GenAI for Beginners
Learning with Demos

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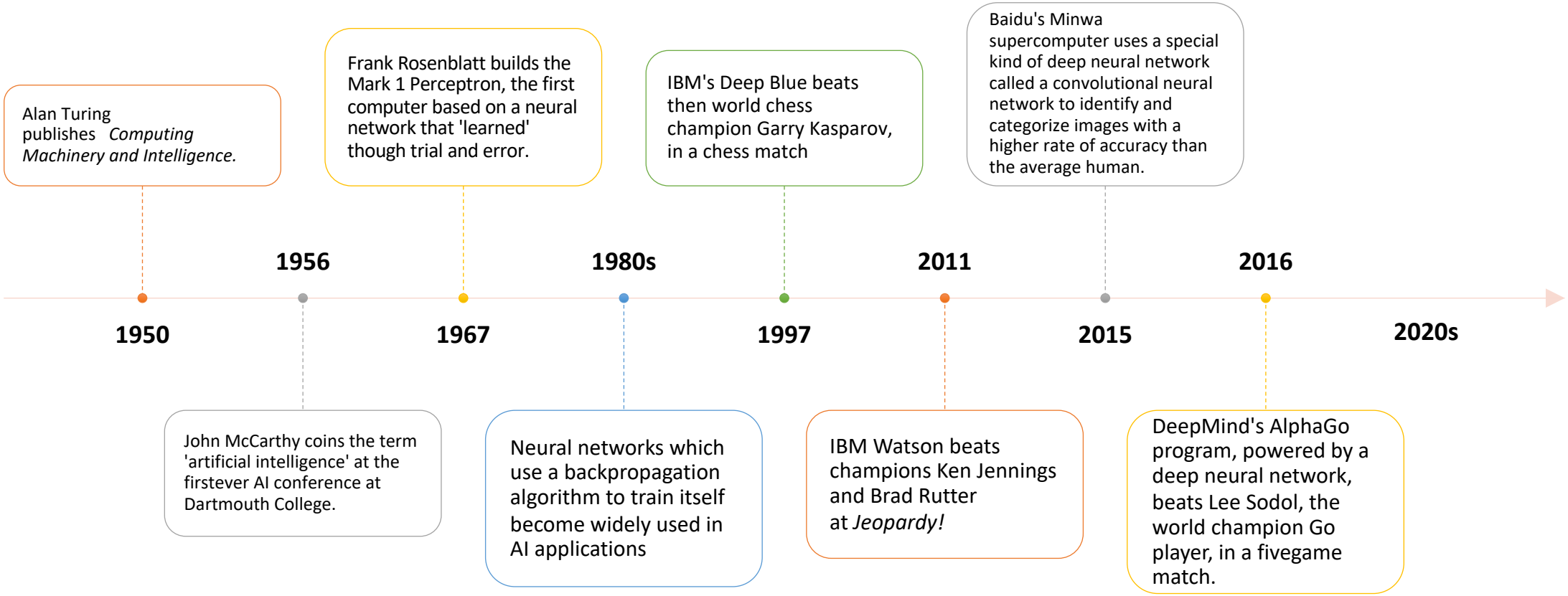
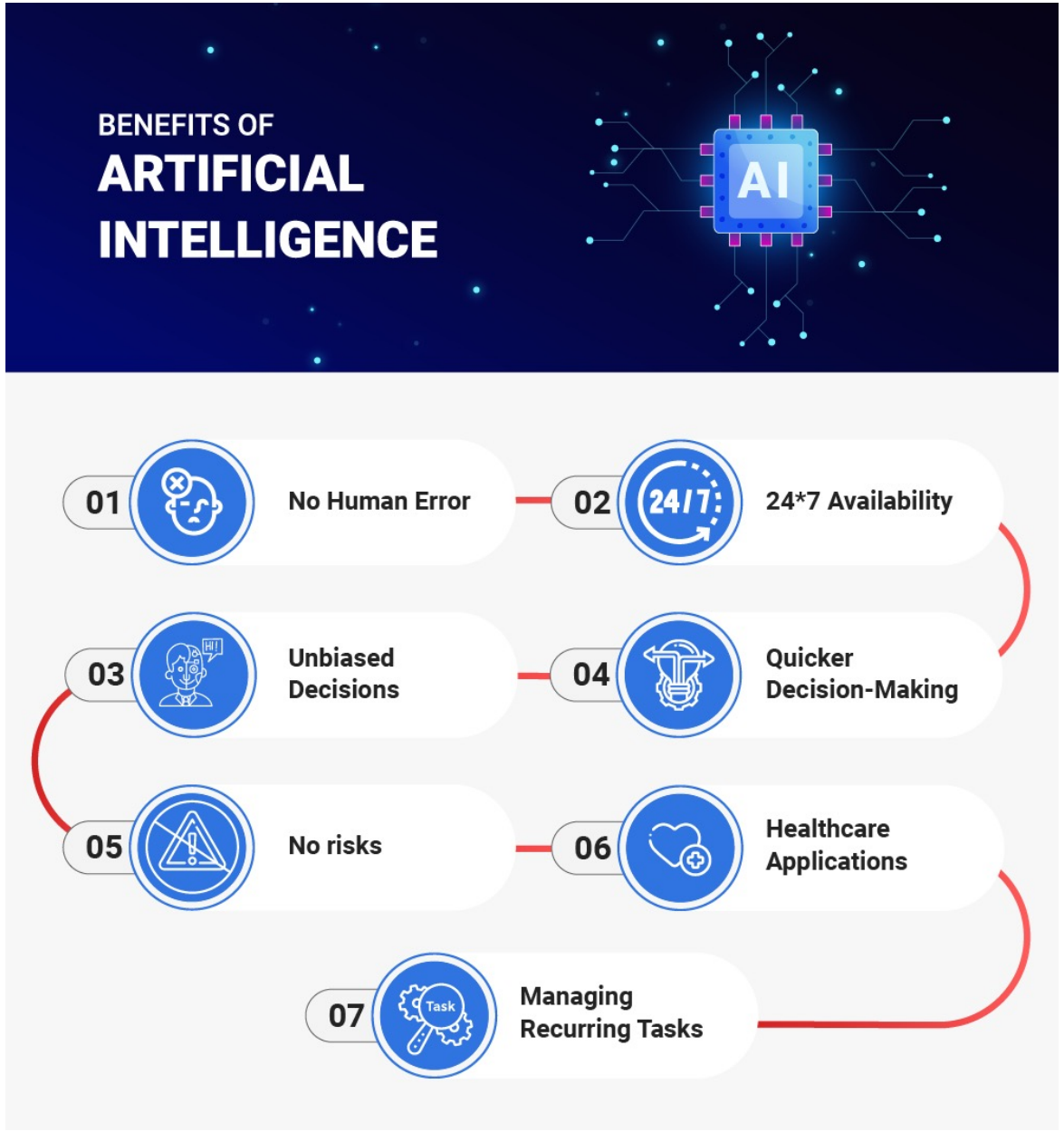
Artificial Intelligence

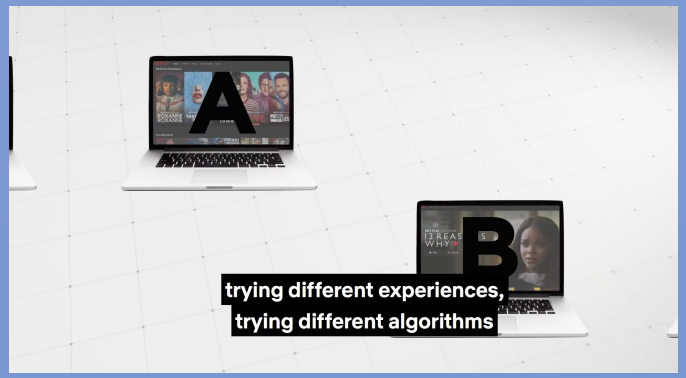
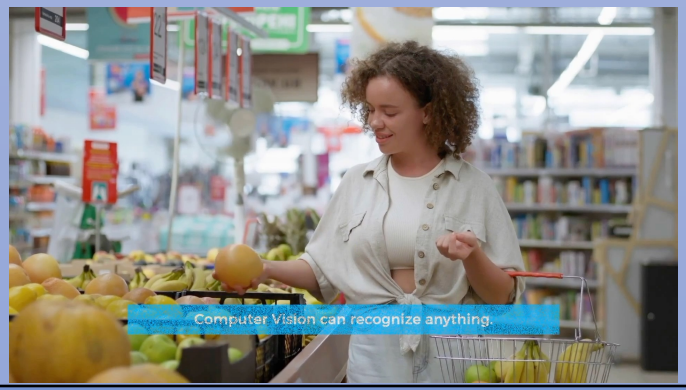
What is AI ?

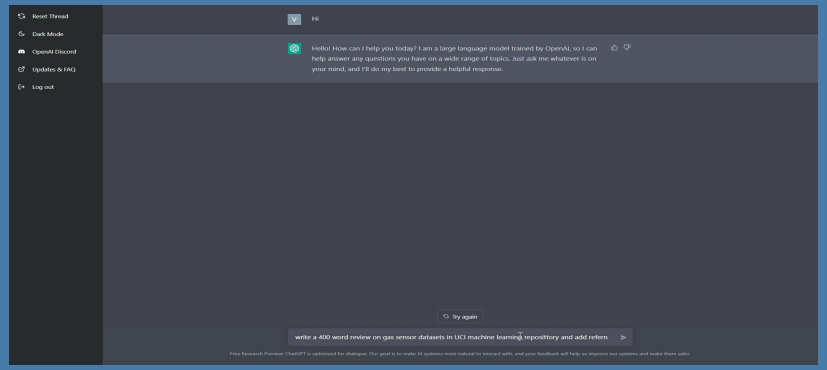
- **Artificial Intelligence** : It’s the capability of a computer system to mimic humanlike cognitive functions.

Demo on AI

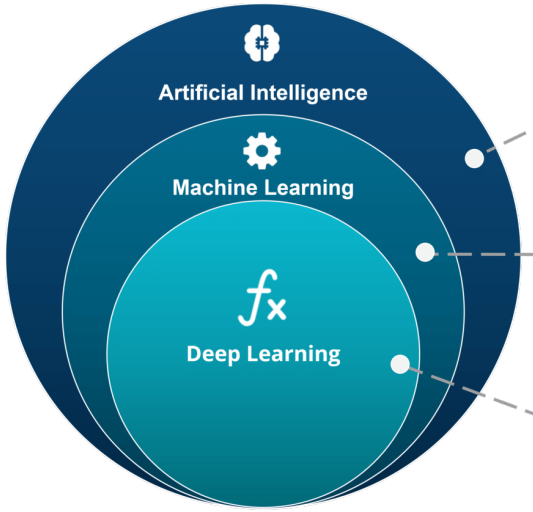

Alan Turing publishes *Computing Machinery and Intelligence.*
1950
1956
John McCarthy coins the term 'artificial intelligence' at the firstever AI conference at Dartmouth College.
Frank Rosenblatt builds the Mark 1 Perceptron, the first computer based on a neural network that 'learned' though trial and error.
1967
1980s
Neural networks which use a backpropagation algorithm to train itself become widely used in AI applications
IBM's Deep Blue beats then world chess champion Garry Kasparov, in a chess match
1997
2011
IBM Watson beats champions Ken Jennings and Brad Rutter at *Jeopardy!*
Baidu's Minwa supercomputer uses a special kind of deep neural network called a convolutional neural network to identify and categorize images with a higher rate of accuracy than the average human.
2015
2016
DeepMind's AlphaGo program, powered by a deep neural network, beats Lee Sodol, the world champion Go player, in a fivegame match.
2020s


BENEFITS OF
ARTIFICIAL
INTELLIGENCE
AI
01
No Human Error
02
24/7
24*7 Availability
03
HI!
Unbiased
Decisions
04
Quicker
Decision-Making
05
No risks
06
Healthcare
Applications
07
Task
Managing
Recurring Tasks

Type of Workload	Description	Demo
Machine learning	The way we "teach" a computer model to make predictions and draw conclusions from data	
Computer vision	Capabilities within AI to interpret the world visually through cameras, video, and images.	
Natural language processing	Capabilities within AI for a computer to interpret written or spoken language, and respond in kind.	

Type of Workload	Description	Demo
Generative AI	Capabilities within AI that create original content in a variety of formats including natural language, image, code, and more.	

AI Vs ML Vs DL



ARTIFICIAL INTELLIGENCE
A technique which enables machines to mimic human behaviour

MACHINE LEARNING
Subset of AI technique which use statistical methods to enable machines to improve with experience

DEEP LEARNING
Subset of ML which make the computation of multi-layer neural network feasible

Machine Learning Foundations

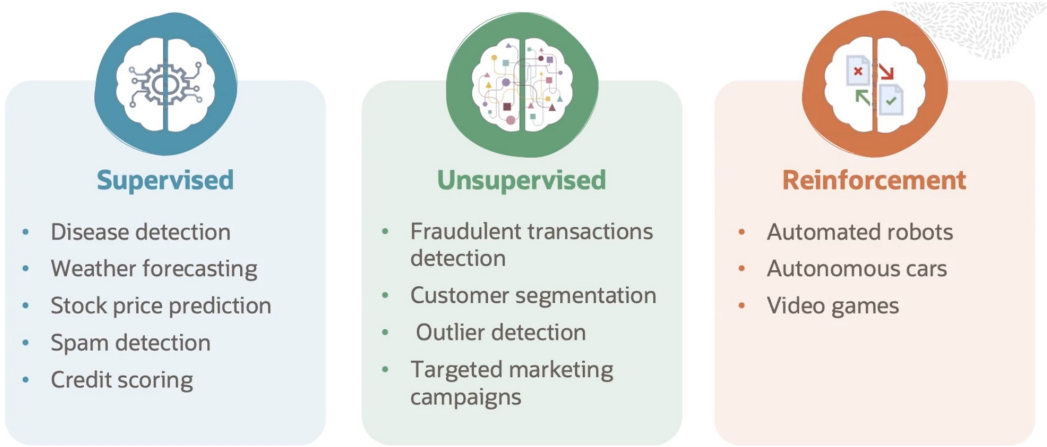
Machine Learning – Key Terminologies

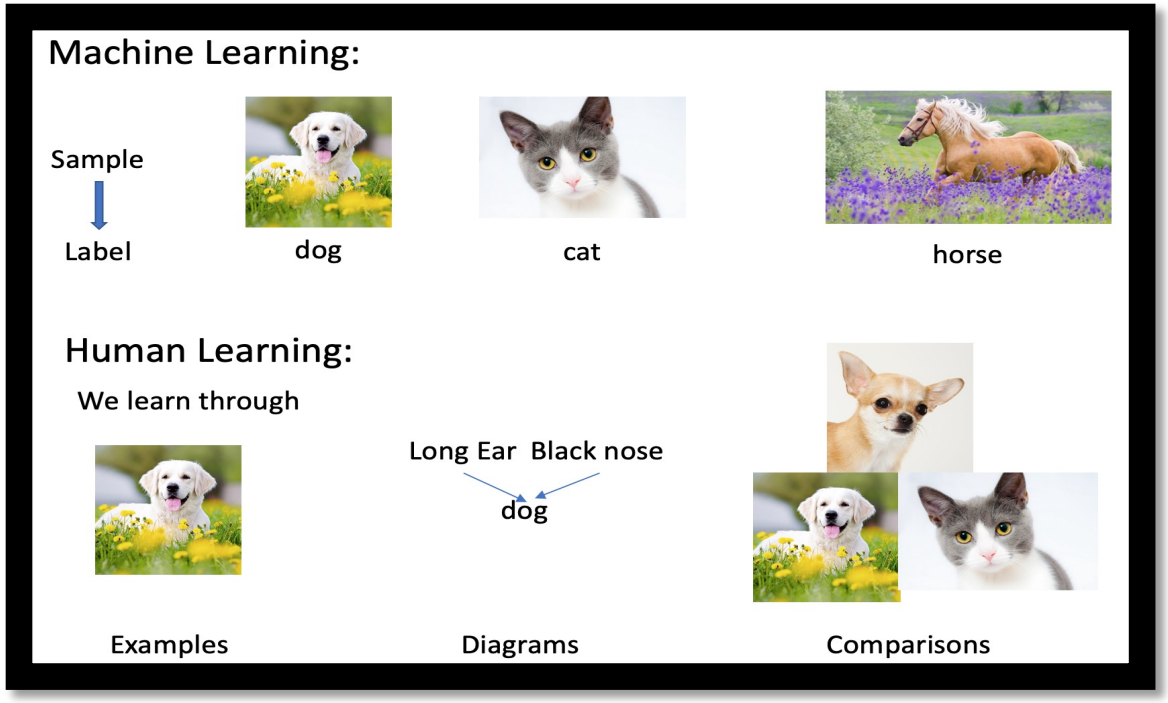
Artefact	Description	Example
Algorithm	In machine learning, an algorithm refers to a set of rules and statistical techniques used to learn from data.	The Decision Tree algorithm can be used to classify emails as "spam" or "not spam" based on features like the email's sender, the frequency of certain words, etc.
Model	a model is what an algorithm creates after being trained on data. It's essentially the learned representation of the data. Program that can find patterns of make decisions.	After feeding a dataset of house features and prices to a regression algorithm, the model it creates can predict prices of new houses based on their features.
Training	This is the process of presenting data to a machine learning algorithm to create a model. The algorithm uses training data to learn.	A neural network is shown thousands of pictures of cats and dogs during training, and it learns to recognize features that distinguish one from the other.
Labels	labels are the outputs you want the model to predict.	In a dataset of tumor information, the label might be whether the tumor is malignant or benign.

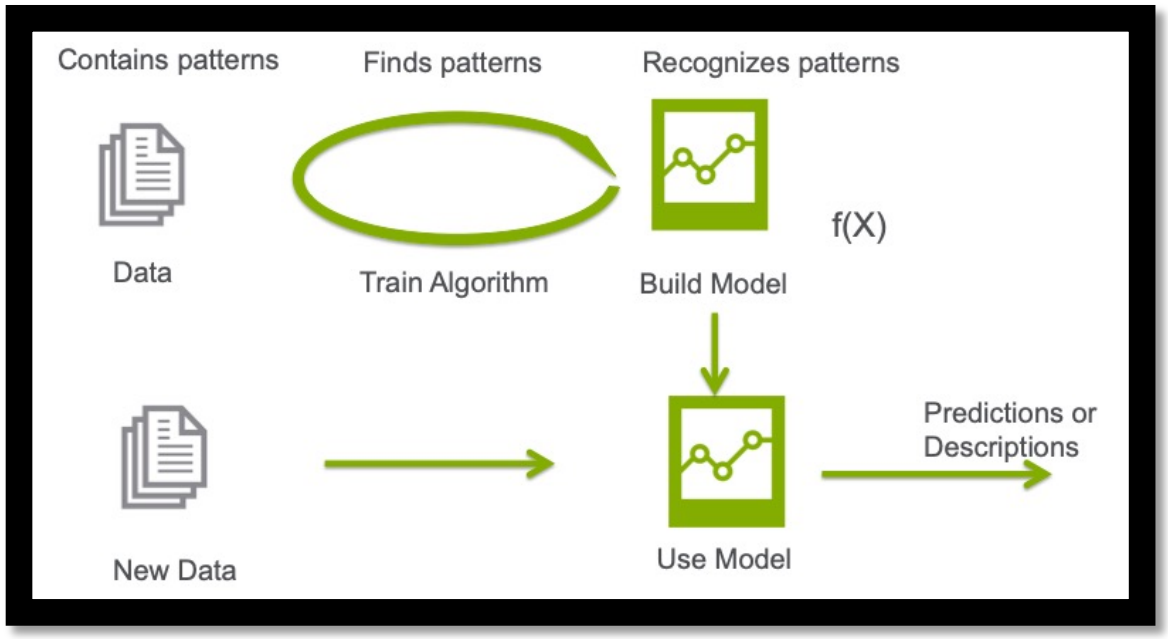
Machine Learning – Real World Example

Types of Machine Learning

Artefact	Description	Example
Supervised	The dataset being used has been prelabeled and classified by users to allow the algorithm to see how accurate its performance is. data acts as a teacher and “trains” the machine, increasing in its ability to make a prediction or decision.	email spam filtering. Here, the algorithm is trained with many example emails along with information whether they are "spam" (unwanted email) or "not spam". It learns to classify new emails into these categories based on the training it received.
UnSupervised Learning	The raw dataset being used is unlabeled and an algorithm identifies patterns and relationships within the data without help from users.	Market segmentation is a typical unsupervised learning task. Customer data is analyzed to find patterns and group customers into clusters based on similarities such as purchasing behavior, demographics, or usage statistics. No specific output labels are used; instead, the algorithm identifies the clusters on its own.
Reinforcement Learning	The dataset uses a “rewards/punishments” system, offering feedback to the algorithm to learn from its own experiences by trial and error. Replacing the human operator, an agent—a computer program acting on behalf of someone or something—helps determine outcome based upon a feedback loop.	chess game. The learning algorithm plays the game repeatedly and improves its strategy over time through a system of rewards (such as capturing an opponent's piece or winning the game) and penalties (like losing pieces or the game).







What is Machine Learning ?

- Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of *data* and *algorithms* to imitate the way that humans learn, gradually improving its accuracy.

- In machine learning, computers apply **statistical learning** techniques to automatically identify patterns in data.

- Those **patterns** are then used to create a data **model** that can make predictions.

- With increased data and experience, the results of machine learning are more accurate—much like how humans improve with more practice.

•**Learning Approaches**:
  - **Supervised Learning**: Learning from labelled data to predict outcomes for new data.
  - **Unsupervised Learning**: Identifying patterns and structures in unlabelled data.
  - **Reinforcement Learning**: Learning to make decisions by receiving rewards or penalties for actions.

