Part I - Generative AI Holistic Overview

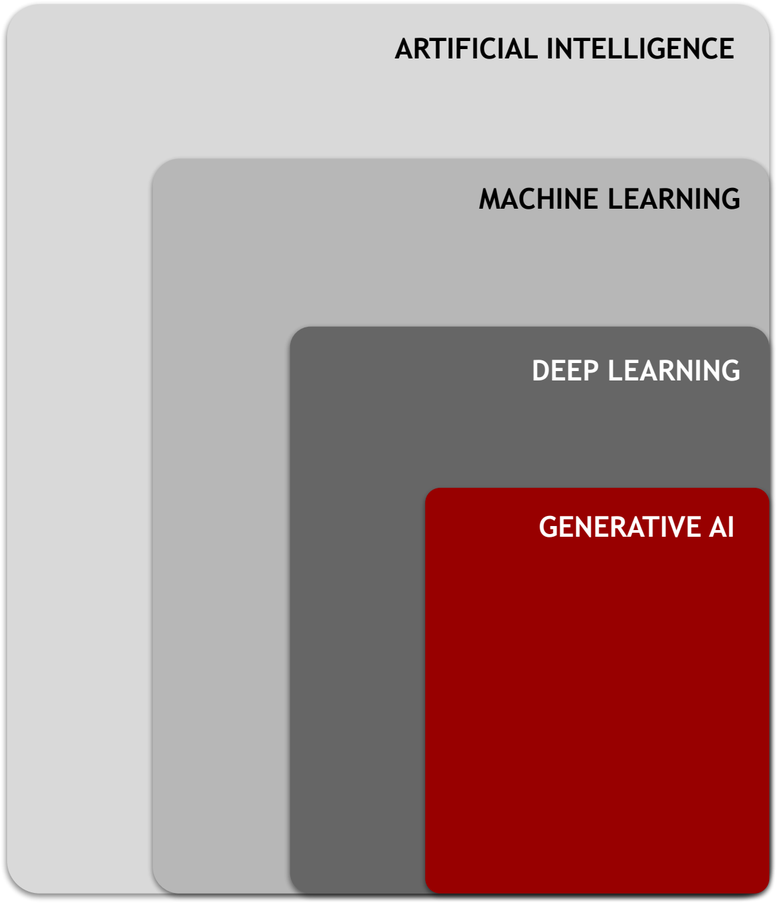
Overall objectives of the Webinar Series

01	AI Holistic Perspective
02	Scalable AI on Cloud
03	Prompt Engineering
04	Working with Large Language Models

Agenda for Today

01	Understanding the fundamentals
02	Generative AI & it’s usecases
03	An Introduction to LLMs
04	Github Co-Pilot

Machine Learning is a type of AI, and Generative AI (GenAI) is a type of machine learning



1956 Class of problems we can solve when ***computers think/act like humans***

1997 ***Make predictions*** based on relationships inferred from historical data

2012 A ML Technique in which layer of ***neural networks are used to process data***

2020 ***Generate a wide variety of content*** using complex models trained on enormous datasets

Overview - What is AI?

It is the quest to build machines that can reason, learn, and act intelligently, and it has barely begun

MIT

Artificial intelligence (AI) applies advanced analysis and logic-based techniques, including machine learning, to interpret events, support and automate decisions and take action

