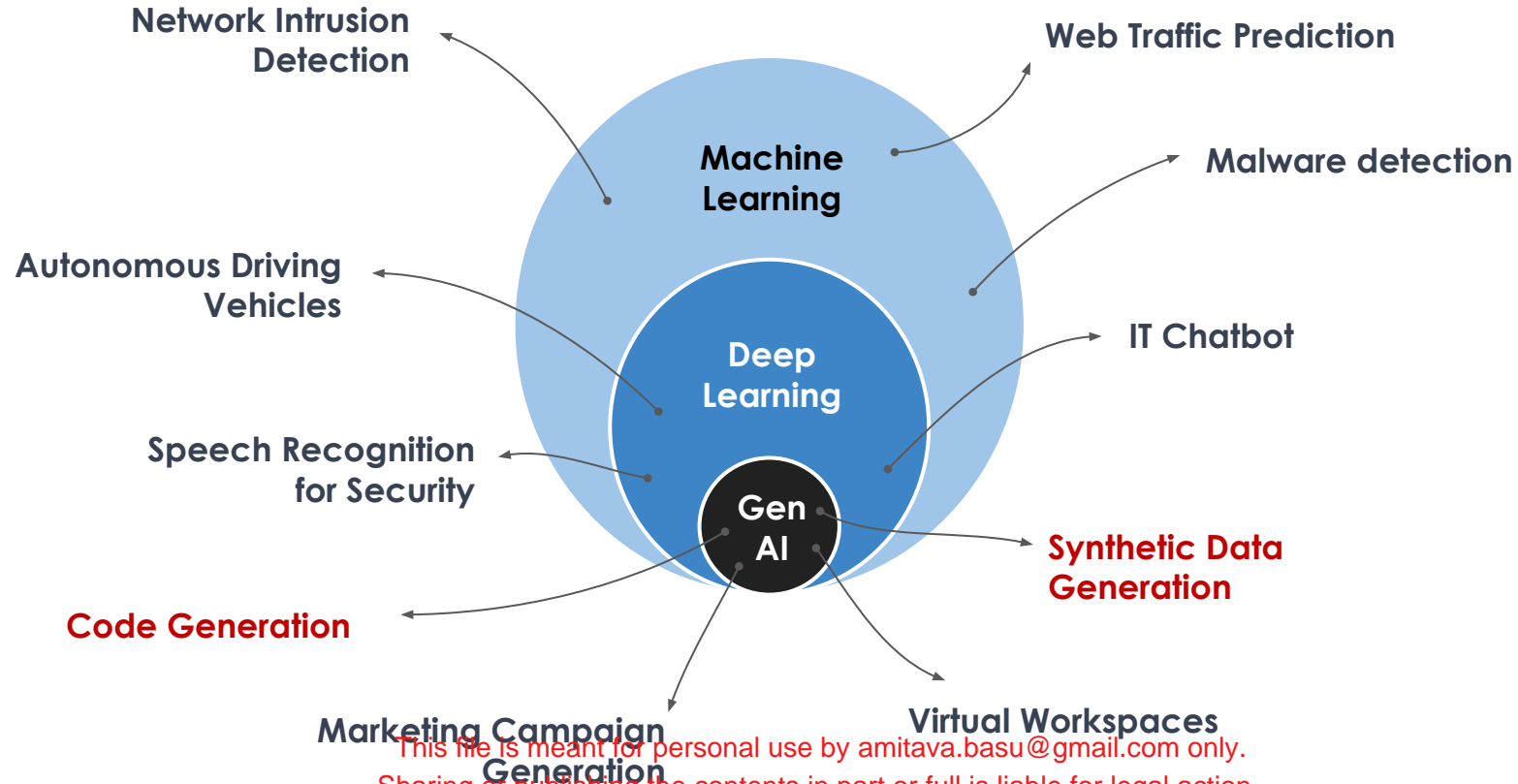

Customer Segmentation

Price Optimisation

Fraud Detection

Machine Learning

Customer Sentiment Analysis

Image Recognition

Deep Learning

Face Detection

Gen AI

Virtual Try-on

Product Personalisation

Virtual Shopping assistant

Business Problems solved by GenAI - Healthcare

Patient Risk Stratification

Disease Outbreak Prediction

Likelihood of readmission

Machine Learning

Medical Image Segmentation

Drug Discovery

Deep Learning

Medical Image Synthesis

Gen AI

Doc Bot

Personalized Treatment Plans

Business Problems solved by GenAI - Tech

Network Intrusion Detection

Web Traffic Prediction

Machine Learning

Malware detection

Autonomous Driving Vehicles

Deep Learning

IT Chatbot

Speech Recognition for Security

Gen AI

Synthetic Data Generation

Code Generation

Marketing Campaign Generation

Virtual Workspaces

Interacting with Generative AI Models

Hands-on: Exploring ChatGPT

Mind Map
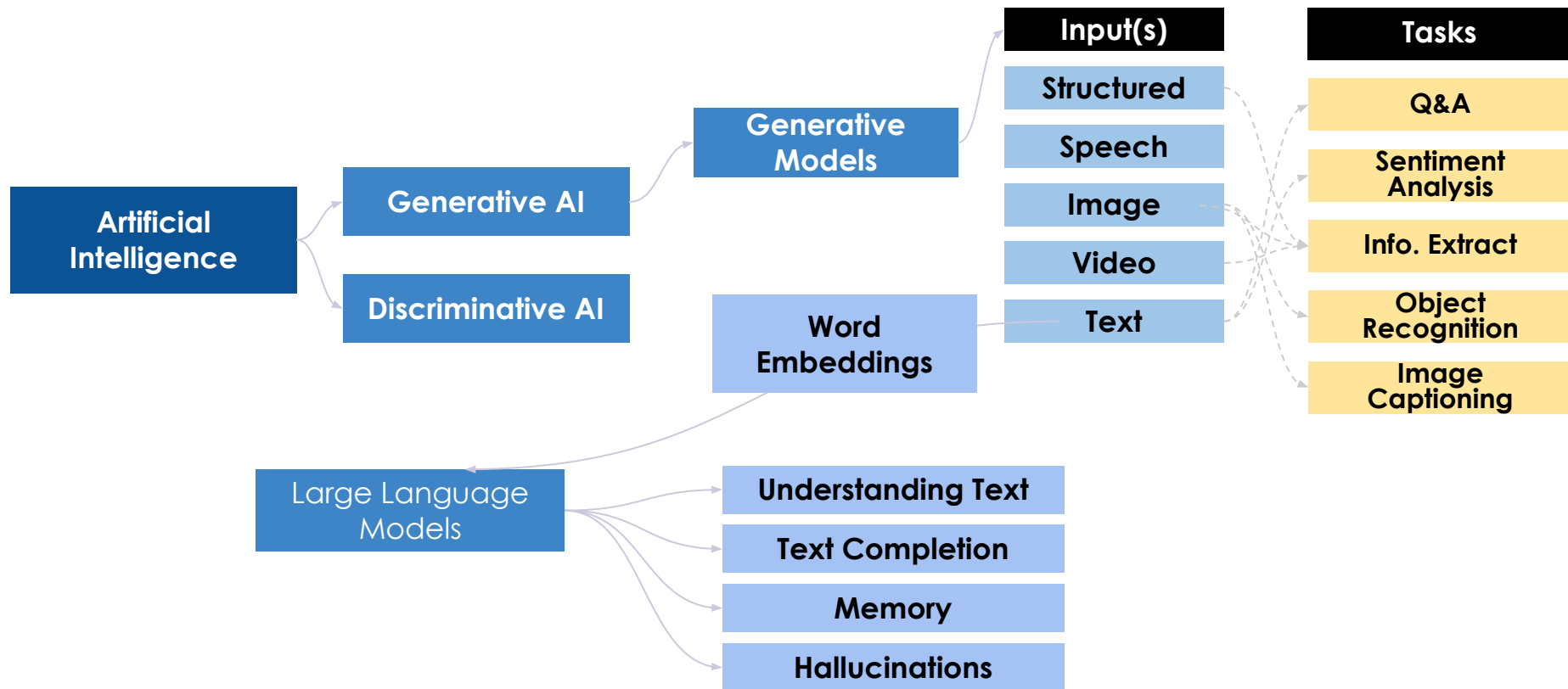
Artificial Intelligence → **Generative AI** → **Generative Models** → **Input(s)**

Input(s):
- Structured
- Speech
- Image
- Video
- Text

Tasks:
- Q&A
- Sentiment Analysis
- Info. Extract
- Object Recognition
- Image Captioning

Artificial Intelligence → **Discriminative AI**

Word Embeddings → Text

Large Language Models:
- Understanding Text
- Text Completion
- Memory
- Hallucinations

Summary

Here's a brief recap:

- We gained a clear understanding of the concepts of Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL),and Generative AI including their definitions, key principles, and how they are related to each other.

- Discriminative models aim to classify or differentiate between different classes or categories, while generative models focus on creating new data that resembles a given training dataset.

- The historical perspective provided insights into the evolution of generative AI techniques such as GANs, Stable diffusion and their applications.

Summary

Here's a brief recap:

- We explored various business applications of AI, highlighting how organizations leverage AI technologies to enhance operations, improve decision-making, automate tasks and personalize user experiences.

- We explored state-of-the-art models in the field of AI. ChatGPT, a text-based model, focuses on generating human-like text responses in conversational settings. We also used ChatGPT to generate code.

Learning Outcomes

Upon completion of this module, you should able to:

- Explain the key definitions and fundamentals of AI, ML , DL and Generative AI

- Identified supervised and unsupervised tasks.

- Explore the difference between Discriminative and Generative AI.

- Explain a brief history of Generative AI.

- Analyze the behaviour of LLMs and understood their processes of text completion and prediction.

- Identify various business use-cases of AI, DL , ML and GenAI.

- Explore ChatGPT (text and code).

Happy Learning !