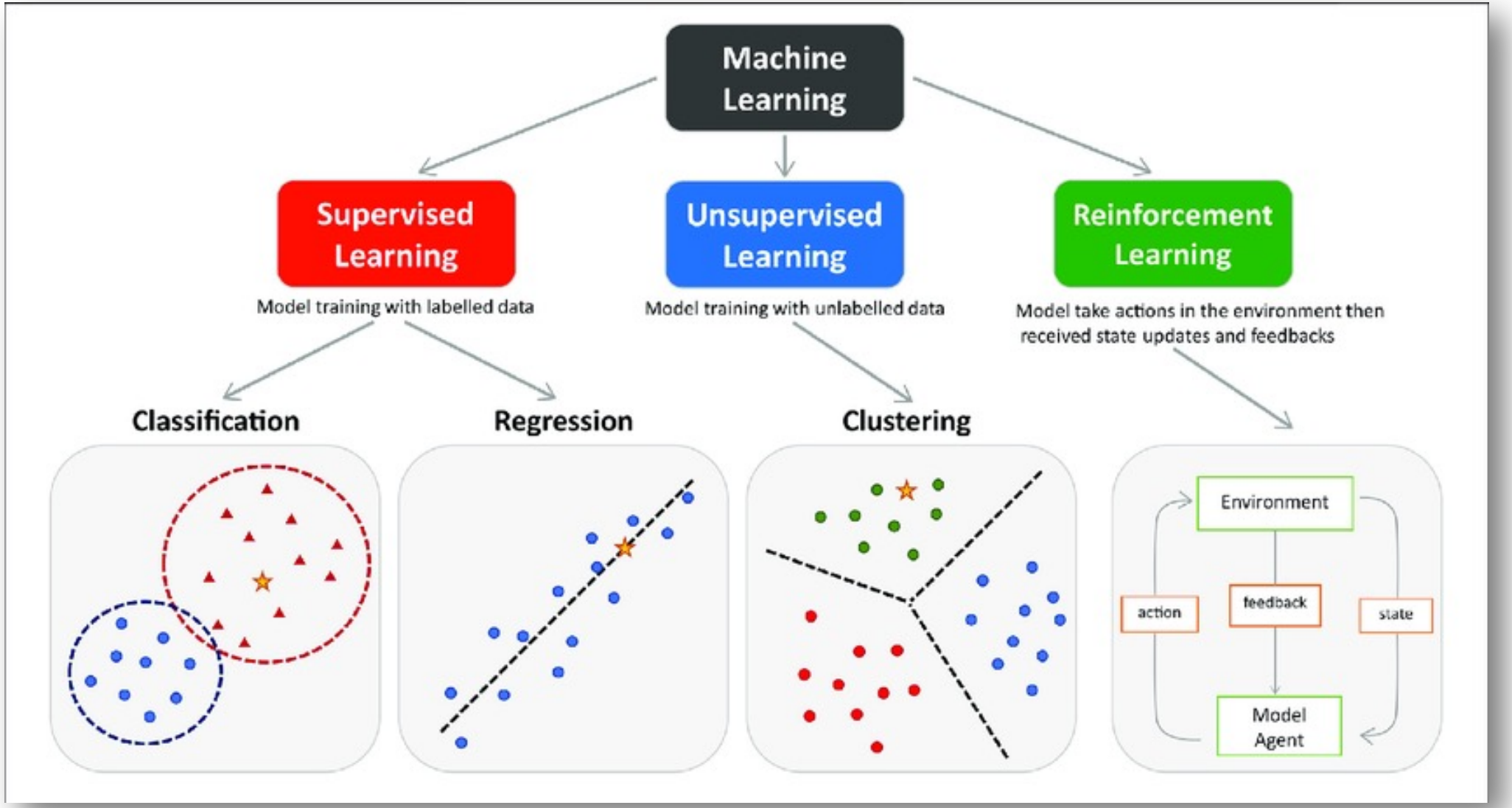
•**Data Centric**: Relies heavily on data *quality* and *quantity* for training models.

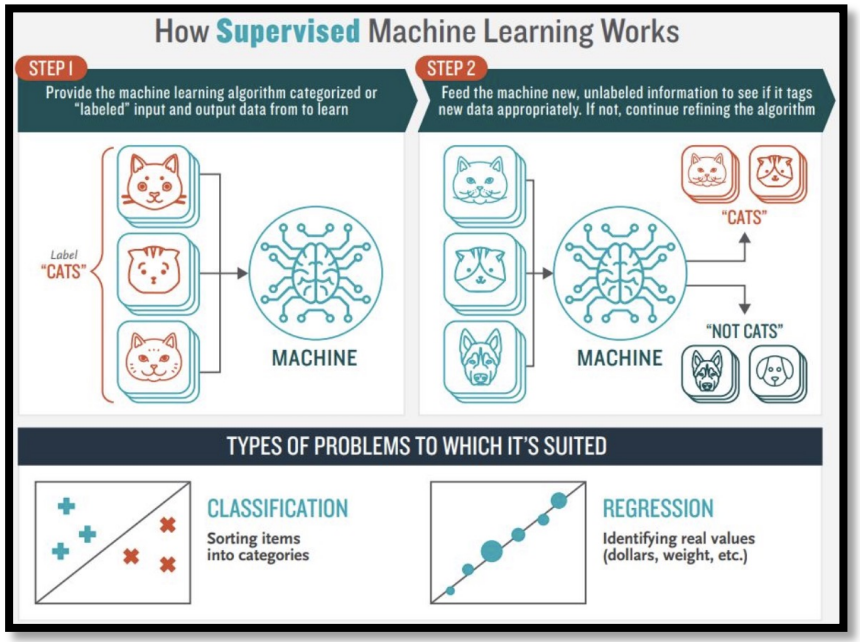
•**Algorithms**: Utilizes a variety of algorithms tailored to specific types of data and learning tasks.

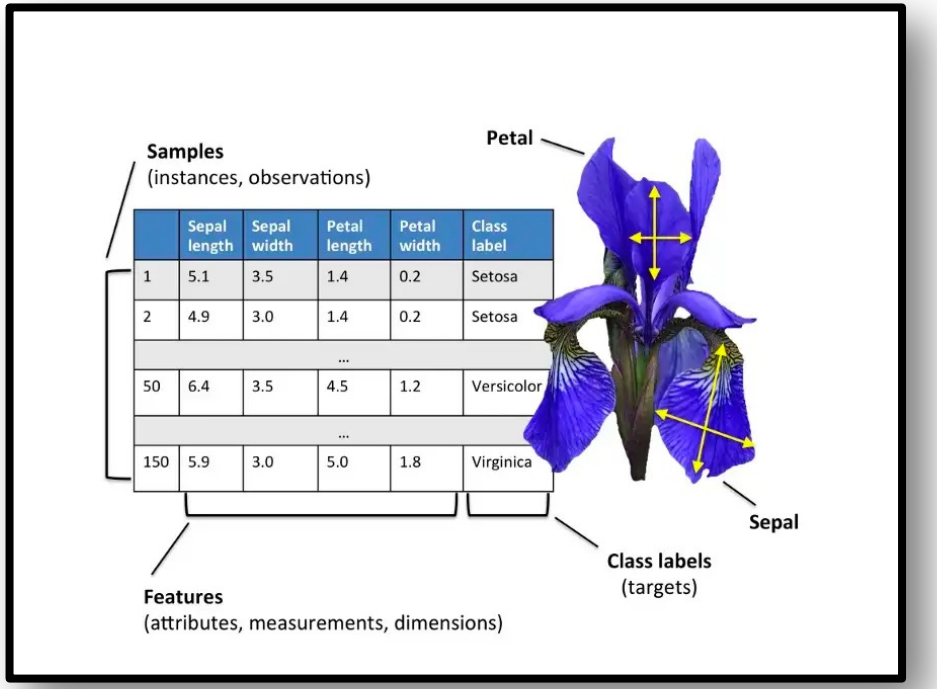
•**Applications**: Applied in diverse fields such as **healthcare**, **finance**, **autonomous vehicles**, and more for tasks like prediction, classification, and clustering.

•**Deployment**: Trained models are deployed in realworld applications to provide insights, automate tasks, or enhance decisionmaking.

Types of Machine Learning Algorithms



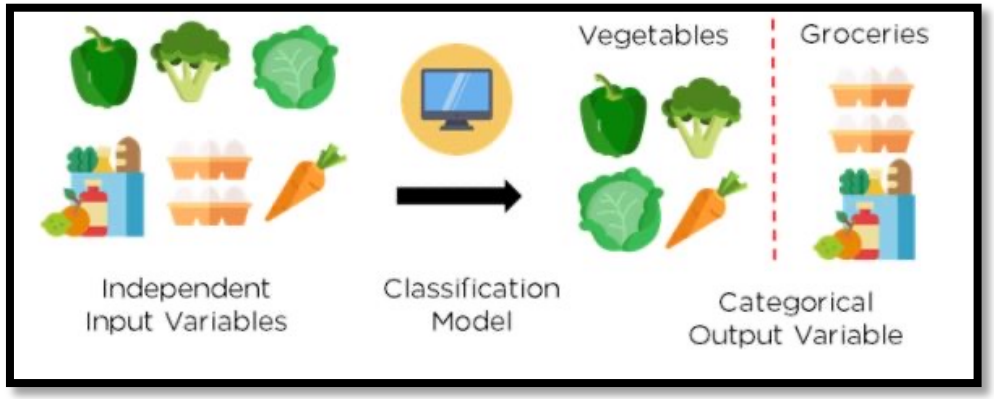


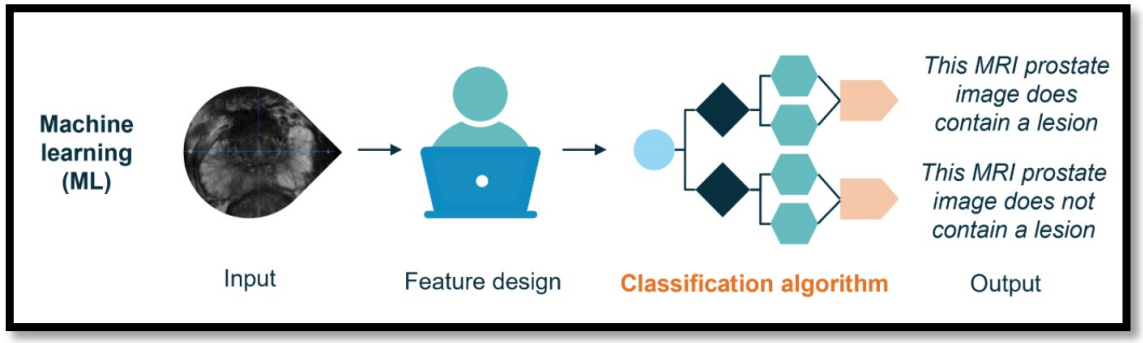


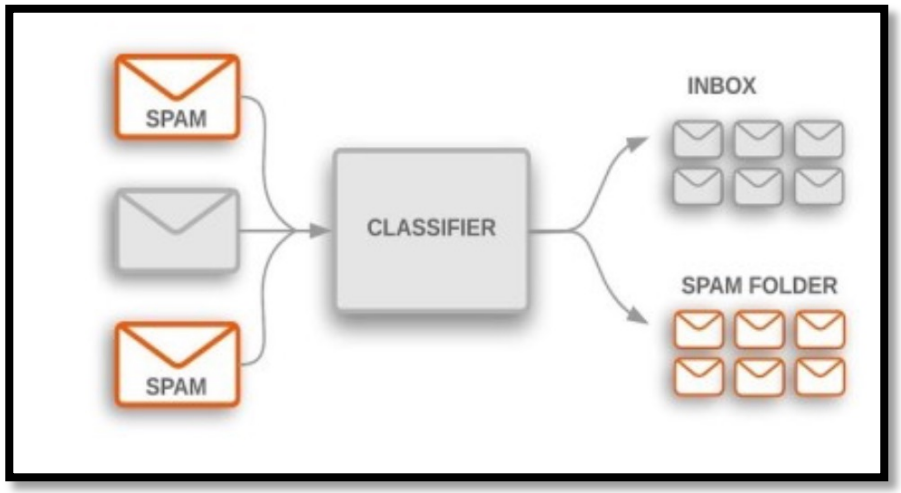
	Sepal length	Sepal width	Petal length	Petal width	Class label
1	5.1	3.5	1.4	0.2	Setosa
2	4.9	3.0	1.4	0.2	Setosa
...					
50	6.4	3.5	4.5	1.2	Versicolor
...					
150	5.9	3.0	5.0	1.8	Virginica

Supervised Machine Learning

- **Definition**: Supervised learning involves training a model on a dataset that includes both the **input data** and the corresponding **correct outputs**.
- **Labeled Data**: The training dataset must be labeled, meaning each example in the dataset is paired with the correct answer.
- **Algorithm Types**: Linear regression, Logistic regression, Support Vector Machines, Decision Trees and neural networks.
- **Training Process**: The model **learns a function** that maps inputs to desired outputs and makes predictions based on that function.
- **Overfitting Risk**: Supervised learning models can overfit the training data, meaning they may not perform well on new, unseen data.
- **Applications**: Used in various applications like **image** and **speech recognition**, medical diagnosis, spam detection, and stock price prediction.

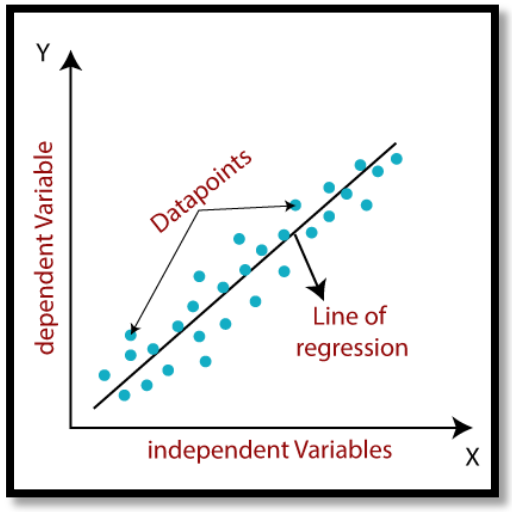


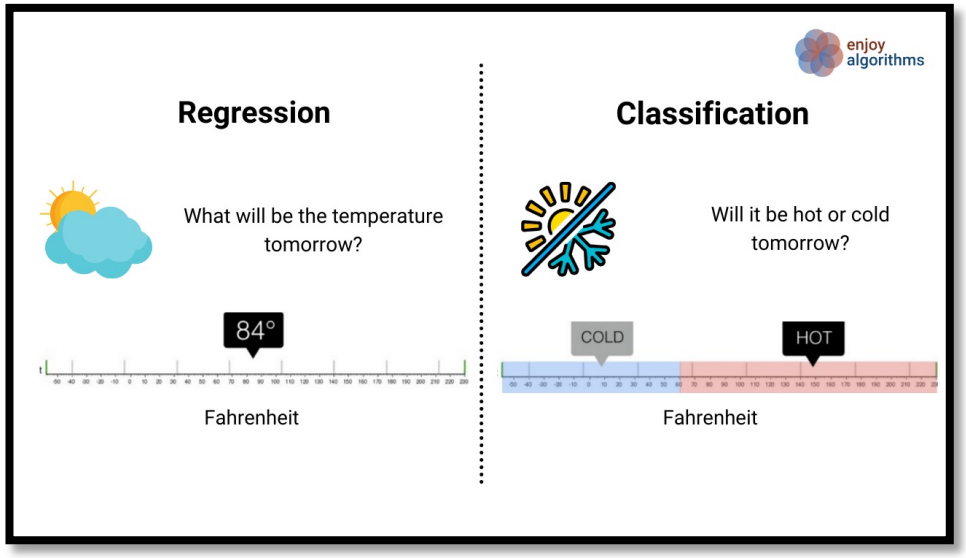




Supervised Machine Learning – Classification

- **Definition**: Classification involves assigning **category labels** to new observations based on past observations and their labels.
- **Binary vs. MultiClass**: Classification can be **binary** (**two classes**, e.g., spam or not spam) or **multiclass** (more than two classes, e.g., classifying types of fruits).
- **Common Algorithms**: Logistic regression, Decision trees, Random forests, support vector machines (SVM), and neural networks.
- **Feature Selection**: Choosing the right features (or inputs) is critical for building an effective classification model.
- **Labelling Data**: Requires a labelled dataset where each instance is tagged with the correct class for training.
- **Overfitting and Underfitting**: Balancing the complexity of the model to prevent overfitting (model is too complex) or underfitting (model is too simple).
- **Applications**: Used in various fields like **email spam detection**, image recognition, medical diagnosis, and sentiment analysis.
- **Realtime Decision Making**: Fraud detection in banking.





Supervised Machine Learning – Regression

1) **Definition**: Regression analysis predicts a continuous output (dependent variable) based on one or more predictor (independent) variables.

2) **Linear Regression**:
   - Simplest form of regression.
   - Assumes a **linear relationship** between input variables and the output.
   - Example: Predicting house prices based on size (square feet).

3) **Multiple Regression**:
   - Involves **two or more** independent variables.
   - Example: Predicting car prices based on features like age, mileage, brand, and engine size.

4) **Line of Regression :** regression line can be used to predict the value of y for a given value of x.

5) **Applications**:
   - Widely used in finance (stock prices prediction), healthcare (medical diagnoses), and many other fields.
   - Example: **Forecasting** sales in retail based on historical data and market trends.

6) **Overfitting and Underfitting Considerations**:
   - Important to ensure the model fits the training data well but also generalizes to new, unseen data.
   - Example: A complex model might fit the training data on stock market prices very well but fails to predict future prices accurately, indicating overfitting.

UnSupervised Machine Learning (Clustering / Association)

1) **Definition**: Unsupervised learning involves **analyzing** and **clustering unlabeled datasets** to discover hidden patterns or data groupings without human intervention.

2) **Data**: It deals with data that has not been labeled, classified, or categorized, and the algorithm tries to act on the data without any guidance.

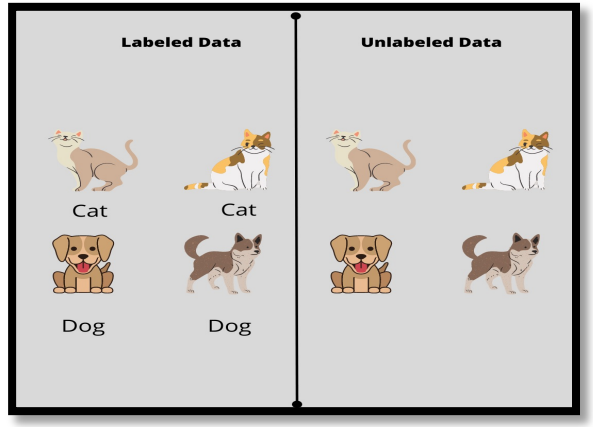
3) **Clustering**:
    1) The most common unsupervised learning technique.
    2) It's used to **group data points into clusters** so that items in the same cluster are more similar to each other than to those in other clusters.
    3) Example: Market segmentation in business, where customers are grouped based on purchasing behavior or interests.

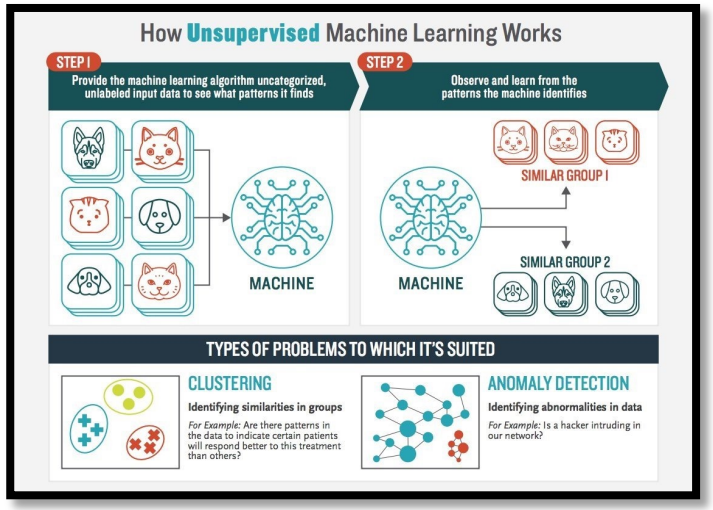
4) **Association**:
    1) This technique identifies sets of items in your dataset that frequently occur together.
    2) Example: In retail, finding products that are often bought together to optimize store layouts or crosspromoting products.

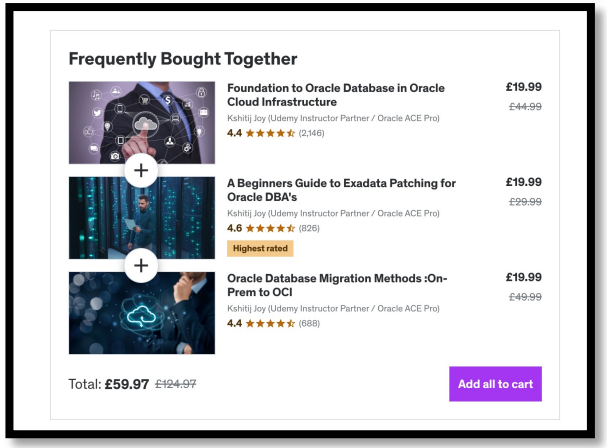
5) **Anomaly Detection**:
    1) The identification of unusual patterns that do not conform to expected behavior.
    2) Example: Detecting fraudulent transactions in banking by identifying patterns that deviate significantly from the majority of data.

6) **Applications**:
    1) Common in fields like **bioinformatics**, image and **speech recognition**, and recommendation systems.
    2) Example: **Recommender systems** in streaming services like Netflix or Spotify, which group users with similar preferences.

7) **Challenges**:
    1) More difficult than supervised learning due to the lack of labeled data.
    2) Example: Determining the right number of clusters in a dataset without predefined categories.







ReInforcement Machine Learning

1.Core Concept:

- Involves an agent learning to make decisions by performing actions and receiving feedback in the form of rewards or penalties.

2.Environment and Agent Interaction:

The agent interacts with its environment in discrete time steps. At each time step, the agent receives the environment's state, performs an action, and receives a reward.

3.Key Components:

- **Agent**: Learns from the environment.
- **Environment**: Where the agent performs actions.
- **Actions**: Set of all possible moves the agent can make.
- **State**: Current situation returned by the environment.
- **Reward**: Feedback from the environment.

4.Learning Process:

The agent learns a policy: a strategy of choosing an action given a state, to maximize cumulative reward over time.

5.Exploration vs. Exploitation:

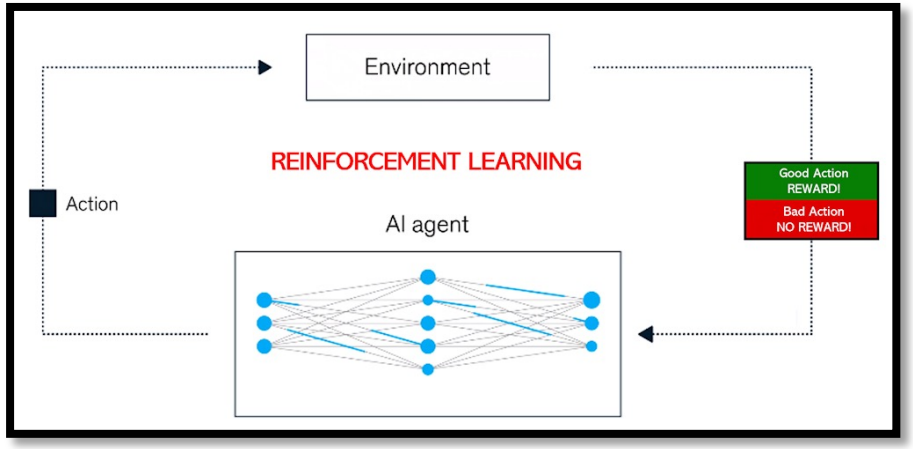
- Balancing exploration (trying new things) with exploitation (using known information) is a key challenge.

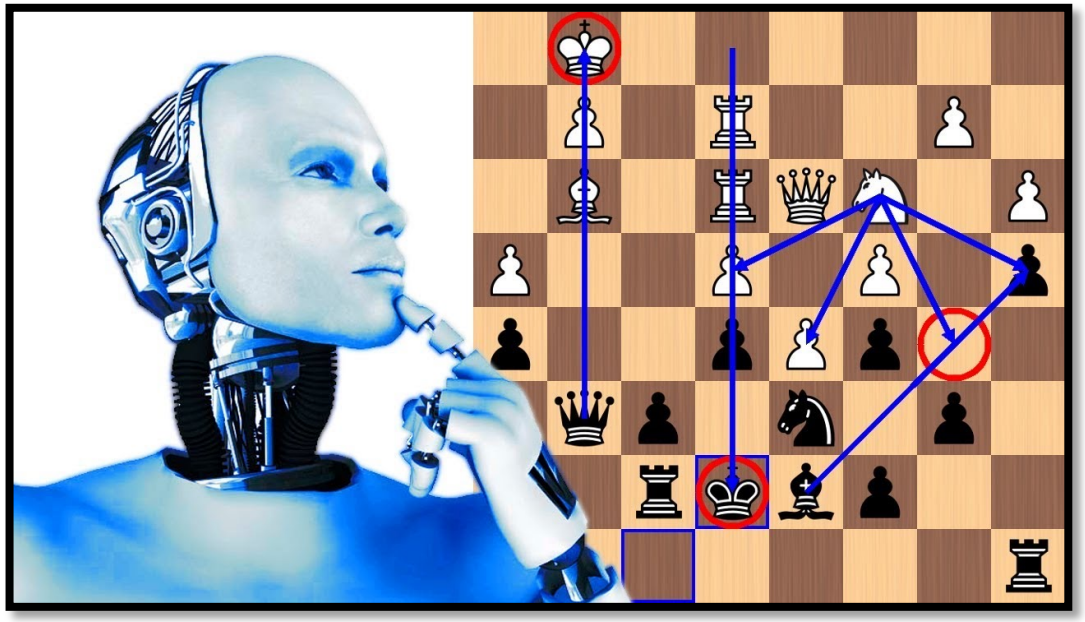
6.Applications:

- Game playing (e.g., chess, Go).
- Robotics for control tasks.
- Autonomous vehicles.