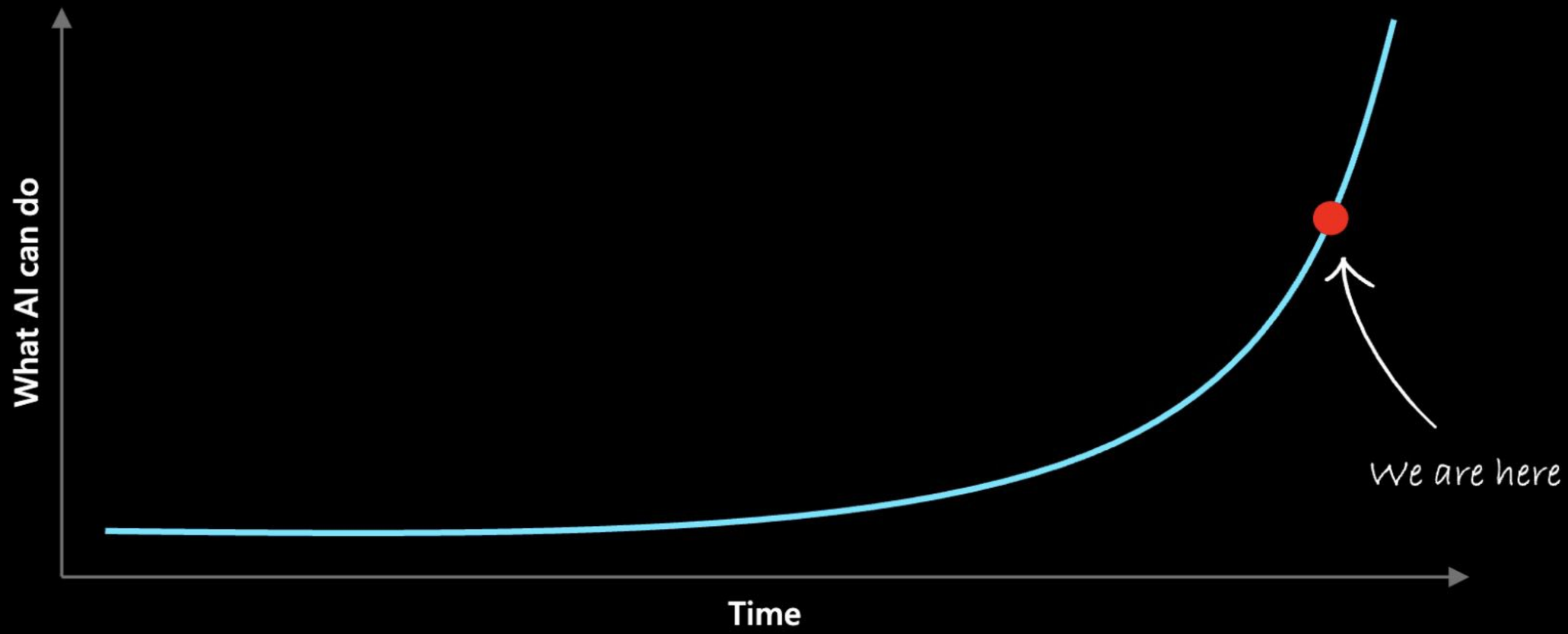
Gartner

AI is computer programming that learns and adapts. It can't solve every problem, but its potential to improve our lives is profound

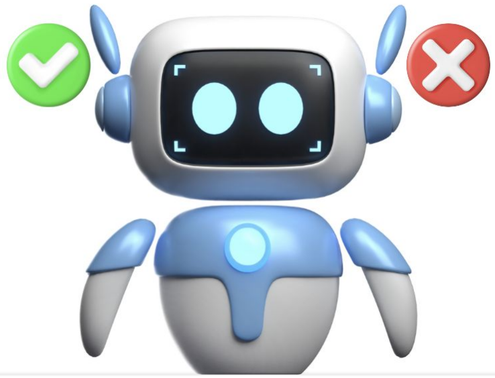
Google

It is the capability of a computer system to mimic human-like cognitive functions such as learning and problem-solving