7.Challenges and Considerations:

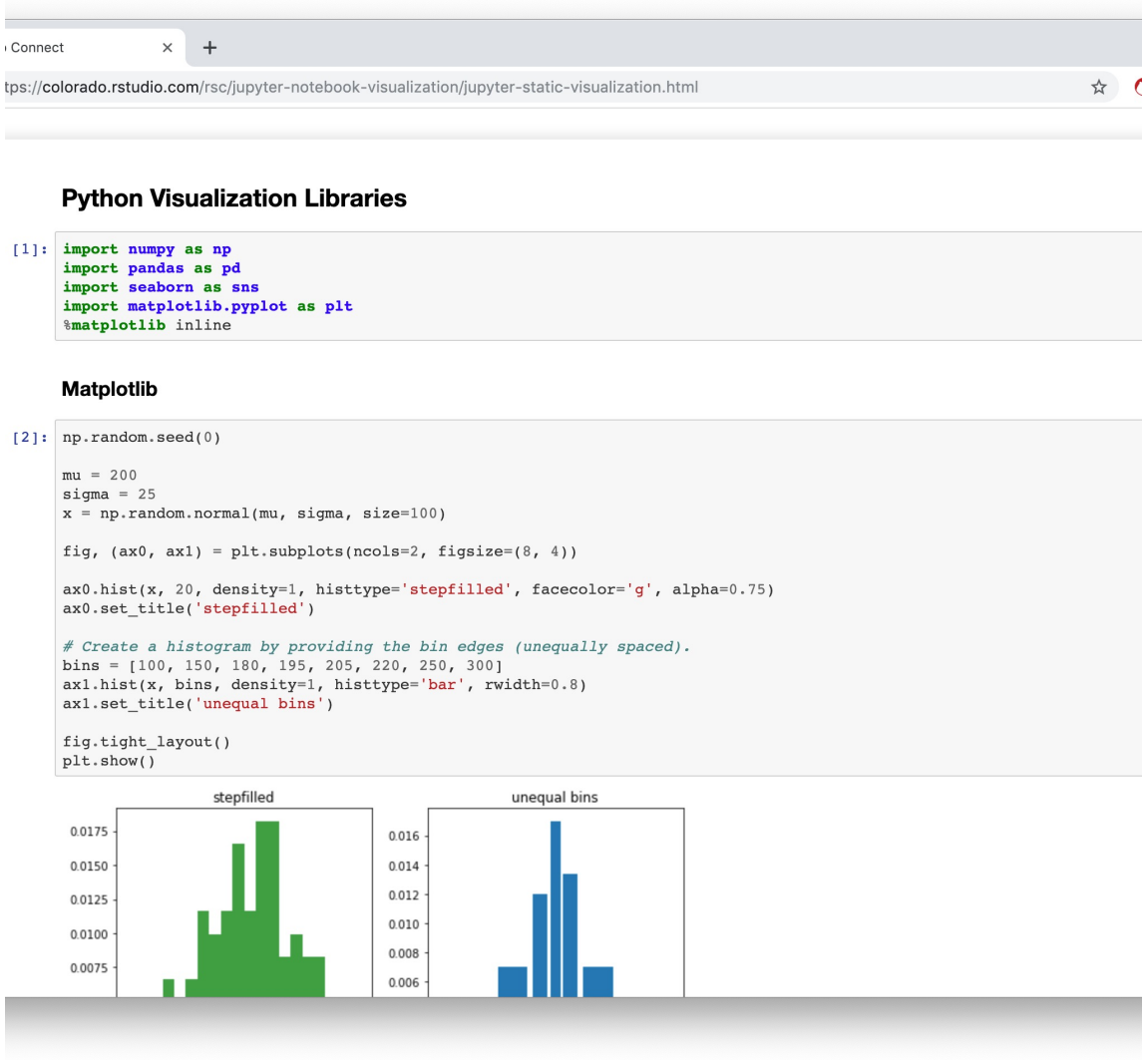
- Requires a lot of data and computational resources.
- Balancing exploration and exploitation can be complex.
- Dealing with environments with a lot of variability or uncertainty.



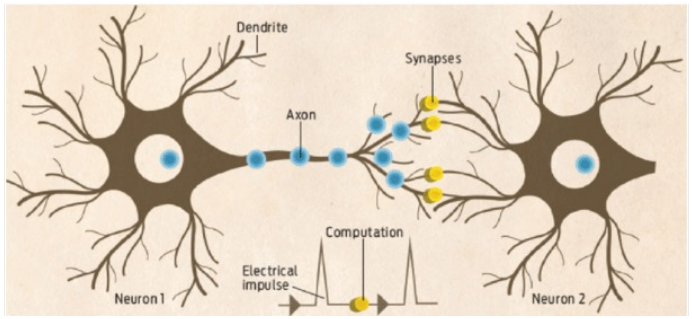


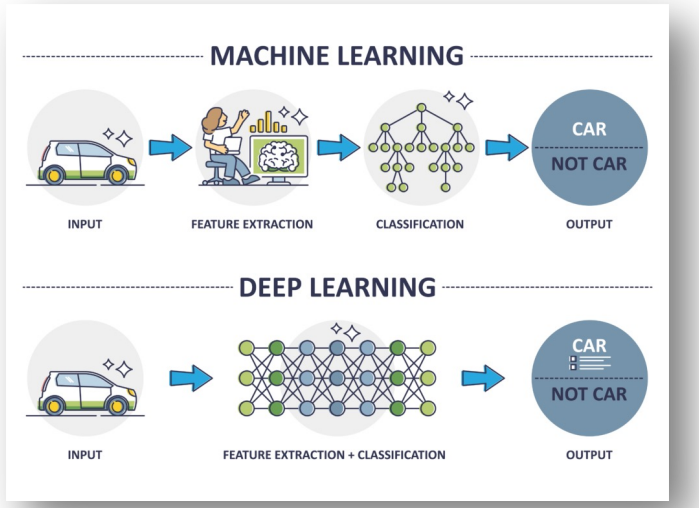
What is a Jupyter Notebook ?

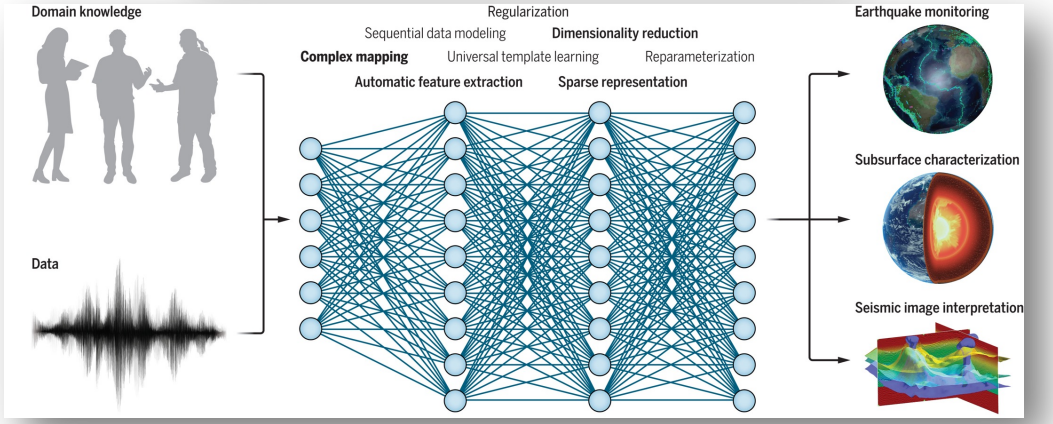
- **Interactive Computing Platform**: Jupyter Notebooks provide an interactive environment for writing and running code in a variety of programming languages, most notably Python.
- **Live Code Execution**: Code cells within a notebook can be executed independently and the results are displayed immediately below the code cell.
- **Support for Multiple Languages**: Primarily used for Python, it also supports over 40 programming languages including R, Julia, and Scala.
- **Rich Text Elements**: Notebooks can include narrative text (Markdown), equations (LaTeX), images, and links, allowing for comprehensive documentation of the code and its explanations.
- **Data Visualization**: Integration with data visualization libraries like Matplotlib, Plotly, and Bokeh makes it easy to create interactive graphs and charts directly within a notebook.
- **Collaboration and Sharing**: Notebooks can be shared with others and can be converted into a variety of formats (like HTML, PDF, and slides) for easy presentation and sharing.
- **Educational and Research Tool**: Widely used in academia and research for teaching programming, computational thinking, and data analysis.
- **Integration with Data Science Tools**: Seamlessly integrates with popular data science tools and platforms, facilitating tasks such as data cleaning, statistical modeling, machine learning, and more.



Deep Learning Foundations

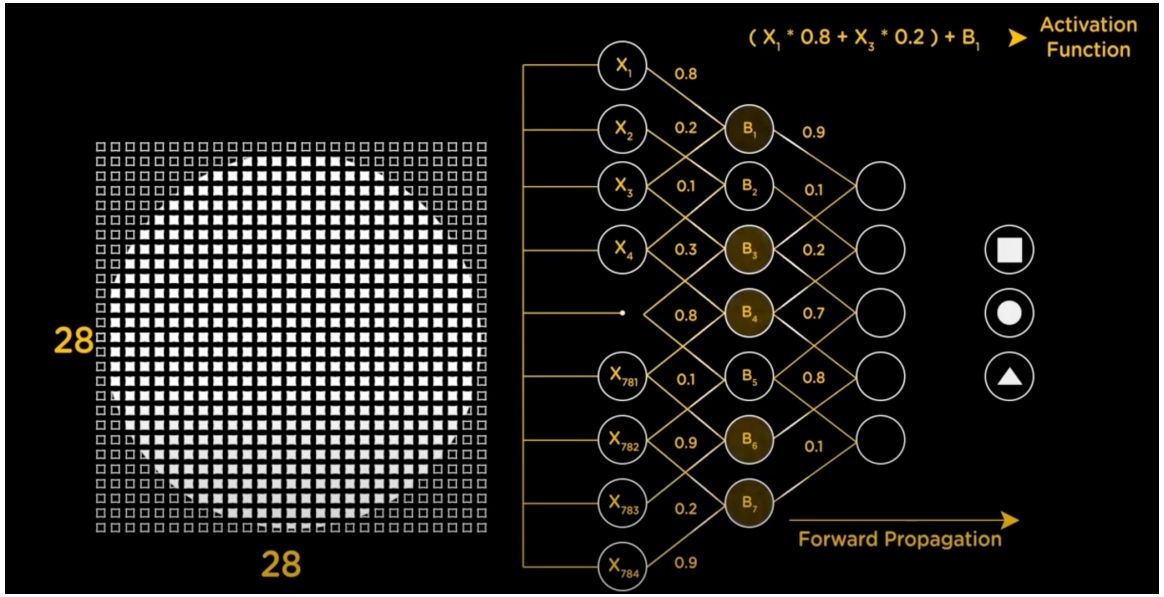


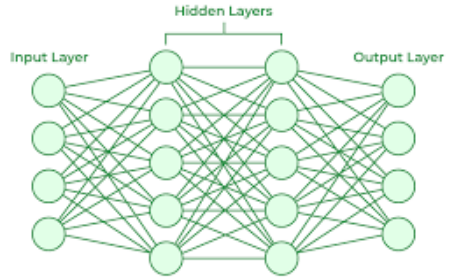


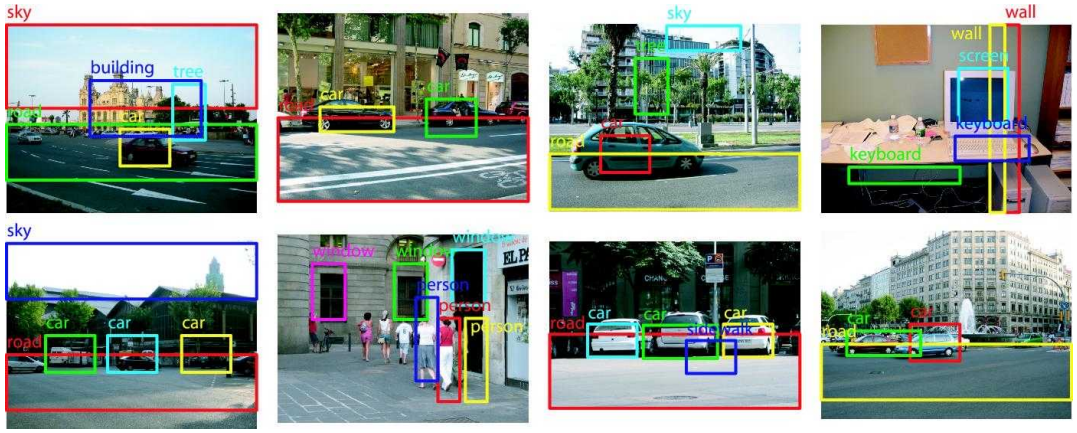


What is Deep Learning ?

1. **Definition**: Deep learning is a machine learning technique that teaches computers to process data in a way that is inspired by the human brain.
2. **Neural Networks**: At the heart of deep learning are artificial neural networks, which are algorithms inspired by the structure and function of the brain.
3. **A human brain** contains millions of interconnected neurons that work together to learn and process information.
4. **Artificial neural networks**, are made of many layers of artificial neurons that work together inside the computer.
5. **Automates feature extraction**, removing some of the dependency on human experts.
6. **Layers of Neurons**: Deep learning models consist of layers of interconnected nodes or neurons, and 'deep' refers to the number of layers through which the data is transformed.
7. **Learning from Unstructured Data**: Deep learning excels at learning from unstructured data like images, text, or sound.Example: Recognizing faces in images using Convolutional Neural Networks (CNNs).
8. **Large Data Requirements**: Generally requires large amounts of labeled data for training.
9. **Powerful Computational Resources**: Requires significant computational power, often using GPUs or specialized hardware.
10. **Versatile Applications**: Used in various applications like autonomous vehicles, medical diagnosis, natural language processing,
11. **Frameworks and Tools**: Tools like TensorFlow, PyTorch, Keras, and others are commonly used for building and training deep learning models.







What is a Neural Network ?

1. **Basic Concept**: A neural network is a machine learning program, or model, that makes decisions in a manner similar to the human brain, by using processes that mimic the way biological neurons work together to identify phenomena

2. **Structure**: Comprised of layers of interconnected nodes, or neurons, including input layers, hidden layers (one or more), and an output layer.

3. **Neuron Functionality**: Each neuron performs a simple calculation (like weighted sum followed by a nonlinear function) on its inputs.

4. **Learning Process**: Neural networks learn to perform tasks by considering examples, generally without taskspecific programming. For example, they might learn to identify images that contain cats by analyzing examples of cat images and noncat images.

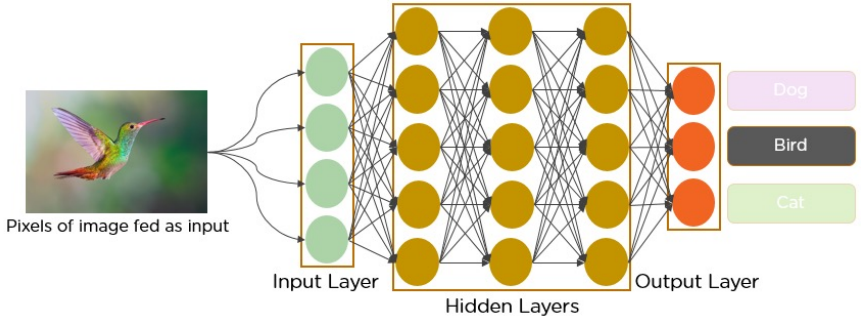
5. **Weights and Biases**: Connections between neurons have weights that adjust as learning proceeds. The network also uses biases, an extra input to nodes (neurons) in each layer to help them make better decisions.

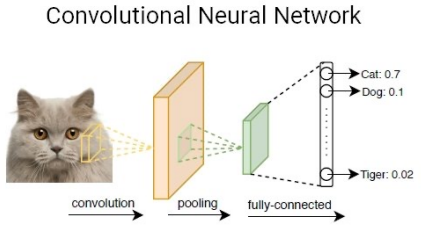
6. **Types of Neural Networks**: Includes feedforward neural networks, convolutional neural networks (CNNs), recurrent neural networks (RNNs), and more.

7. **Examples**:
    - **Image Recognition**: CNNs are used to identify objects, faces, scenes, and other elements in images.
    - **Speech Recognition**: RNNs are commonly used for speech recognition in virtual assistants like Siri or Alexa.
    - **Predictive Text**: Neural networks are used in keyboards on smartphones to predict the next word a user might type.

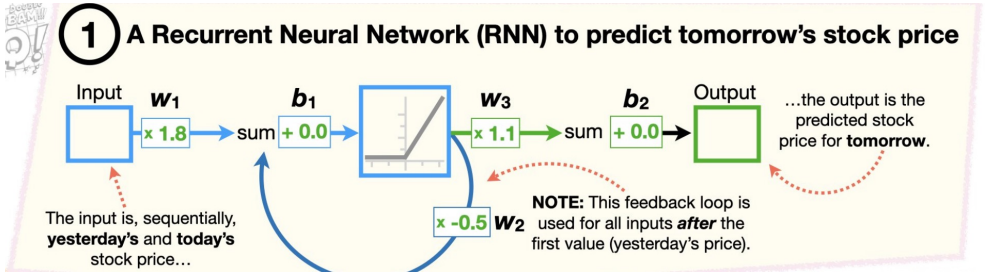
8. **Applications**: Beyond these examples, neural networks are used in a multitude of applications including selfdriving cars, medical diagnosis, stock market trading, and more.

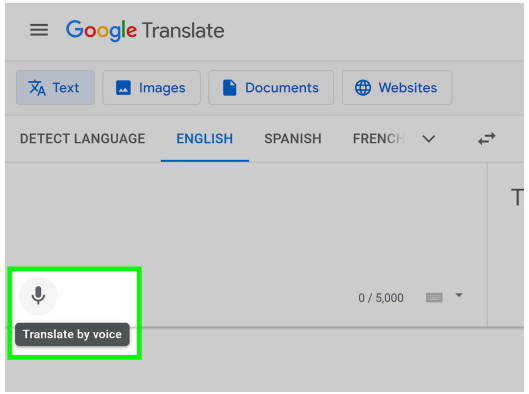
Deep Fake Video

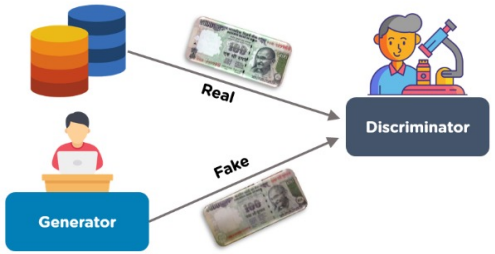


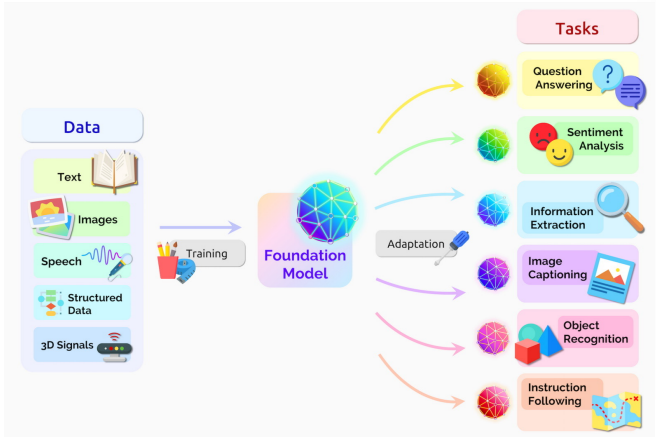


Deep Learning Models

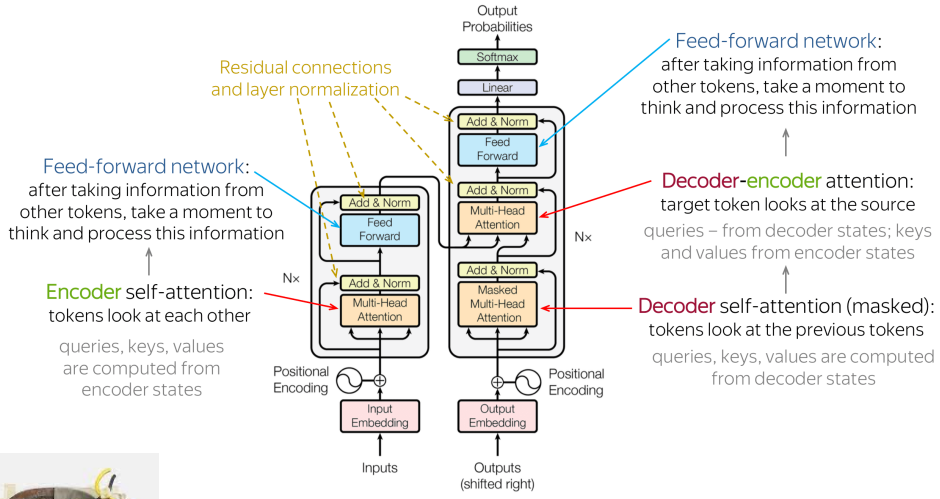


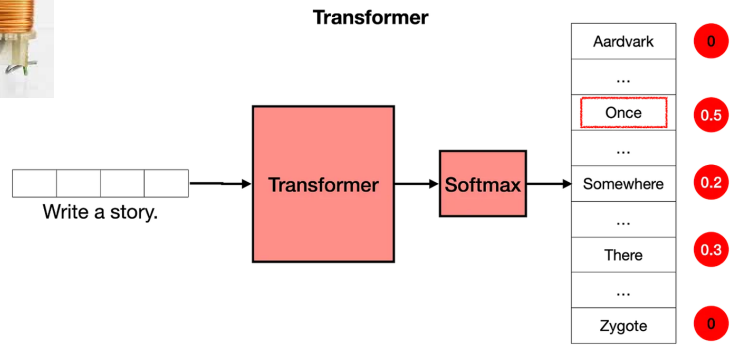




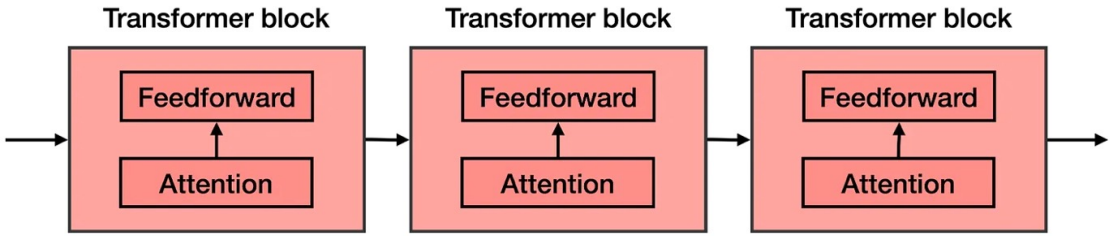


1. **Convolutional Neural Networks (CNNs)**:
   - Ideal for image and video processing.
   - Example: Image classification in social media platforms, like distinguishing between pictures of cats and dogs.
2. **Recurrent Neural Networks (RNNs)**:
   - Designed for sequential data, such as time series or natural language.
   - Example: Predicting the next word in a sentence for text autocomplete features.
3. **Long ShortTerm Memory Networks (LSTMs)**:
   - A type of RNN effective in learning from sequences with longrange dependencies.
   - Example: Used in machine translation services like Google Translate
4. **(GANs)**:
   - Consists of two networks, a generator and a discriminator, that compete against each other.
   - Example: Creating photorealistic images or deepfakes.
5. **Transformer Models**:
   - Based on selfattention mechanisms for handling sequential data.
   - Example: OpenAI's GPT3 for generating humanlike text in applications like chatbots or content creation.