Microsoft

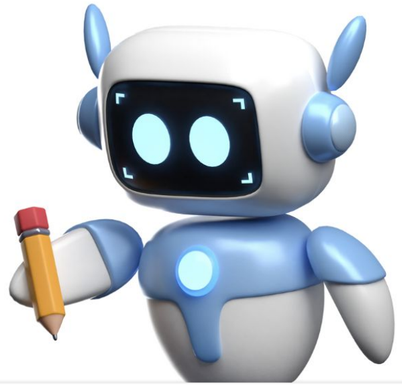

What AI can do
Time
We are here

Key ML Types



DISCRIMINATIVE MODEL

Used to classify or predict



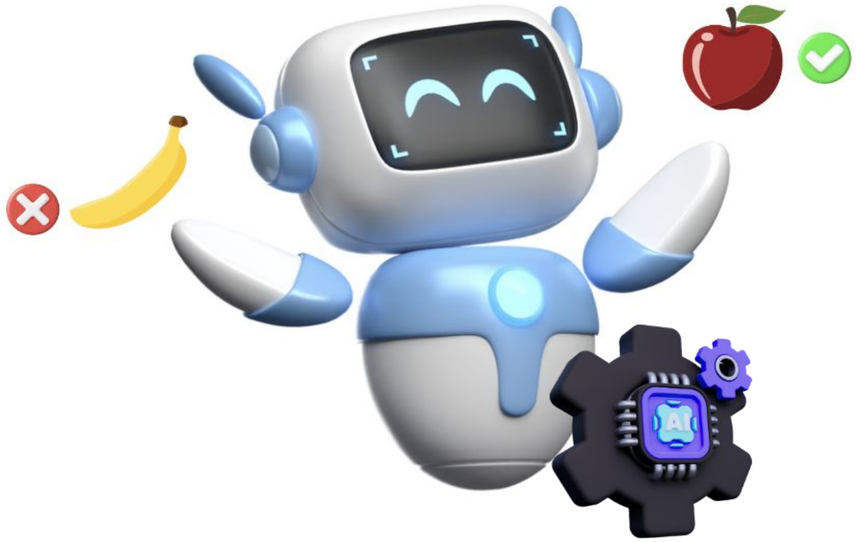
GENERATIVE MODEL

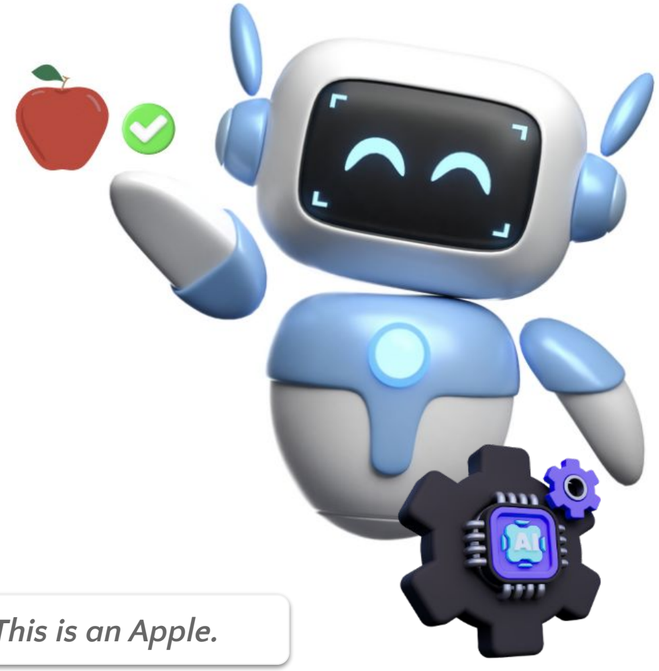
Generates new data

Discriminative Model

This is not an Apple.

This is an Apple.

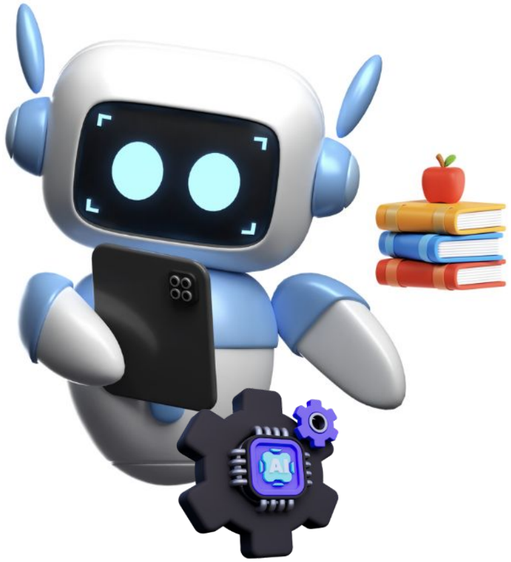




This is an Apple.