The softmax layer turns the scores into probabilities, and these are used to pick the next word in the text.



The transformer is a concatenation of many transformer blocks. Each one of these is composed by an attention component followed by a feedforward component (a neural network).

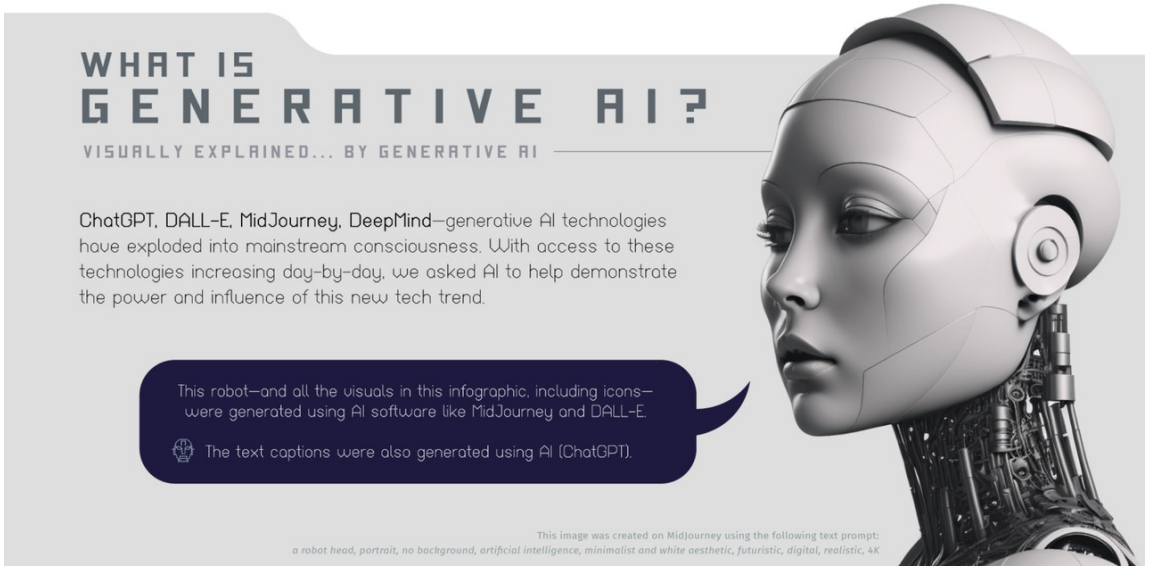
What is Transformer Model ?

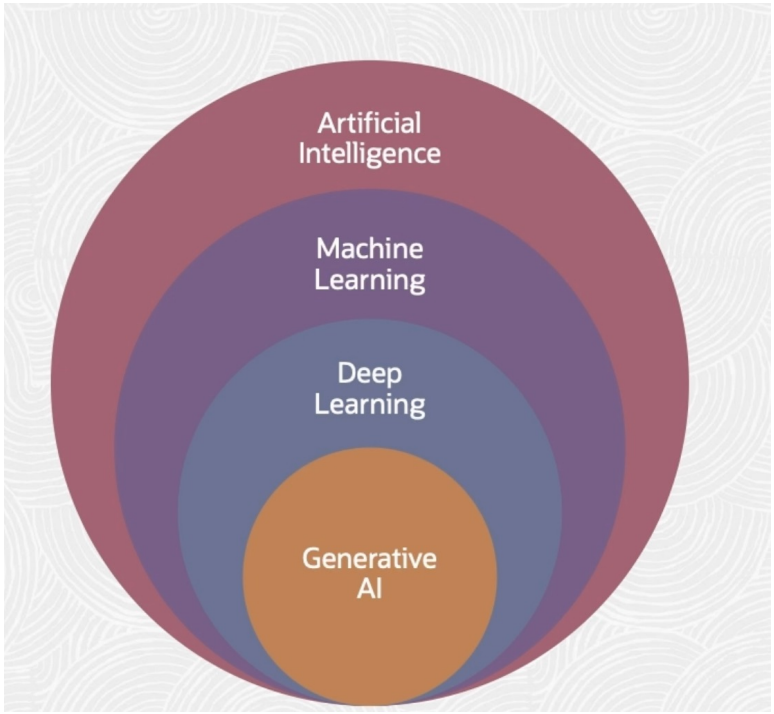
Transformers are a type of neural network architecture that have revolutionized the field of natural language processing (NLP). Here are some key points about transformer models:

1. **Architecture:** Transformers use a unique architecture primarily based on selfattention mechanisms, allowing them to weigh the importance of different parts of the input data.
2. **Parallel Processing:** Unlike previous sequencebased models like RNNs and LSTMs, transformers process entire sequences of data in parallel, significantly speeding up training and inference times.
3. **Attention Mechanism:** The core of the transformer is the attention mechanism, which allows the model to focus on different parts of the input sequence when producing output, enhancing its ability to understand context and relationships in the data.
4. **No Recurrence:** Transformers do not require recurrent layers. This absence of recurrence means they can handle longer sequences of data more effectively than RNNs and LSTMs.
5. **Scalability:** The parallel nature of transformers makes them highly scalable with increased data and computational resources, leading to improvements in performance.
6. **Layer Structure:** A typical transformer model consists of an encoder and a decoder, each comprising multiple layers of selfattention and feedforward neural networks.
7. **Application in NLP:** Transformers have become the backbone of many stateoftheart NLP models, used in tasks like machine translation, text generation, summarization, and questionanswering.
8. **BERT and GPT:** Notable implementations of transformer models include BERT (Bidirectional Encoder Representations from Transformers) for understanding context in language, and GPT (Generative Pretrained Transformer) for generating humanlike text.
9. **Beyond NLP:** While initially designed for NLP tasks, the transformer architecture has also been adapted for use in other areas, such as computer vision and audio processing.

Context :

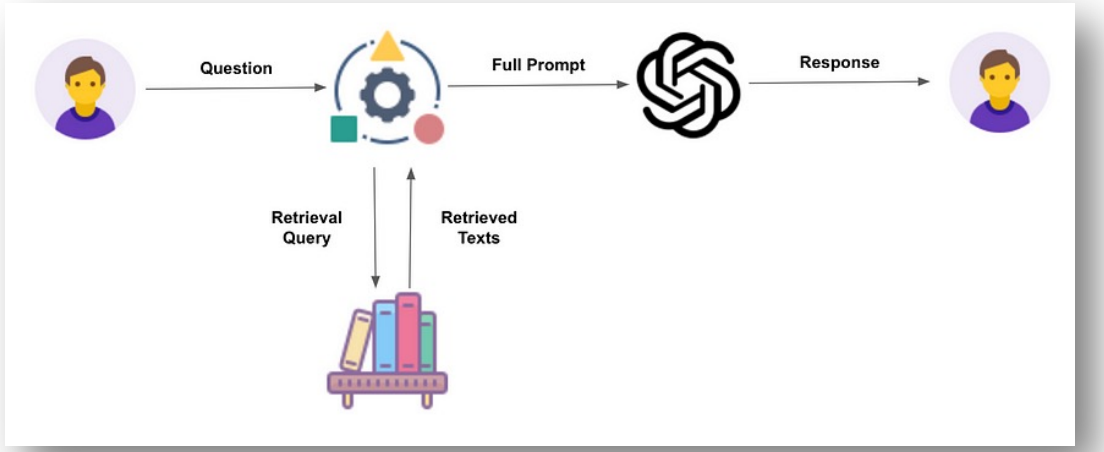
- Sentence 1: The **bank** of the river.
- Sentence 2: Money in the **bank**.

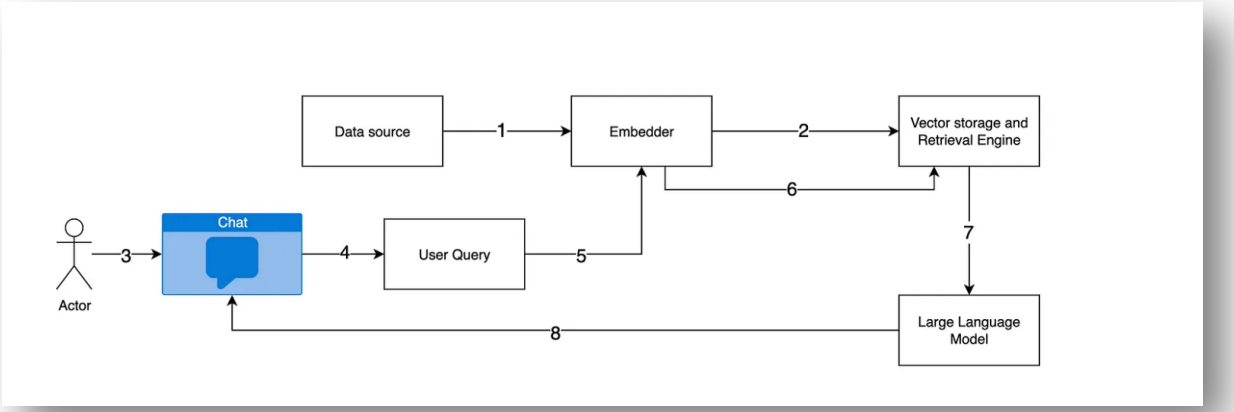




What is Generative AI ?

1. **Content Creation**: Generative AI can create a wide range of content, including text, images, music, and even code.
2. **Learning from Data**: These systems learn from large datasets to understand patterns and styles, enabling them to produce similar outputs.
3. **Deep Learning Models**: Many generative AI systems use deep learning techniques, particularly neural networks, to generate content.
4. **Applications**: Generative AI is used in various fields such as art, entertainment, marketing, and software development.
5. **Improving Efficiency**: By automating the creation process, it can significantly reduce the time and effort required to produce content.
6. **Challenges and Ethical Considerations**: There are concerns regarding originality, copyright, and the potential misuse of generated content.
7. **Continual Evolution**: Generative AI technologies are rapidly evolving, becoming more sophisticated over time.
8. **UserGenerated Input**: These systems can start with a simple user input (like a text prompt) and expand it into a fullfledged creation.
9. **Interdisciplinary Impact**: Its impact is felt across various disciplines, revolutionizing traditional methods in fields like journalism, design, and education.





What is RetrieverAugmented Generation RAG ?

Combines Retrieval and Generation: RAG uses a retriever to find relevant information and a generator to create responses based on that info.

Example: If asked "What is climate change?", RAG retrieves scientific articles on the topic and then generates a concise explanation.

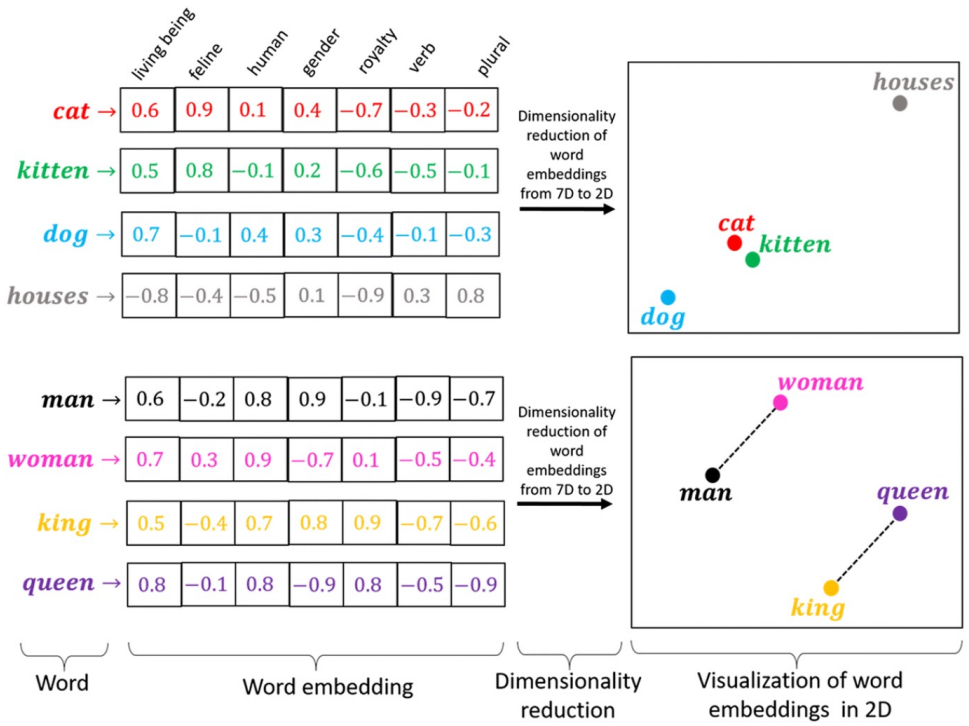
Improves Response Quality: By using external information, RAG provides more accurate and detailed answers.

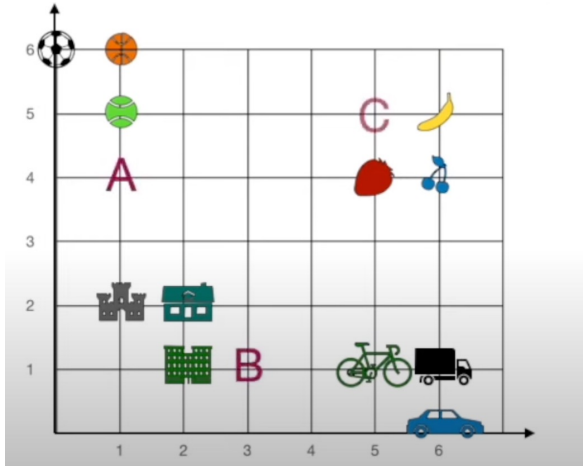
Applicable in Various Domains: The model is adaptable for different uses like customer service chatbots or educational tools, where precise information is crucial.

Enhances Contextual Awareness: RAG's use of relevant documents ensures responses are contextually appropriate, reducing errors seen in purely generative models.

Workflow:

- User submits a query.
- Query is transformed into a vector representation.
- Relevant documents are retrieved from a data source based on similarity.
- LLM utilizes both the query and retrieved documents (or their context) to generate a final response.





What is Embedding ?

An embedding is a way of converting the features of an object, like a word, into a vector of real numbers.

Transforming Data: Embeddings turn complex data (like words or pictures) into vectors or a list of numbers that a computer can understand and work with.

Finding Similarities: They help find similarities between items. For example, in word embeddings, similar words are represented by numbers that are close together.

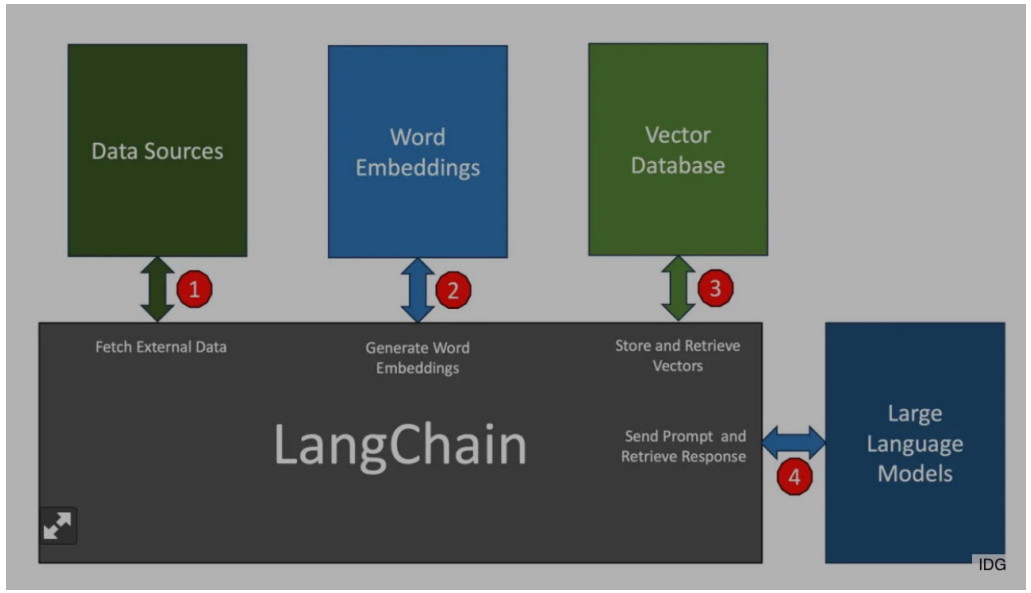
Making Data Smaller: They help make big, complicated data simpler and smaller, so it's easier for computers to handle.

Used Everywhere: Embeddings are used in many areas, like helping computers understand language or recommend things you might like.

Different Types: Word2Vec (Google) / GloVe (Global Vectors for Word Representation) / BERT (Bidirectional Encoder Representations from Transformers)

Learning from Data: Computers can learn to create these embeddings by looking at lots of examples, which helps them understand and predict new, unseen data.

Improving Understanding: Some advanced embeddings can even understand the context, meaning they can tell the difference in meaning when a word is used in different ways.



What is Langchain ?

Just as **LEGO** bricks are assembled following a structured guide to create a **final model**, LangChain integrates various data sources with AI language models to build an application.

Langchain is a technology framework designed for integrating language models into applications effectively.

Integration of Language Models: Simplifies the process of incorporating sophisticated language AI models into various software applications.

Modular and Flexible: Provides modular components that developers can mix and match to build custom solutions tailored to specific needs.

DeveloperFriendly: Designed to be accessible for developers, reducing the complexity typically associated with implementing AIdriven conversational agents.

Simple Example:

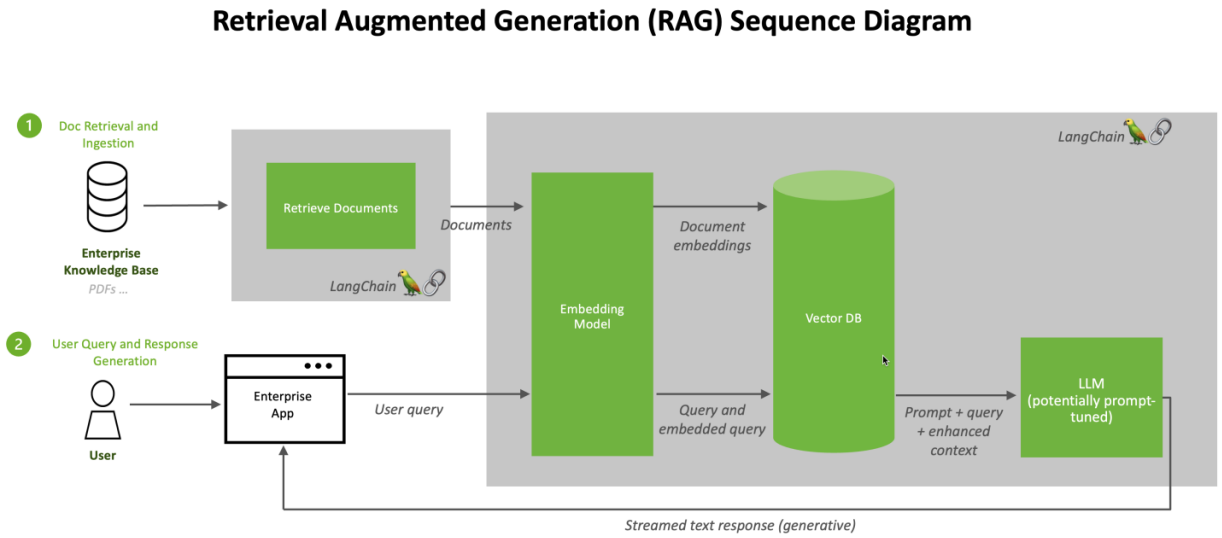
User Query:
A user types or asks, "What is the weather like in Chandigarh today?" using an app integrated with LangChain.

Retrieve Data:
LangChain processes the query and identifies that it needs weather data. It accesses an external database or API specifically set up for weather information.

Data Processing:
The system retrieves the current weather data for Chandigarh from the weather database or API. Let's say the data shows it's "sunny and 40°C".

Generate Response:
LangChain uses a language model to generate a natural language response based on the retrieved data. The model formats the response to be informative and userfriendly.

Deliver Response:
The final response, "The weather in Chandigarh today is sunny with a temperature of 40°C," is delivered to the user through the app.



Role of Langchain in a RAG

1.Document Retrieval and Ingestion:

Langchain's Role: Langchain appears to facilitate the retrieval of documents from an "Enterprise Knowledge Base" (which might consist of PDFs and other documents).

2. Processing and Embeddings:

Langchain's Role: After documents are retrieved, they are likely processed through an embedding model to convert text content into vector embeddings

3. Vector Database:

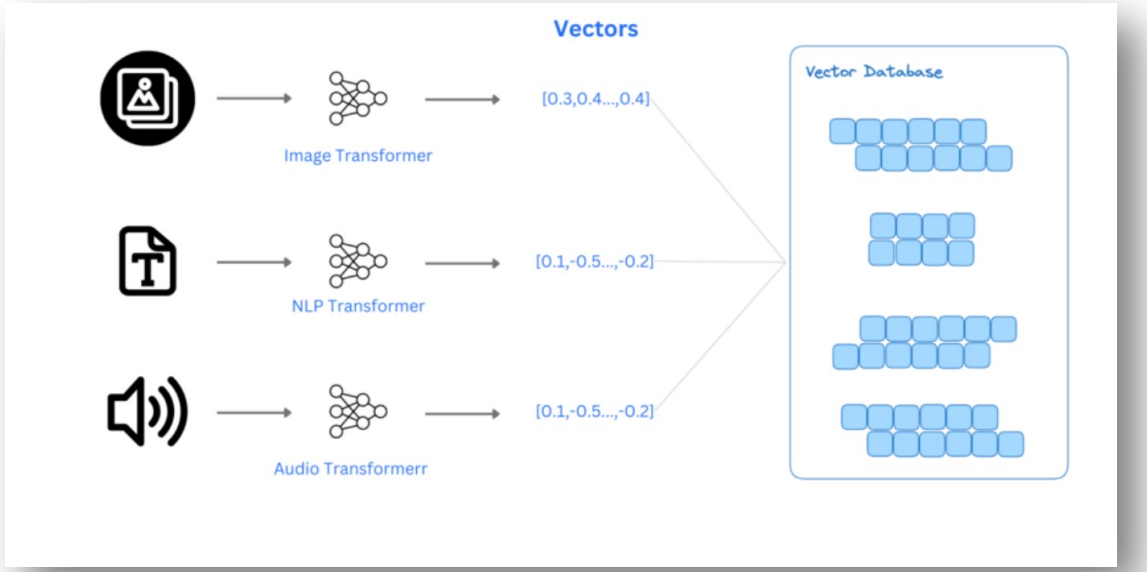
Langchain's Role: The document embeddings are stored in a vector database. This database is used to perform efficient similarity searches between the query embeddings and the document embeddings.

4. Query and Enhanced Context Preparation:

Langchain's Role: Once the relevant documents (or their embeddings) are identified, Langchain helps in preparing the enhanced query context by combining the original user query with information retrieved from the vector database

5. Response Generation:

Langchain's Role: Langchain likely manages the interaction with this language model, ensuring that the input is correctly formatted and that the generation process is effectively executed.



What is Vector Database ?

A vector database is a type of database designed for storing, indexing, and querying vectors, which are arrays of numbers representing data in highdimensional space.

Purpose: Primarily used for storing embeddings that represent complex data like images, text, and audio in a form that machines can understand and process.

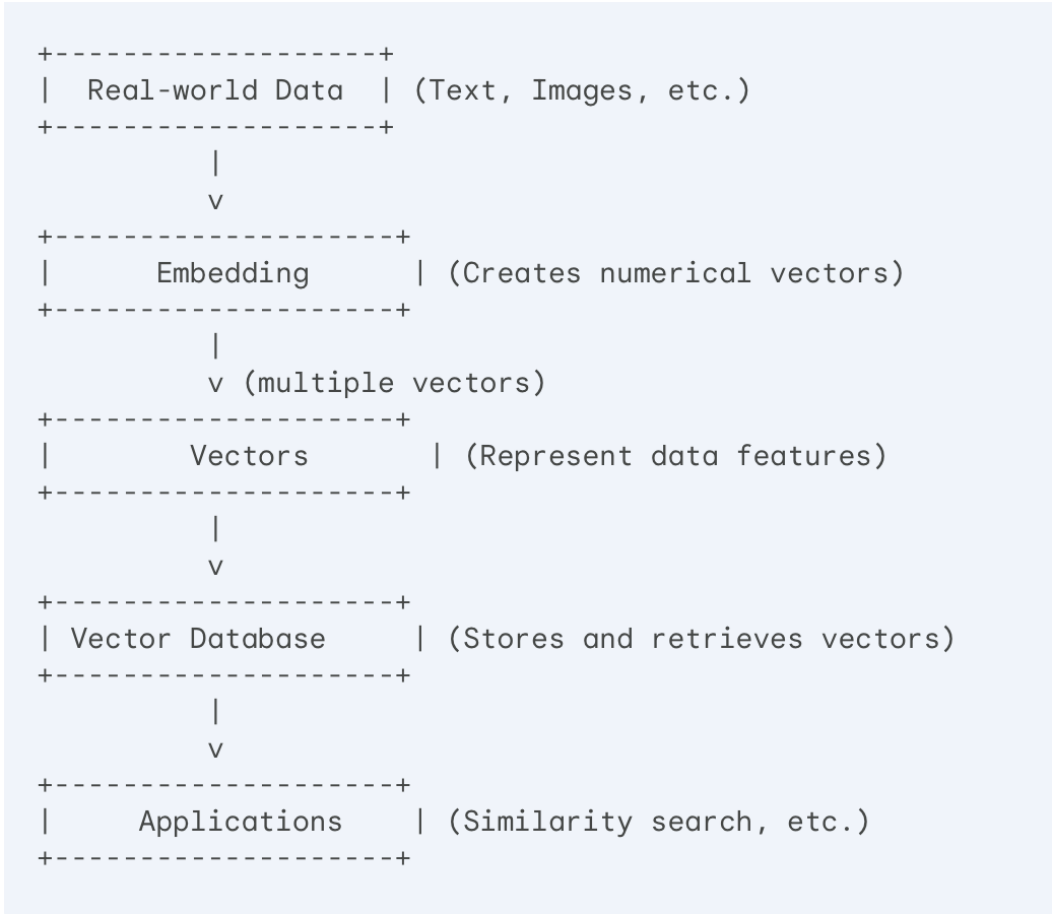
Similarity Search: Optimized for similarity search, allowing quick retrieval of items that are most similar to a given query in terms of vector distance, such as Euclidean distance or cosine similarity.

Applications: Widely used in machine learning, artificial intelligence, and recommendation systems for tasks like image recognition, natural language processing, and personalized content discovery.

Scalability: Designed to handle large volumes of data, supporting scalability and efficient querying in big data applications.

Integration with ML Models: Often integrated with machine learning models to directly store and query modelgenerated embeddings, facilitating dynamic and realtime applications.

Realtime Performance: Capable of providing realtime search and retrieval performance, essential for interactive applications and services.



Embeddings vs Vector Databases

Realworld Data: This represents the data you want to work with, such as text documents, images, or even sounds.

Embedding: This is a process that transforms the realworld data into numerical vectors. The embedding captures the important features of the data.

Vectors: These are the numerical representations of the data created by the embedding process. Each vector is a list of numbers that encodes the data's characteristics.

Vector Database: This is a specialized database designed to store and efficiently retrieve large collections of vectors. It uses techniques to find similar vectors quickly.

Applications: Vector databases are used in various applications, such as similarity search (finding similar data points) and recommendation systems.

Predictive AI Vs Generative AI

Predictive AI:

- **Function:** Predictive AI is primarily designed to analyze existing data and make predictions about future events or outcomes based on that data.
- **Data Analysis:** It often involves statistical methods and machine learning algorithms to identify patterns or trends in historical data.
- **Applications:** Commonly used in forecasting (like weather, stock prices), risk assessment, and customer behavior prediction.
- **Decision Support:** Provides insights and recommendations, aiding in decisionmaking processes.
- **Reactive Nature:** Tends to react to existing data, making predictions about what will happen next.
- **Examples:** Credit scoring models, demand forecasting in supply chain management, and predictive maintenance in manufacturing.

Generative AI:

- **Function:** Generative AI focuses on creating new data that resembles the training data, often creating entirely new and original outputs.
- **Content Creation:** Capable of generating text, images, music, and other forms of media.
- **Applications:** Used in art and design, generating synthetic data for training other AI models, and creating realistic simulations.
- **Creative Potential:** Has the ability to produce creative and novel outputs, going beyond the scope of the input data.
- **Proactive Nature:** Proactively creates new data points rather than just analyzing and reacting to existing data.
- **Examples:** Deep learning models like GPT (for text) and DALLE (for images), music composition AI, and AI for generating synthetic datasets.

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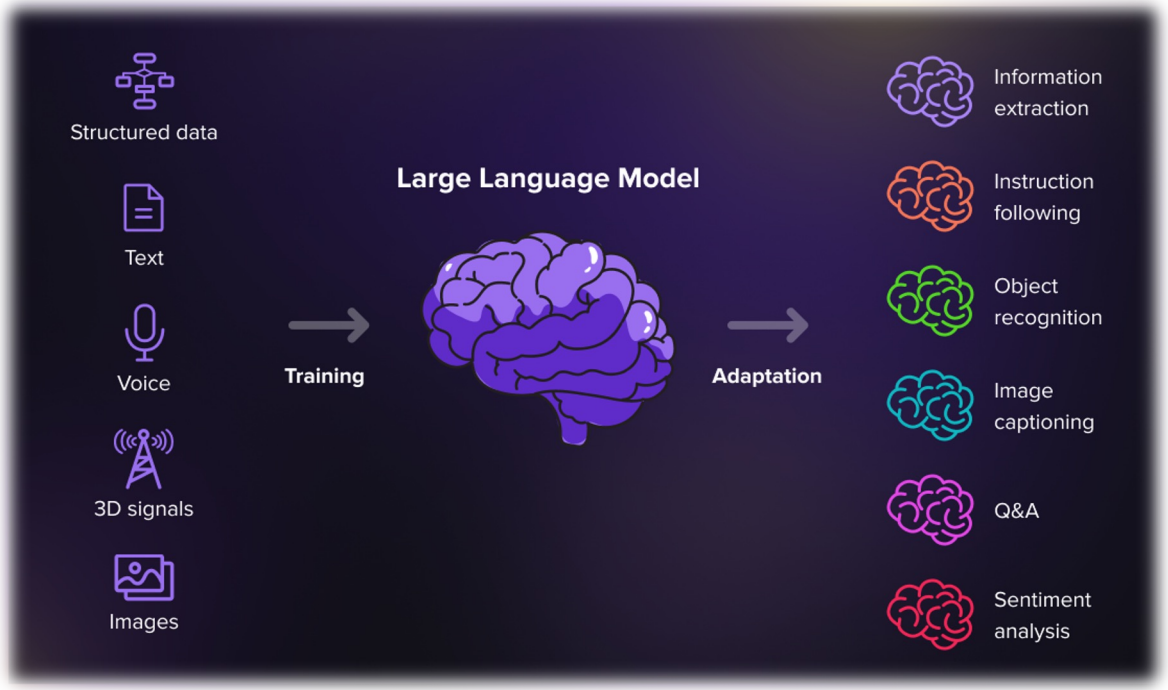


What is LLM ?

Large Language Models (LLMs) are sophisticated AI systems designed for processing, understanding, and generating human language. Here are key points about them, with an example for clarity:

1. **Scale and Complexity:** LLMs are composed of millions or billions of parameters, making them highly complex. Example: GPT4, with its vast number of parameters, can generate humanlike text.

2. **Training Data:** They are trained on vast datasets comprising a wide range of internet text. Example: GPT4 is trained on a diverse dataset that includes books, websites, and other texts.

3. **Natural Language Understanding and Generation:** LLMs are adept at understanding and generating humanlike language. Example: GPT4 can write essays, poems, or even simulate conversation.

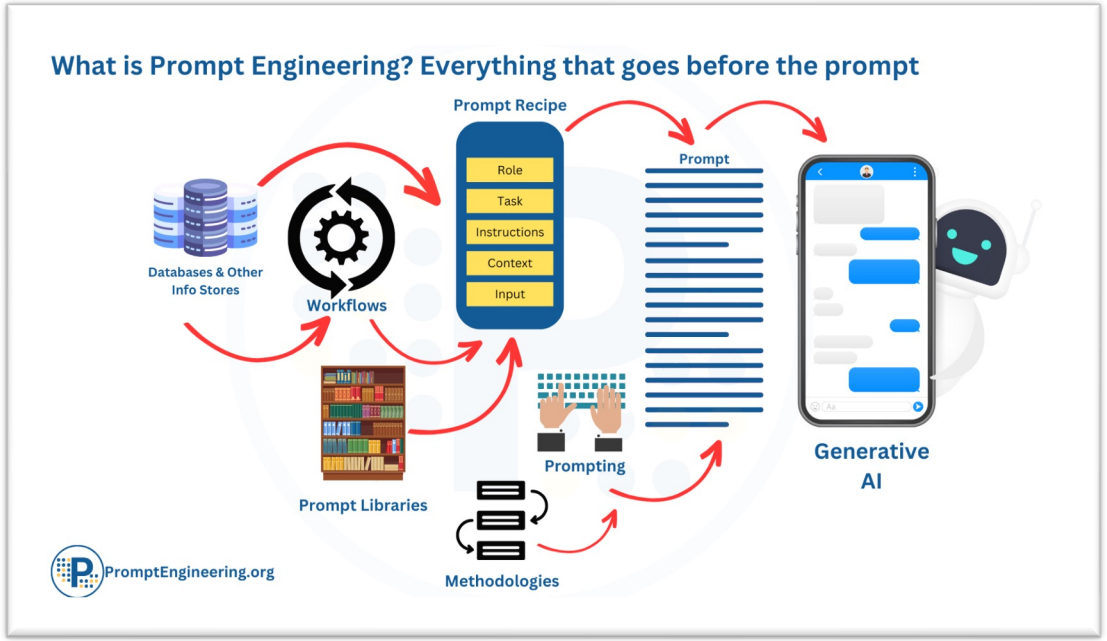
4. **Applications:** They are used in various applications like chatbots, content creation, language translation, and more. Example: GPT4 powers advanced chatbots capable of maintaining context over long conversations.

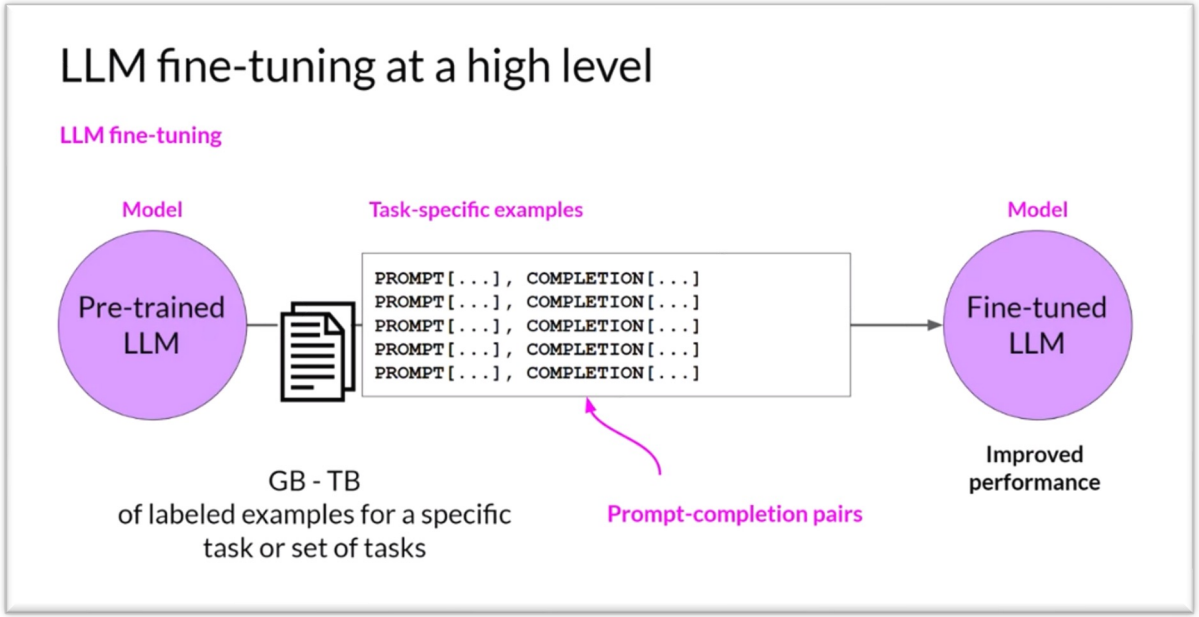
5. **Learning Method:** Most LLMs use a form of deep learning called transformers, which are effective at processing sequences of data. Example: GPT4's transformer architecture enables it to understand and predict language sequences efficiently.

6. **Adaptability:** LLMs can adapt to different styles, tones, and types of language tasks. Example: GPT4 can switch between writing styles, such as formal report writing and casual conversation.

7. **Continual Learning:** Many LLMs are designed to continually learn and improve over time with more data and user interaction. Example: GPT4's performance can improve as it is exposed to more diverse and extensive user interactions.

8. **Customization:** Some LLMs offer customization options for specific industry needs or user preferences. Example: GPT4 can be finetuned for specialized tasks like legal analysis or medical advice, although with limitations.





Prompt Engineering & Fine Tuning

Prompt Engineering:

Definition: The practice of crafting inputs (prompts) to a generative AI model to elicit the best possible output.

Techniques: Includes using specific keywords, structured sentences, or including examples to guide the AI.
Purpose: To maximize the AI's understanding of the task at hand and to generate more accurate, relevant, or creative responses.

Adaptability: It requires an understanding of how the AI interprets different prompts and the ability to adjust them based on the desired outcome.

Skill Level: It can be utilized by both novices and experts; novices might use trialanderror, while experts might use more sophisticated methods based on their understanding of the model.

Model Dependence: Effectiveness can vary significantly across different AI models and versions.

FineTuning:

Definition: The process of adjusting a pretrained generative AI model to better suit specific tasks or data.

DataSpecific: Involves training the AI on a particular dataset to refine its responses to be more in line with that data's characteristics.

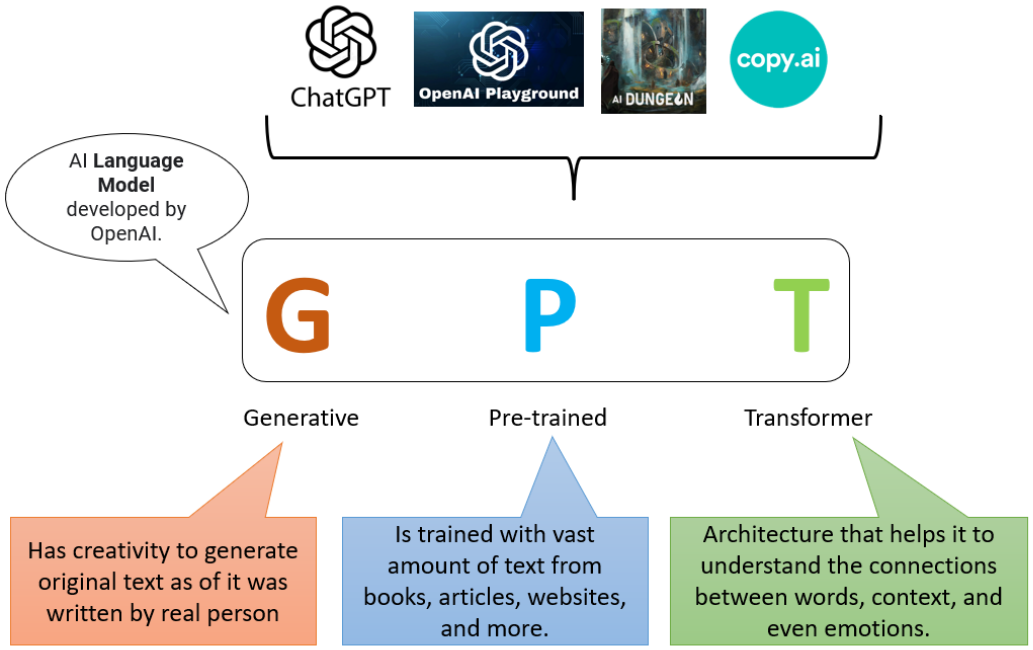
Cost and Resources: Generally requires more computational resources and technical knowledge than prompt engineering.
Customization: Enables the creation of a custom AI that can perform better on specialized tasks.

Continuous Process: Finetuning is not a onetime process; models may require periodic updates as they are exposed to new data or as requirements evolve.

Risk of Overfitting: There's a risk that the model may perform exceptionally well on the training data but fail to generalize to new, unseen prompts.

Both techniques are crucial for optimizing the performance of generative AI models in various applications,
They are often used in tandem: finetuning can provide a better baseline performance, while prompt engineering can optimize individual interactions.

What is GPT ?



1. **GPT**, which stands for "Generative Pretrained Transformer," is an advanced type of AI model developed by OpenAI for natural language processing tasks. Here are some key points about GPT:
2. **Type of AI Model:** GPT is a type of large language model (LLM) that uses deep learning techniques, specifically a transformer architecture, for understanding and generating human language.
3. **Training Method:** It is pretrained on a vast corpus of text data sourced from the internet, including websites, books, and other written material, allowing it to learn a wide range of language patterns and styles.
4. **Generative Capabilities:** GPT is designed to generate coherent and contextually relevant text based on the input it receives, making it useful for applications like content creation, conversation, and text completion.
5. **Versions and Evolution:** There have been several versions of GPT, with each new version (like GPT2, GPT3, GPT4, etc.) generally being larger and more capable than the last in terms of the amount of data it can process and the complexity of the tasks it can perform.
6. **Applications:** GPT is used in a variety of applications, including chatbots, writing assistants, language translation, and even in creative fields for generating art, music, and poetry.
7. **Humanlike Responses:** One of the notable features of GPT is its ability to produce responses that can closely mimic human writing styles, making its applications more natural and userfriendly.
8. **Ethical Considerations:** The deployment of GPT models raises ethical questions around topics like misinformation, privacy, and the potential impact on jobs in fields like writing and customer service.
9. **Accessibility and Use:** GPTpowered tools and services are increasingly accessible to businesses and individuals, enabling a wide range of users to leverage its capabilities for various purposes.

GPT MODELS COMPARISON CHART

Model	Size	Memory capacity	Accuracy	Input formats	Price
GPT-3	175B	1,500 words	<60%	Text, speech	$$
GPT-3.5	20B	8,000 words	<60%	Text, speech	$
GPT-4	>1T (?)	25,000-64,000 words	>80%	Text, speech, image	$$$

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CHAT GPT-3 VS. CHAT GPT-4

CHAT GPT-3	CHAT GPT-4
Only takes text prompts	Take text & image prompts
Creative...sort of	More creative
Hallucinates a lot of facts & opinions	Still Hallucinates, but not as much :)
Barely passed the bar exam	Aced the bar exam
Takes a lot of steering & prompts for developers	More steerable in conversations & developer prompts

"GPT-4 IS MORE RELIABLE, CREATIVE AND ABLE TO HANDLE MUCH MORE NUANCED INSTRUCTIONS THAN GPT-3.5" - OPEN AI

GPT3 Vs GPT4

GPT3 and GPT4 are both iterations of OpenAI's Generative Pretrained Transformer (GPT) series, but there are key differences between them:

1.Model Size and Complexity:

- **GPT3:** Has 175 billion parameters, making it one of the largest language models at its time of release.
- **GPT4:** Is even larger than GPT3, with more parameters (the exact number has not been publicly disclosed), which enhances its understanding and generation capabilities.

2.Performance and Accuracy:

- **GPT3:** Sometimes struggles with complex reasoning tasks and can generate less accurate or relevant responses in certain contexts.
- **GPT4:** Shows improved performance in understanding context and nuance, leading to more accurate and contextually relevant outputs.

3.Training Data and Knowledge:

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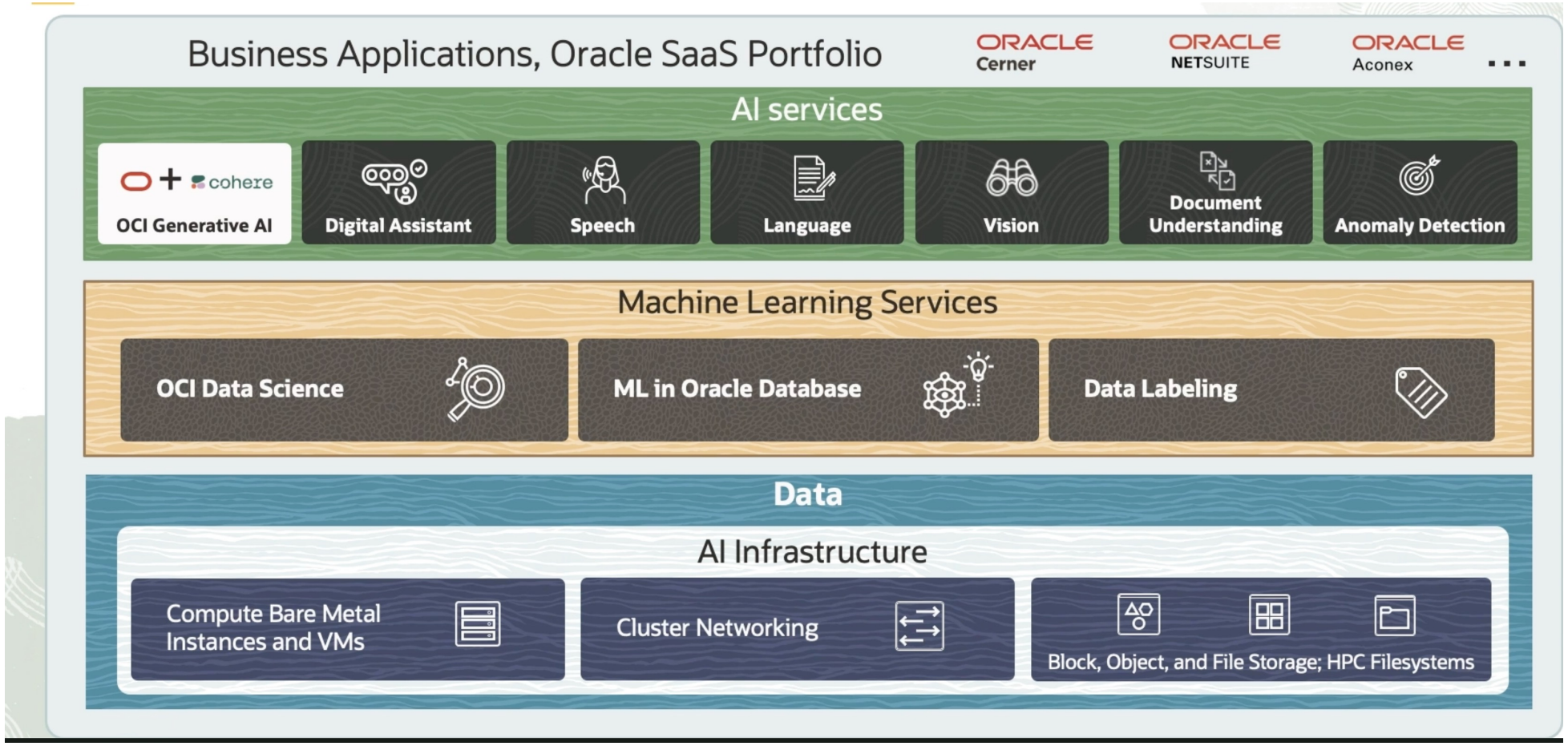
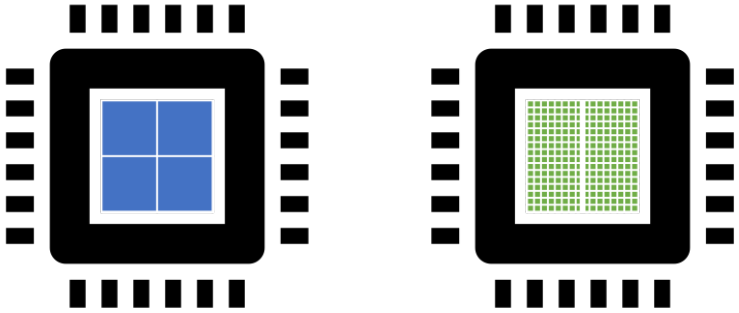
AI Infrastructure

CPU Vs GPU

AIINFRASTRUCTURE





CPU	GPU
Central Processing Unit	Graphics Processing Unit
4-8 Cores	100s or 1000s of Cores
Low Latency	High Throughput
Good for Serial Processing	Good for Parallel Processing
Quickly Process Tasks That Require Interactivity	Breaks Jobs Into Separate Tasks To Process Simultaneously
Traditional Programming Are Written For CPU Sequential Execution	Requires Additional Software To Convert CPU Functions to GPU Functions for Parallel Execution

What is a GPU ?

1. A **GPU**, or Graphics Processing Unit, is a specialized processor primarily designed to accelerate graphics rendering.

2. **Highly Parallel Structure**: GPUs have a parallel processing architecture, which allows them to process many computations simultaneously

3. **Graphics Rendering**: Originally, GPUs were designed to render graphics for applications such as video games and 3D animations

4. **Machine Learning and AI**: In the field of AI and machine learning, GPUs are instrumental for training complex neural networks due to their ability to handle multiple operations concurrently.

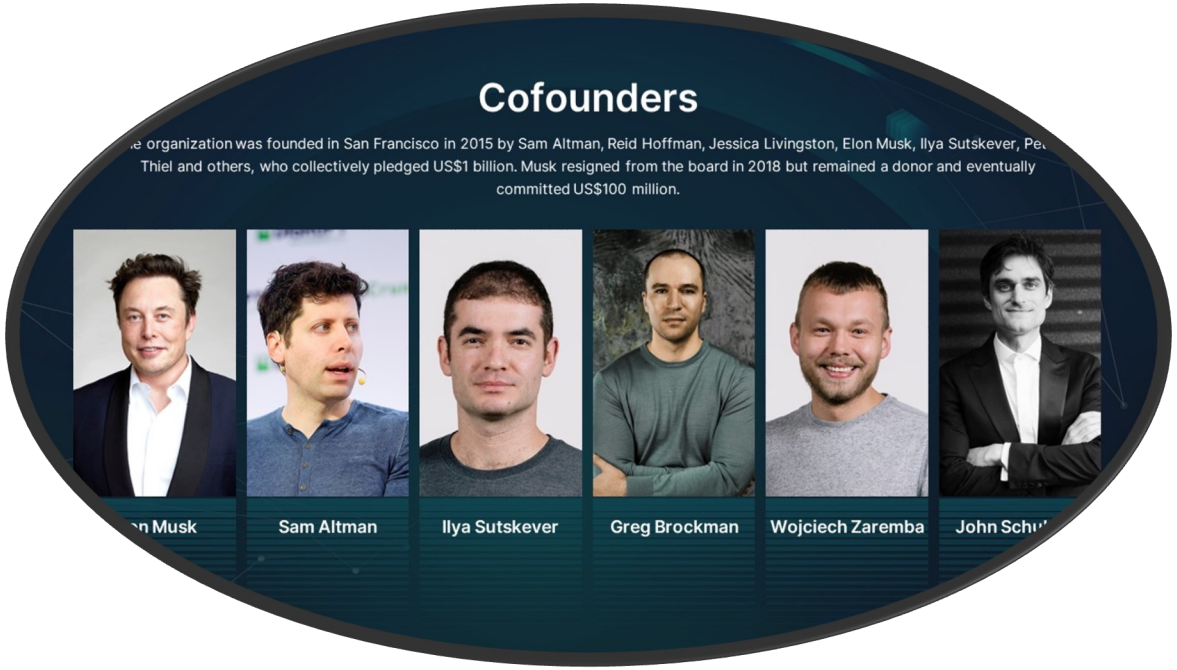
5. **Energy Efficiency**: GPUs are more energyefficient than traditional CPUs for parallel processing tasks, offering a better performanceperwatt ratio

6. **Types of GPUs**: There are two main types of GPUs: integrated GPUs, which are built into the same chip as the CPU and offer basic graphics processing, and dedicated (or discrete) GPUs, which are separate cards with their own memory and processing power, offering superior performance.

7. **VR and AR Applications**: GPUs are essential for powering virtual reality (VR) and augmented reality (AR) applications, providing the necessary speed and performance to create immersive experiences.

8. **Evolution and Innovation**: The technology behind GPUs continues to evolve rapidly, with constant innovations leading to faster, more efficient, and more powerful GPUs suitable for a wide range of applications.

OpenAI / ChatGPT / APIs



What is OpenAI ?

Research Organization: OpenAI is an AI research lab that focuses on developing and promoting friendly AI in a way that benefits humanity as a whole.

Founded in 2015: OpenAI was established in December 2015 by Elon Musk, Sam Altman, Greg Brockman, Ilya Sutskever, Wojciech Zaremba, and others

Advanced AI Models: Developing some of the most advanced AI models, including the Generative Pretrained Transformer (GPT) series, with the latest iterations being GPT3 and GPT4.

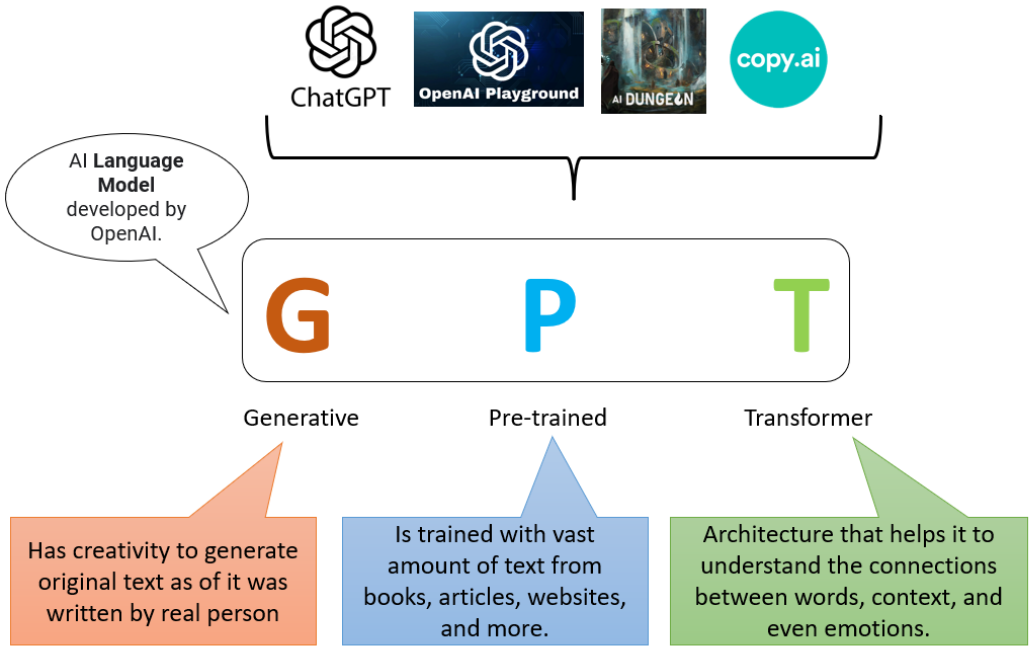
Ethics and Safety: A significant focus for OpenAI is ensuring the ethical use of AI and addressing potential safety risks associated with powerful AI systems.

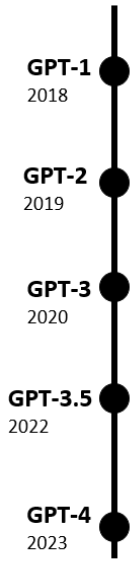
Open Collaboration: Initially, OpenAI started with a commitment to openaccess research, sharing its findings and technologies. However, it has since adopted a more controlled release approach to mitigate potential risks.

Commercial Products: OpenAI has developed several commercial products, such as the API that provides access to models like GPT3 for a variety of textbased tasks, including conversation, summarization, translation, and more.

Partnerships and Licensing: OpenAI has entered into partnerships and licensing agreements, notably with Microsoft, which provides significant Azure cloud computing resources necessary for training and deploying AI models.

What is GPT ?





1. **GPT**, which stands for "Generative Pretrained Transformer," is an advanced type of AI model developed by OpenAI for natural language processing tasks. Here are some key points about GPT:
2. **Type of AI Model:** GPT is a type of large language model (LLM) that uses deep learning techniques, specifically a transformer architecture, for understanding and generating human language.
3. **Training Method:** It is pretrained on a vast corpus of text data sourced from the internet, including websites, books, and other written material, allowing it to learn a wide range of language patterns and styles.
4. **Generative Capabilities:** GPT is designed to generate coherent and contextually relevant text based on the input it receives, making it useful for applications like content creation, conversation, and text completion.
5. **Versions and Evolution:** There have been several versions of GPT, with each new version (like GPT2, GPT3, GPT4, etc.) generally being larger and more capable than the last in terms of the amount of data it can process and the complexity of the tasks it can perform.
6. **Applications:** GPT is used in a variety of applications, including chatbots, writing assistants, language translation, and even in creative fields for generating art, music, and poetry.
7. **Humanlike Responses:** One of the notable features of GPT is its ability to produce responses that can closely mimic human writing styles, making its applications more natural and userfriendly.
8. **Ethical Considerations:** The deployment of GPT models raises ethical questions around topics like misinformation, privacy, and the potential impact on jobs in fields like writing and customer service.
9. **Accessibility and Use:** GPTpowered tools and services are increasingly accessible to businesses and individuals, enabling a wide range of users to leverage its capabilities for various purposes.

Time to Reach 100M Users

Months to get to 100 million global Monthly Active Users

Source: UBS / Yahoo Finance

@EconomyApp

APP ECONOMY **INSIGHTS**

Models

Overview

The OpenAI API is powered by a diverse set of models with different capabilities and price points. You can also make customizations to our models for your specific use case with fine-tuning.

MODEL	DESCRIPTION
GPT-4 Turbo and GPT-4	A set of models that improve on GPT-3.5 and can understand as well as generate natural language or code
GPT-3.5 Turbo	A set of models that improve on GPT-3.5 and can understand as well as generate natural language or code
DALL·E	A model that can generate and edit images given a natural language prompt
TTS	A set of models that can convert text into natural sounding spoken audio
Whisper	A model that can convert audio into text
Embeddings	A set of models that can convert text into a numerical form
Moderation	A fine-tuned model that can detect whether text may be sensitive or unsafe
GPT base	A set of models without instruction following that can understand as well as generate natural language or code
Deprecated	A full list of models that have been deprecated along with the suggested replacement

What is ChatGPT

AI and Machine Learning: ChatGPT is built on the GPT (Generative Pretrained Transformer) architecture, which is a type of artificial intelligence model designed to generate text.

Language Understanding: It has been trained on a diverse range of internet text, enabling it to understand context, answer questions, write essays, and even create poetry or code.

Conversational Interface: ChatGPT is designed to engage in conversations, providing responses that can simulate a humanlike interaction.

Learning Capability: While it can't learn or remember information from individual user interactions in realtime, its design allows for continual updates and training by OpenAI to improve its performance and capabilities.

Versatile Applications: It can be used in various applications such as customer service bots, tutoring systems, content creation aids

Safety and Ethics: OpenAI has implemented safeguards to prevent ChatGPT from generating inappropriate or harmful content, though it's not foolproof.

Customization and Integration: Developers can integrate ChatGPT into their own applications through OpenAI's API, allowing for a wide range of custom uses and functionalities tailored to specific needs.

Continual Development: ChatGPT is part of an ongoing research and development effort, with improvements and new versions being released as AI technology advances.

GPT MODELS COMPARISON CHART

Model	Size	Memory capacity	Accuracy	Input formats	Price
GPT-3	175B	1,500 words	<60%	Text, speech	$$
GPT-3.5	20B	8,000 words	<60%	Text, speech	$
GPT-4	>1T (?)	25,000-64,000 words	>80%	Text, speech, image	$$$

greenice

CHAT GPT-3 VS. CHAT GPT-4

CHAT GPT-3	CHAT GPT-4
Only takes text prompts	Take text & image prompts
Creative...sort of	More creative
Hallucinates a lot of facts & opinions	Still Hallucinates, but not as much :)
Barely passed the bar exam	Aced the bar exam
Takes a lot of steering & prompts for developers	More steerable in conversations & developer prompts

"GPT-4 IS MORE RELIABLE, CREATIVE AND ABLE TO HANDLE MUCH MORE NUANCED INSTRUCTIONS THAN GPT-3.5" - OPEN AI

GPT3 Vs GPT4

GPT3 and GPT4 are both iterations of OpenAI's Generative Pretrained Transformer (GPT) series, but there are key differences between them:

1.Model Size and Complexity:

- **GPT3:** Has 175 billion parameters, making it one of the largest language models at its time of release.
- **GPT4:** Is even larger than GPT3, with more parameters (the exact number has not been publicly disclosed), which enhances its understanding and generation capabilities.

2.Performance and Accuracy:

- **GPT3:** Sometimes struggles with complex reasoning tasks and can generate less accurate or relevant responses in certain contexts.
- **GPT4:** Shows improved performance in understanding context and nuance, leading to more accurate and contextually relevant outputs.

3.Training Data and Knowledge:

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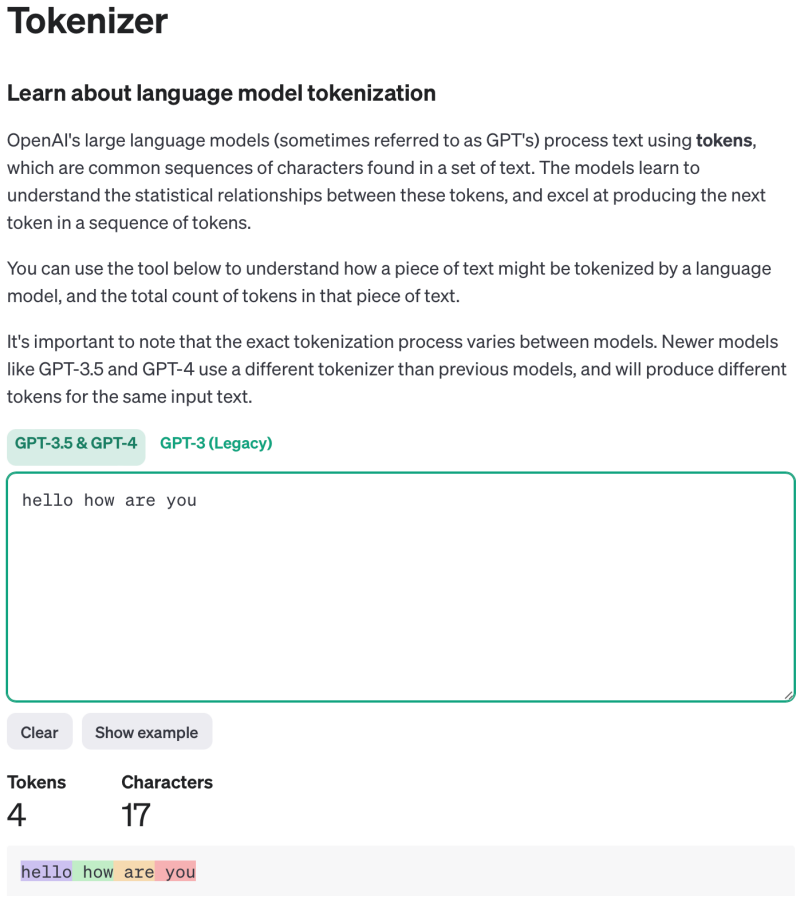
What are Tokens ?



Basic Units of Text: In NLP, a token is the basic unit of text. It can be a word, a part of a word (like a prefix or suffix), or even punctuation. Tokens are the building blocks that models like ChatGPT analyze and generate.

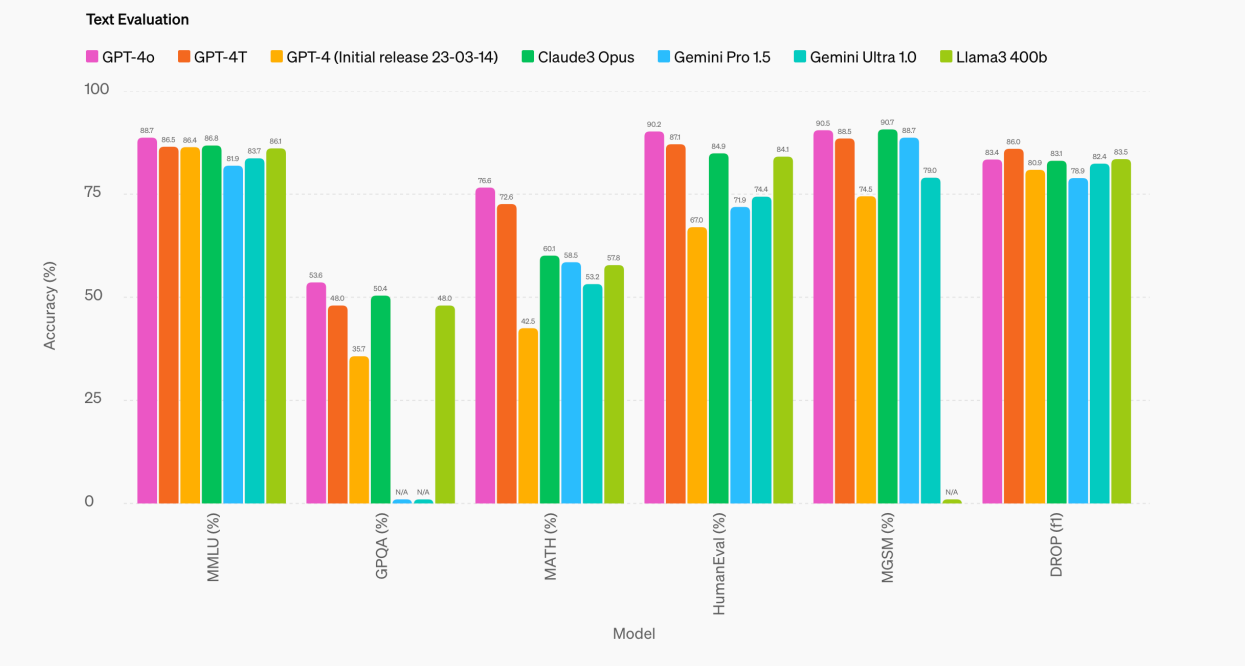
Tokenization: This is the process of breaking down text into its constituent tokens.

Sequence of Tokens: When you input a sentence, ChatGPT tokenizes it, processes the tokens to understand the context and generate a response, and then converts the output tokens back into humanreadable text.

Vocabulary Limit: Language models have a fixed vocabulary size, meaning they can only recognize a certain number of unique tokens.

Efficiency in Processing: Using tokens allows language models to efficiently process large amounts of text by breaking down complex structures into manageable pieces.

GPT-4o



Model	Pricing
gpt-4o	US$5.00 / 1M input tokens US$15.00 / 1M output tokens

Model	Input	Output
gpt-4-turbo	US$10.00 / 1M tokens	US$30.00 / 1M tokens
gpt-4-turbo-2024-04-09	US$10.00 / 1M tokens	US$30.00 / 1M tokens

GPT-4O is an advanced version of the GPT-4 model developed by OpenAI. The "O" stands for "Omni," highlighting its all-encompassing capabilities.

Release Date : May 2024

Multimodal Input (Omni): GPT-4O can process and understand images in addition to text, unlike GPT-3 which only handles text.

Context Length: GPT-4O can maintain context over longer conversations compared to GPT-3.

Higher Accuracy in Response Generation: GPT-4O provides more accurate and relevant responses, reducing the chances of generating incorrect or nonsensical text.

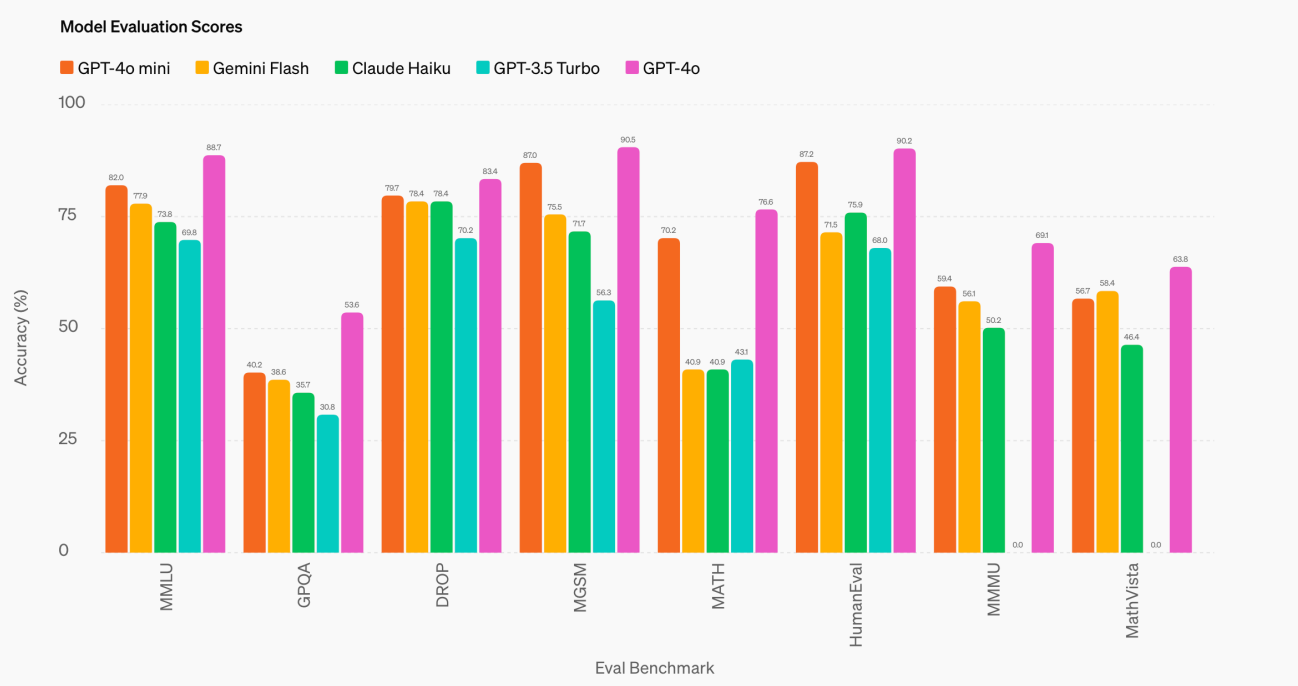
Improved Efficiency and Speed: GPT-4O is optimized to deliver responses faster than GPT-3, making it more suitable for real-time applications.

Enhanced Adaptability: GPT-4O can better adapt to different styles and tones based on user input, providing more personalized interactions.

Human like Response Time : It can respond to audio inputs in as little as 232 milliseconds, with an average of 320 milliseconds

Pricing : It’s considered to be almost 50% cheaper as compared to GPT-4 Models

GPT-4o Mini



Model	Pricing
gpt-4o-mini	US$0.150 / 1M input tokens US$0.600 / 1M output tokens

Model	Pricing
gpt-4o	US$5.00 / 1M input tokens US$15.00 / 1M output tokens

Model	Input	Output
gpt-4-turbo	US$10.00 / 1M tokens	US$30.00 / 1M tokens
gpt-4-turbo-2024-04-09	US$10.00 / 1M tokens	US$30.00 / 1M tokens

GPT-4o Mini is a compact, efficient version of the larger GPT-4 model designed for deployment in resource-constrained environments.

Release Date : July 2024

Compact Size
GPT-4o Mini is designed to run efficiently on hardware with limited computational resources.

Faster Inference
Provides faster response times compared to full-sized GPT models, making it ideal for time-sensitive tasks.

Energy Efficiency
Prioritizes low power consumption, unlike larger models that require significant energy to function.

Edge Deployment
Designed to function independently of cloud infrastructure, unlike traditional GPT models that rely heavily on server-based computations.

Customizable and Scalable
Offers greater flexibility in adapting to particular use cases, unlike one-size-fits-all larger GPT models.

Cost-Effective
Lower operational costs due to reduced resource requirements.

Simplified Training
Difference: Easier and faster to train compared to large-scale GPT models that need extensive datasets and powerful GPUs.

What is Azure OpenAI

Azure OpenAI refers to the collaboration between Microsoft Azure (a cloud computing platform), and OpenAI (an artificial intelligence research organization).

Integration of OpenAI Models: Provides access to OpenAI's AI models like GPT, Codex, and DALLE on Microsoft Azure's cloud platform.

Enterprise Applications: Designed for business use, helping companies integrate AI into various functions such as customer support and content generation.

Scalable Infrastructure: Utilizes Azure's cloud infrastructure for scalable AI model deployment and management.

Security and Compliance: Focuses on high security and adherence to regulatory standards to protect user data.

DeveloperFriendly: Offers tools and APIs for developers to easily implement and customize AI solutions.

Customization Options: Allows users to tailor AI models to better fit their specific requirements.

Global Reach: Available worldwide through Azure’s extensive global infrastructure.

Collaboration and Innovation: Supports collaborative AI development and innovation within the Azure ecosystem.

OpenAI API CallsVs Azure OpenAI

OpenAI

Python Copy

```python
import os
from openai import OpenAI

client = OpenAI(
    api_key=os.getenv("OPENAI_API_KEY")
)
```

Azure OpenAI

Python Copy

```python
import os
from openai import AzureOpenAI

client = AzureOpenAI(
    api_key=os.getenv("AZURE_OPENAI_API_KEY"),
    api_version="2023-12-01-preview",
    azure_endpoint=os.getenv("AZURE_OPENAI_ENDPOINT")
)
```

OpenAI

Python Copy

```python
completion = client.completions.create(
    model="gpt-3.5-turbo-instruct",
    prompt="<prompt>"
)

chat_completion = client.chat.completions.create(
    model="gpt-4",
    messages="<messages>"
)

embedding = client.embeddings.create(
    model="text-embedding-ada-002",
    input="<input>"
)
```

Azure OpenAI

Python Copy

```python
completion = client.completions.create(
    model="gpt-35-turbo-instruct", # This must match the custom deployment name you chose for your model.
    prompt="<prompt>"
)

chat_completion = client.chat.completions.create(
    model="gpt-35-turbo", # model = "deployment_name".
    messages="<messages>"
)

embedding = client.embeddings.create(
    model="text-embedding-ada-002", # model = "deployment_name".
    input="<input>"
)
```

Understanding Azure OpenAI API Calls

azure_endpoint = "https://cloudalchemyoai.openai.azure.com/",
api_key=os.environ.get("OPENAI_API_KEY"),
api_version="20240215preview”

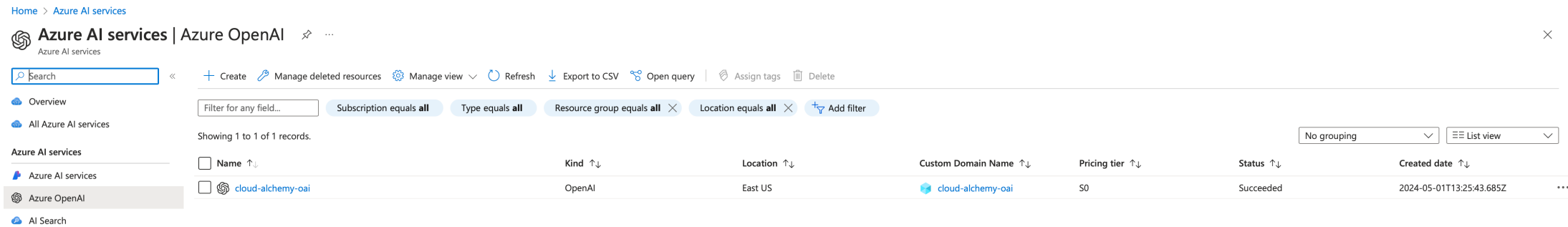
```
completion = client.chat.completions.create(
model="air_text_lab", # model = "deployment_name"
messages = message_text,
temperature=0.7,
max_tokens=800,
top_p=0.95,
frequency_penalty=0,
presence_penalty=0,
stop=None
)
```

```python
#Note: The openai-python library support for Azure OpenAI is in preview.
#Note: This code sample requires OpenAI Python library version 1.0.0 or higher.
import os
from openai import AzureOpenAI

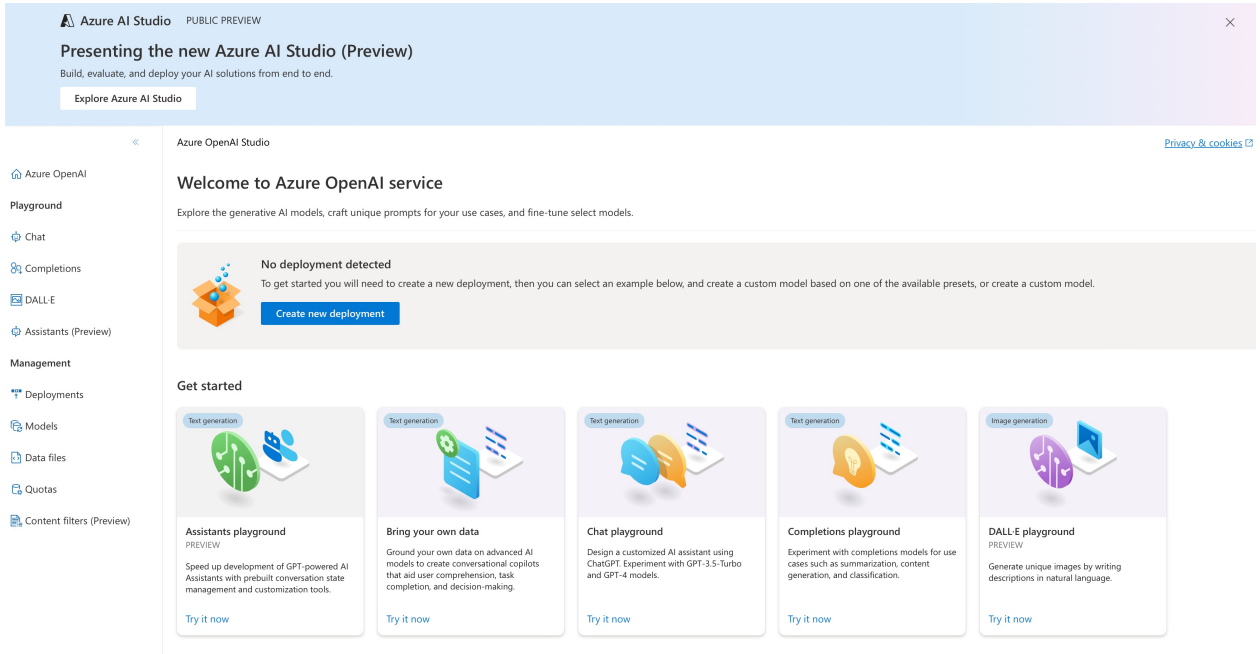
client = AzureOpenAI(
  azure_endpoint = "https://cloud-alchemy-oai.openai.azure.com/",
  api_key=os.getenv("AZURE_OPENAI_KEY"),
  api_version="2024-02-15-preview"
)

message_text = [{"role":"system","content":"You are an AI assistant that helps people find information."},{"role":"user","content":"Who is prime minister of India"},
{"role":"assistant","content":"As of my last update, the Prime Minister of India is Narendra Modi. He has been in office since May 2014. Please note that political positions can change, so it's always a good idea to verify with the latest sources."}]

completion = client.chat.completions.create(
  model="air_text_lab", # model = "deployment_name"
  messages = message_text,
  temperature=0.7,
  max_tokens=800,
  top_p=0.95,
  frequency_penalty=0,
  presence_penalty=0,
  stop=None
)
```



What is Azure OpenAI Studio



Azure OpenAI Studio (***oai.azure.com***) is a platform designed to facilitate the use of AI technologies for various applications.

Comprehensive AI Platform: Azure OpenAI Studio provides an integrated environment to build, train, and manage AI models using OpenAI's advanced technologies.

UserFriendly Interface: Features an intuitive user interface that simplifies the process of deploying and scaling AI models.

Access to OpenAI Models: Users have access to a range of OpenAI's models like GPT3, Codex, and DALLE directly through the studio.

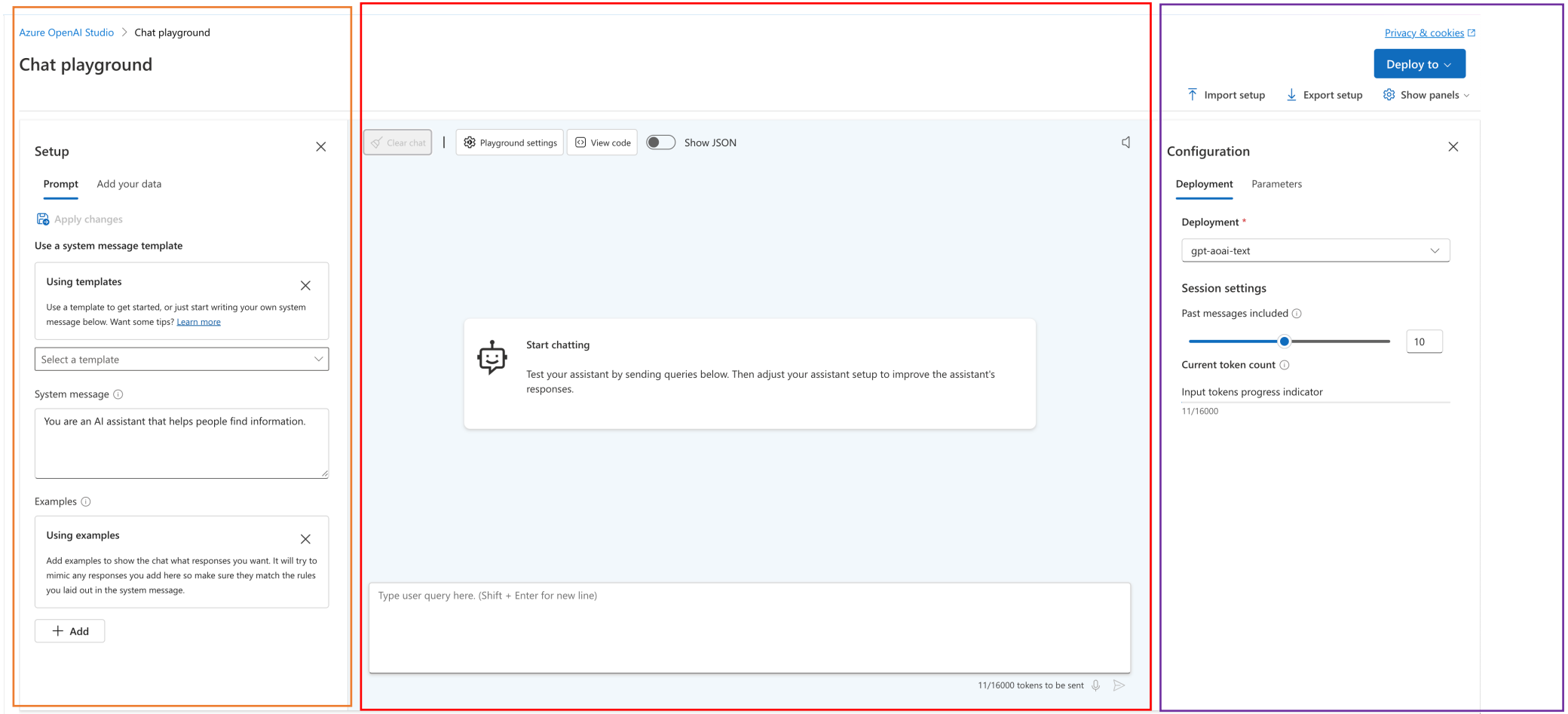
Customization and FineTuning: Offers tools for customizing and finetuning AI models to meet specific organizational needs.

Security and Compliance: Emphasizes strong security measures and compliance with industry standards to ensure data protection.

Collaboration Tools: Supports collaborative project management and development, enabling teams to work efficiently on AI projects.

Scalability: Designed to handle the needs of largescale enterprises, providing the infrastructure to scale AI applications as needed.

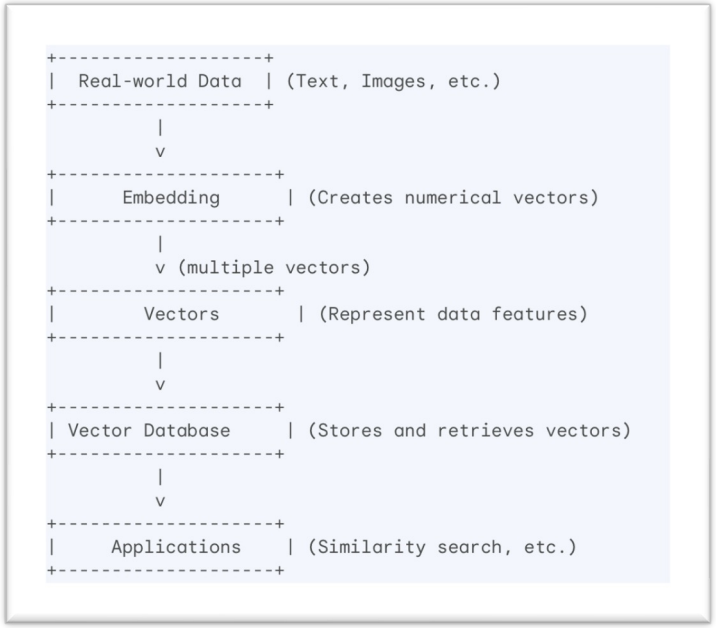
Chats PlayGround– At a Glance

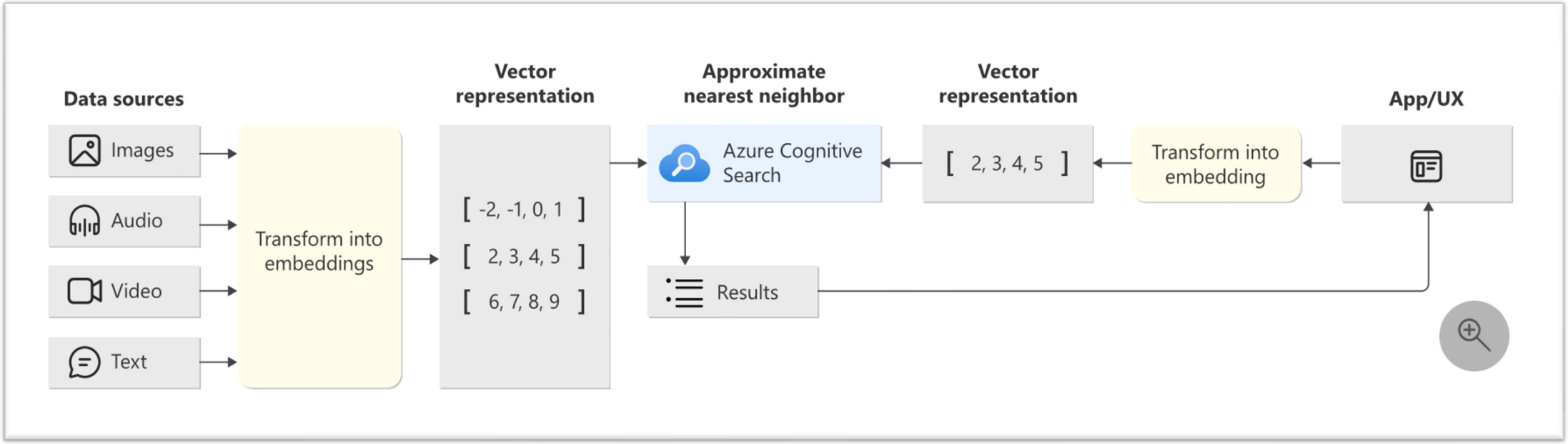


History behind Azure OpenAI

- **2019 Partnership**: Microsoft and OpenAI formed a partnership, emphasizing the integration of OpenAI's technologies with Microsoft Azure.
- **$1 Billion Investment**: Microsoft announced an investment of $1 billion into OpenAI as part of their partnership agreement.
- **2021 Azure OpenAI Service Launch**: Launched to enterprise customers, allowing them access to OpenAI's AI models like GPT3, through Microsoft's Azure platform.
- **Expanding Capabilities**: The service has since expanded to include more sophisticated AI models, such as Codex and DALLE, enhancing its offerings for complex enterprise applications.
- **Enterprise Focus**: Designed specifically for enterprise use, Azure OpenAI aims to support businesses in incorporating AI into their operations securely and at scale.

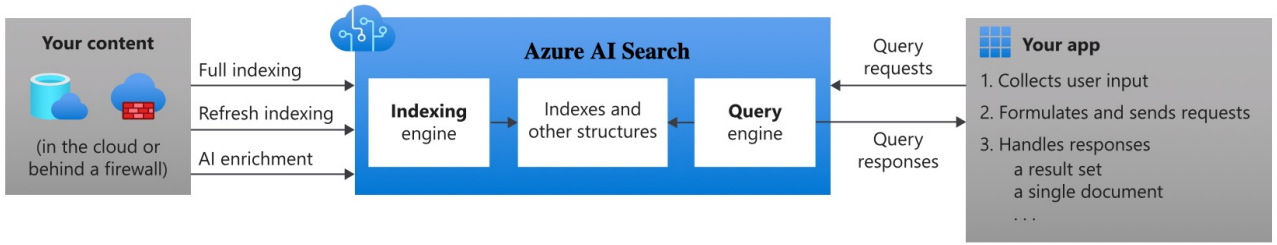
How vector search works in Azure AI Search

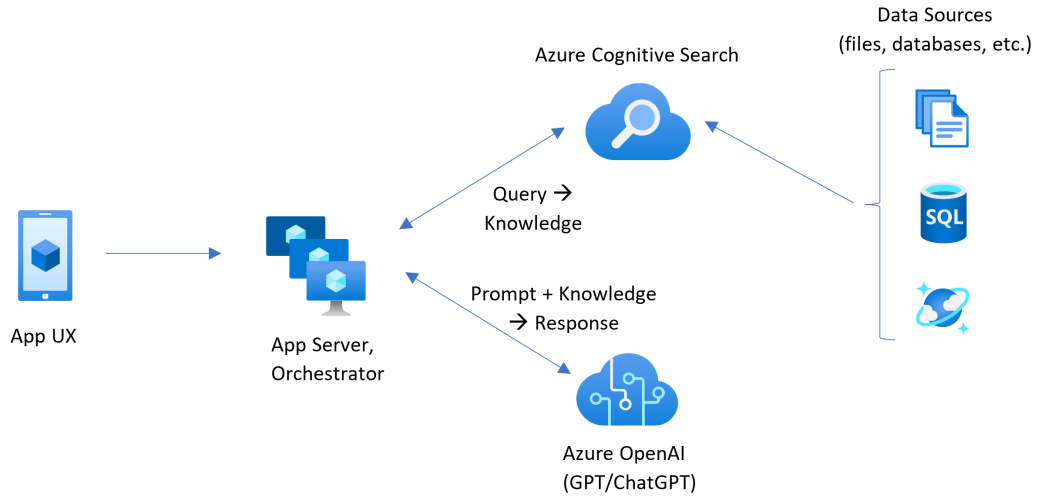




Azure AI Search

Azure AI Search (formerly known as "Azure Cognitive Search") provides secure information retrieval at scale over userowned content in traditional and generative AI search applications.





Data Chunking

Instead of treating the entire document as a single unit, chunking divides it into smaller segments, typically based on paragraphs, sections, or sentences.

AI Powered Indexing:

Utilizes AI to automatically extract and enrich data from a variety of sources including documents, images, and media files.

Semantic Search:

Uses advanced machine learning models to understand the **intent** behind queries, providing more relevant results.

Cognitive Skills:

Integrates predefined cognitive skills such as optical character recognition (**OCR**), language **detection**, and entity recognition or allows the creation of custom skills.

Scalable Infrastructure:

Automatically scales to accommodate data volume and query traffic, ensuring efficient performance without manual intervention.

Integration with Azure Ecosystem:

Works seamlessly with other Azure services, such as Azure AI, Azure Functions, and more, for comprehensive data processing and handling.

Prereqs for RAG with Azure AI Search

i. Create a Storage account *acasdatastore*

ii. Create Embedding Deployment embeddingacasrag

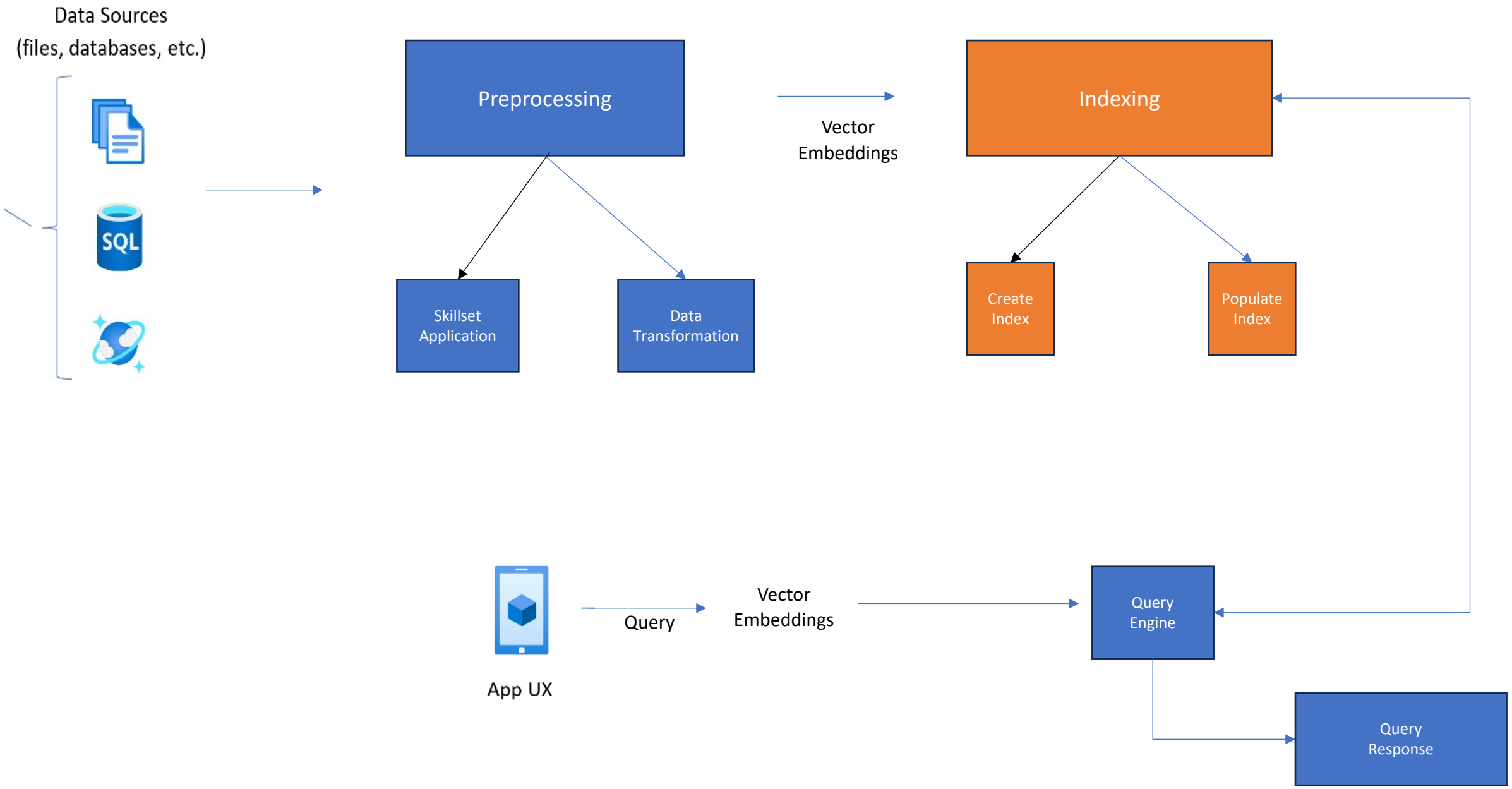
iii. Create Chats Deployment chatmodelrag

iv. Create Azure AI Search Service azureaisearchrag

v. Using the chats Deployment

    i. Upload the documents.

vi. Ingestion > preprocessing > Indexing


Data Sources
(files, databases, etc.)
SQL
Preprocessing
Skillset Application
Data Transformation
Vector Embeddings
Indexing
Create Index
Populate Index
App UX
Query
Vector Embeddings
Query Engine
Query Response

Azure OpenAI Fine Tuning

Babbage-002 & Davinci-002:

- GPT3 based: smaller, lower latency
- Understand & generate natural language or code
- Completion support

GPT-35-Turbo:

- Most capable & cost effective GPT-3.5 model
- More sophisticated capabilities
- Chat support

Fine-tuning models

Models	Training per compute hour	Hosting per hour	Input Usage per 1,000 tokens	Output Usage per 1,000 tokens
Babbage-002	N/A	N/A	N/A	N/A
Davinci-002	N/A	N/A	N/A	N/A
GPT-3.5-Turbo (4K)	$45	$3	$0.0005	$0.0015
GPT-3.5-Turbo (16K)	$68	$3	$0.0005	$0.0015

Customization of PreTrained Models: Tailor models like GPT to specific data needs.

Improving Model Performance: Aligns model outputs more closely with userspecific styles and terminologies.

Dataset Requirements: Users provide their own data for training to finetune the models.

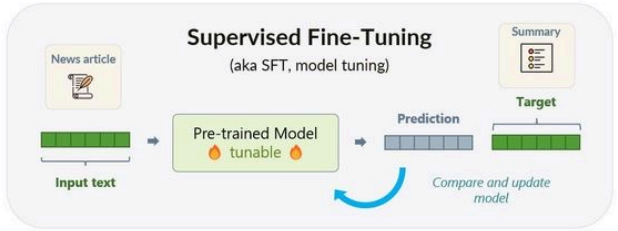
Training Process: Finetuning continues training a pretrained model on new datasets, requiring fewer resources than training from scratch.

Cost : Fine-tuning on Azure OpenAI can be expensive, especially for large models and extensive datasets.
Compute Costs: 10 hours * $10/hour = $100
Storage Costs: 5 GB * $0.02/GB = $0.10
API Usage: 500,000 tokens * $0.06/1,000 tokens = $30
Total Estimated Cost: $130.10

Accessibility through Azure: Integrated into Azure, finetuning benefits from its cloud infrastructure and services.

Custom Deployments: Models can be easily deployed within Azure, integrating with other Azure services.

Need for Fine Tuning



Babbage-002 & Davinci-002:

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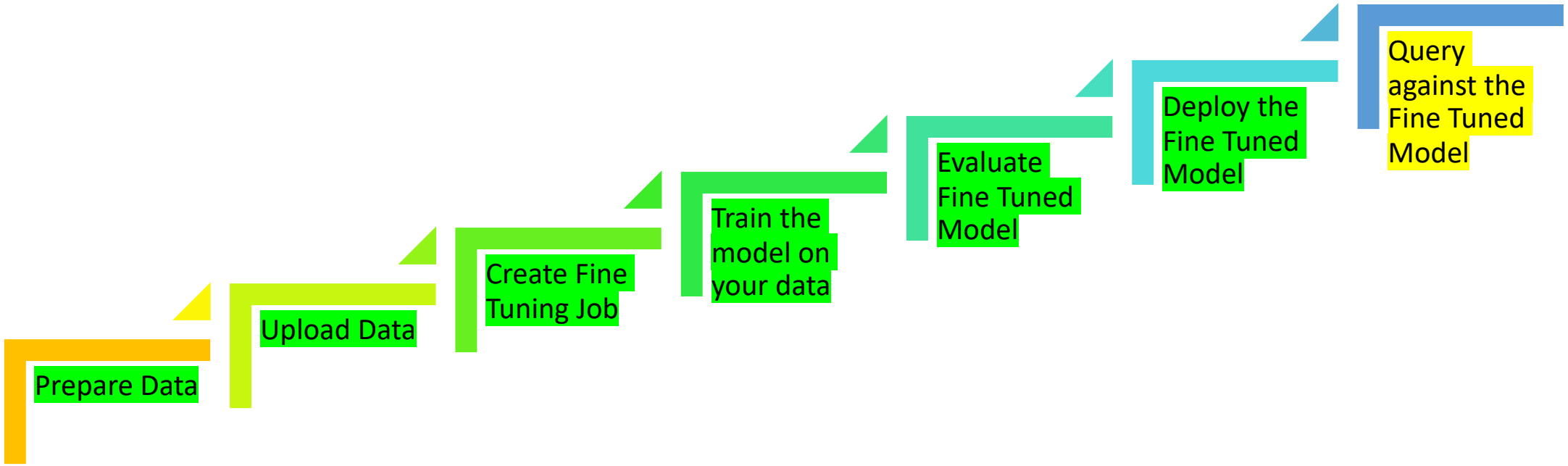
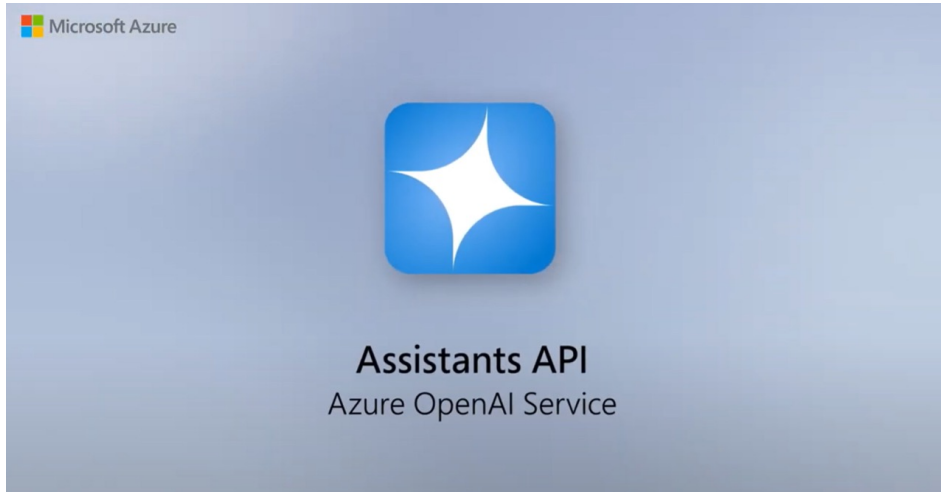
- **DomainSpecific Knowledge:** When the model needs to generate text with specialized vocabulary and concepts.
- **Custom Instructions and Formatting**: When output needs to follow specific templates or formats.
- **Company or Brand Voice**: When text needs to reflect a particular style or tone.
- **Proprietary or Confidential Information**: When generating or processing sensitive information specific to an organization.
- **Enhanced Context Understanding**: When maintaining context over long interactions is crucial.
- **Unique Customer Interactions**: When handling specific customer queries unique to a product or service.
- **Regulatory Compliance**: When generating text that adheres to specific legal or regulatory standards.
- **Interactive Applications**: When creating engaging and interactive user experiences.

Azure OpenAI Fine Tuning



Azure OpenAI Assistants API



Assistants API

Tool	Input
Code Interpreter	$0.03/session

Tool	Input
File Search*	$0.10 / GB of vector-storage per day (1 GB free)

The Assistants API is designed to help developers build powerful AI assistants capable of performing a variety of tasks.

Enhanced Developer Experience: Simplifies the creation of sophisticated copilot-like experiences in applications.

Automated Tasks: Can sift through data, suggest solutions, and automate tasks.

Customizable Personality: Allows tuning of AI models' personality and capabilities through specific instructions

Parallel Tool Access: Supports accessing multiple tools simultaneously, including Azure-hosted tools and custom-built tools

Persistent Threads: Enables persistent conversation threads that store message history and manage context length automatically.

File Handling: Can access and create files in various formats, cite files in messages, and use tools to generate files.

No Extra Cost for Tools: No additional pricing or quota for using Assistants, except for code interpreter or file search tools.

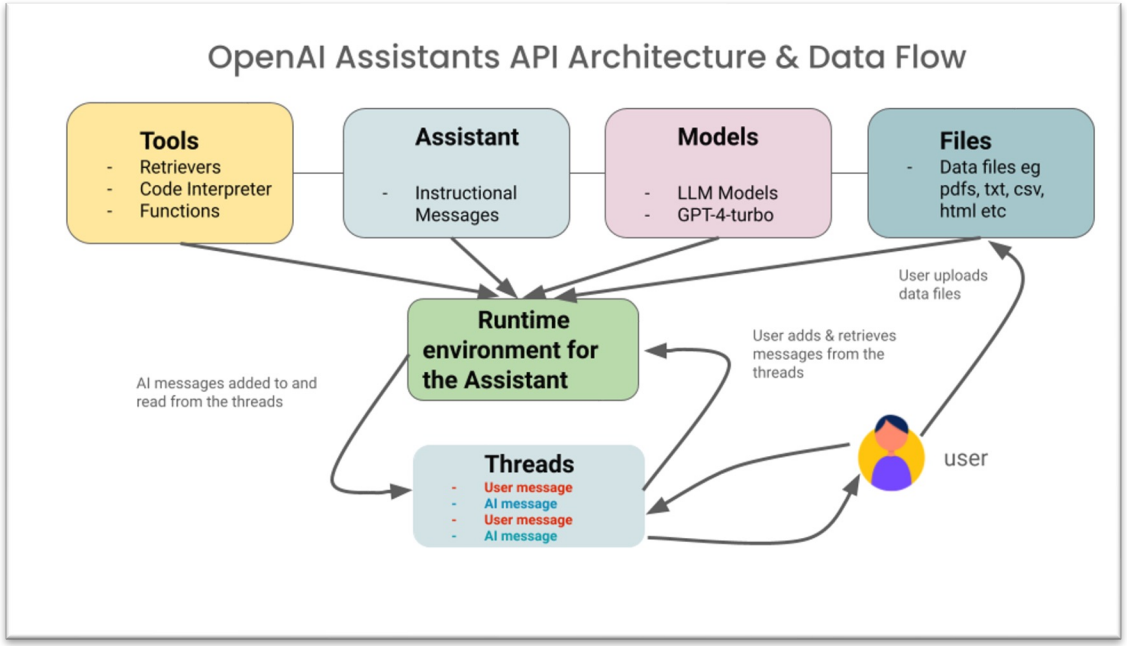
Versatile Use Cases: Suitable for applications like product recommenders, sales analyst apps, coding assistants, and employee Q&A chatbots

Assistants Playground: Offers a no-code environment to test assistant capabilities.

Assistants API – Components / Terms

Component	Description	Example
Assistant	A custom AI that uses Azure OpenAI tools to help users.	An AI customer support agent that helps users fix their devices using Azure OpenAI models.
Thread	A chat session between a user and the Assistant. It saves messages and automatically trims older ones to fit.	A user starts a chat to ask about their order status. The whole conversation is stored in the thread.
Message	A text, image, or file sent by the user or the Assistant.	User: "What's the status of my order #12345?" Assistant: "Your order #12345 has been shipped and will arrive by Friday."
Run	When the Assistant starts working based on the chat contents. It uses tools and models to complete tasks and adds new messages to the chat.	A user asks the Assistant to summarize a document. The Assistant starts a run to read and summarize the document, then sends the summary.
Run Step	The detailed actions the Assistant takes during a Run. It shows the tools or messages used to complete tasks.	Step 1: The Assistant reads the user's question. Step 2: The Assistant uses a summarization tool. Step 3: The Assistant creates a summary and sends it to the user.

Azure OpenAI
Assistants API (Architecture)



Components and Their Roles:

User:
Interacts with the system by uploading data files and sending/receiving messages in threads.

Files:
Represents the data files uploaded by the user (e.g., PDFs, TXT, CSV, HTML, etc.).

Threads:
Contains user messages and AI messages. Messages are added to and retrieved from these threads.

Runtime Environment for the Assistant:
Central environment where the assistant operates, interacting with models, tools, and files to process user inputs and generate responses.

Assistant:
Comprises instructional messages that guide the AI's behaviour and responses.

Models:
LLM (Large Language Models) and GPT-4-turbo that generate AI responses based on the instructional messages and user inputs.

Tools:
Additional functionalities such as retrievers, code interpreters, and other functions that assist the AI in generating accurate and context-aware responses.

Data Flow:

User Uploads Data Files:

Users upload data files (e.g., PDFs, TXT, CSV, HTML, etc.) to the system.

Message Exchange:

Users add and retrieve messages from threads. These messages are either user inputs or AI responses.

Interaction with Runtime Environment:

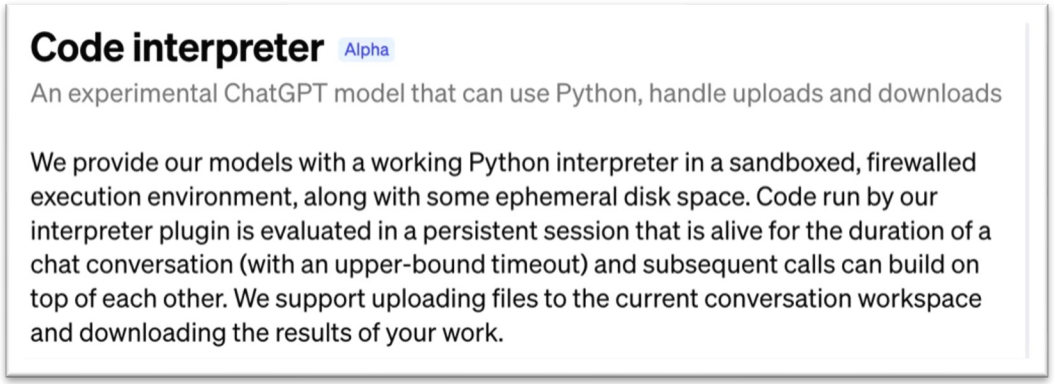
- The runtime environment processes the user messages and interacts with the assistant to generate AI messages.
- It accesses models (LLMs and GPT-4-turbo) to generate responses based on the instructional messages.
- It utilizes tools (retrievers, code interpreters, functions) to enhance the AI's capabilities.

Threads Management:

AI messages are added to and read from the threads, maintaining a continuous interaction loop with the user.

Source: https://ai.gopubby.com/crafting-intelligent-user-experiences-a-deep-dive-into-openai-assistants-api-00439ace108a

Assistants API - Code Interpreter



Code Interpreter allows Assistants to write and run Python code in a **sandboxed** execution environment. This tool can process files with **diverse data and formatting**, and generate files with data and images of graphs.

Code Analysis: Analyzes code snippets submitted through the API, understanding the code's purpose and functionality.

Supported Languages: Interprets code written in various programming languages, including popular choices like Python, C++, Java, and many more.

File Support: Works with various file formats like .py, .cpp, .java, and plain text files containing code.

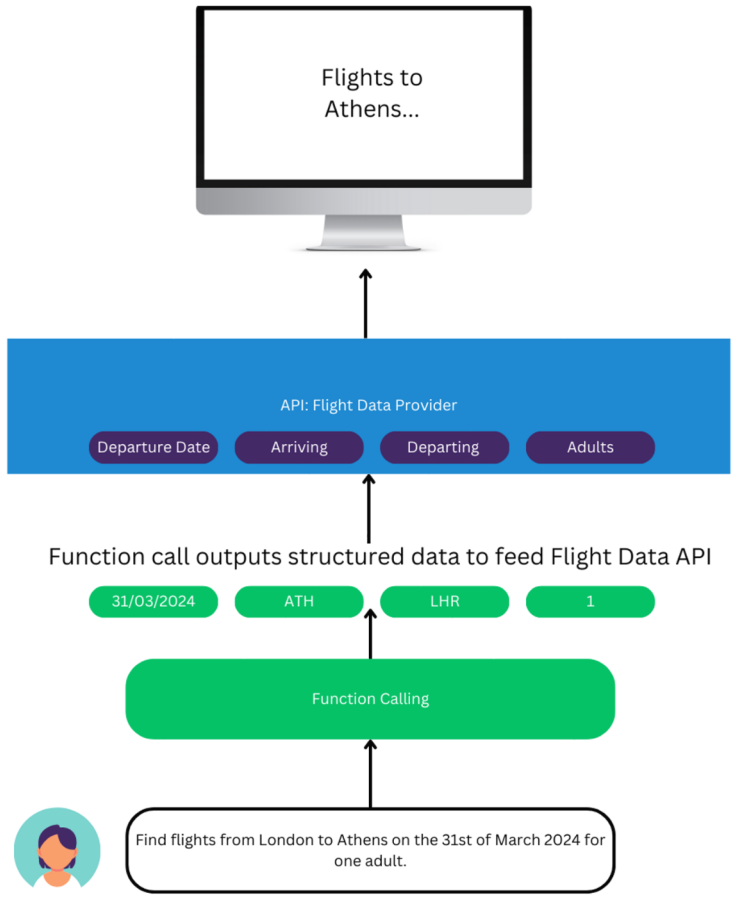
Beyond Interpretation: Provides functionalities beyond simple understanding, like suggesting **code fixes** or generating code snippets based on prompts.

Parallel Processing: Enables assistants to utilize code interpreter alongside other tools like file search for a more comprehensive workflow.

Model Choice: Leverage the latest OpenAI models for code interpretation to benefit from larger context windows and up-to-date training data.

Billable Service: Using code interpreter incurs additional charges on top of standard Azure OpenAI usage.

AAPI- Function Calling



Customizable Actions: Define functions to extend the capabilities of your Azure OpenAI assistants, enabling them to perform specific tasks beyond built-in functionalities.

Dynamic Execution: The model decides when to call a function based on the context of the conversation and the prompt.

Function Definition: Functions are described using a specific syntax within the prompt, including details like name, parameters, and expected output.

Parameter Passing: Functions can receive arguments (parameters) from the user or previous function calls to customize their behavior.

JSON Response: When the model decides to call a function, it provides a JSON object containing the function name and arguments within the response.

Iterative Calls: The model can call functions multiple times within a conversation, allowing for complex workflows and information exchange.

Prompt Engineering: By strategically using keywords and context in the prompt, you can influence when and how the model calls functions.

Error Handling: It's essential to design functions that handle potential errors gracefully, as the model may generate invalid JSON or incorrect arguments.

AAPI - File Search

Tool	Input
File Search*	$0.10 / GB of vector-storage per day (1 GB free)

- File Search augments the Assistant with knowledge from outside its model.
- OpenAI automatically parses and chunks your documents, creates and stores the embeddings,
- Uses both vector and keyword search to retrieve relevant content to answer user queries.
- File search has **additional charges** beyond the token based fees for Azure OpenAI usage.
- Vector Store: Vector store objects give the file search tool the ability to search your files.
- Vector Store : Adding a file to a vector store automatically parses, chunks, embeds, and stores the file in a vector database that's capable of both keyword and semantic search.

* Vector Store

```
assistant = client.beta.assistants.create( name="Financial Analyst Assistant", instructions="You are an expert financial analyst. Use your knowledge base to answer questions about audited financial statements.", model="gpt-4-turbo", tools=[{"type": "file_search"}], )
```

- Attaching Vector Store
- ```
  assistant = client.beta.assistants.create( instructions="You are a helpful product support assistant and you answer questions based on the files provided to you.", model="gpt-4-turbo", tools=[{"type": "file_search"}], tool_resources={ "file_search": { "vector_store_ids": ["vs_1"] } } )
  ```
  .
  ```