Generative Language Model

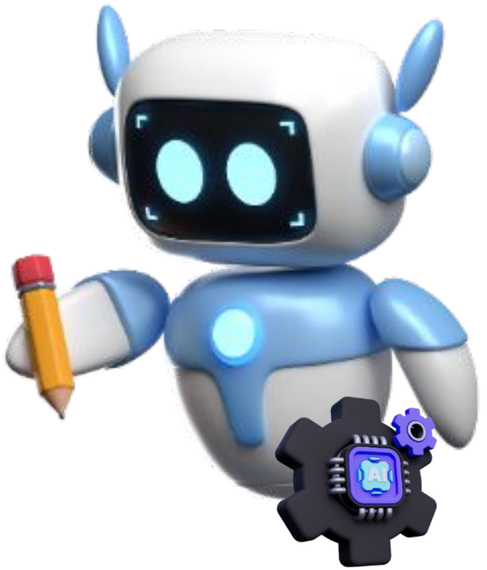
Read this huge pile of books on apples



So, you have read about apple and its various types

Now tell me what is an apple?

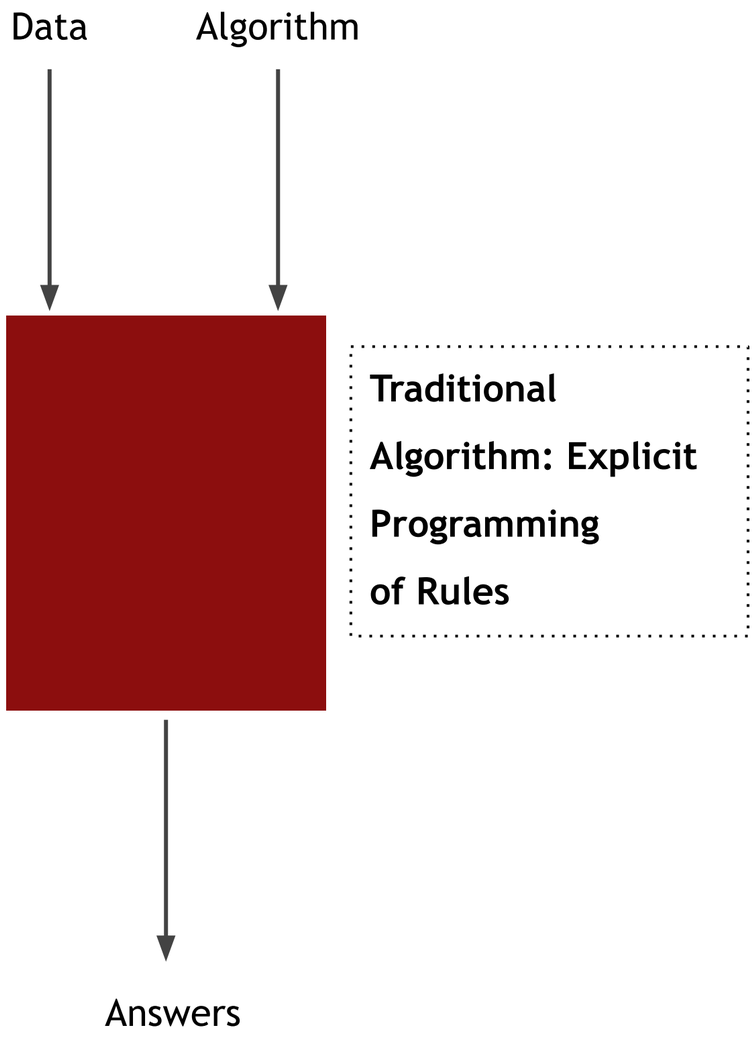
An apple is a ...

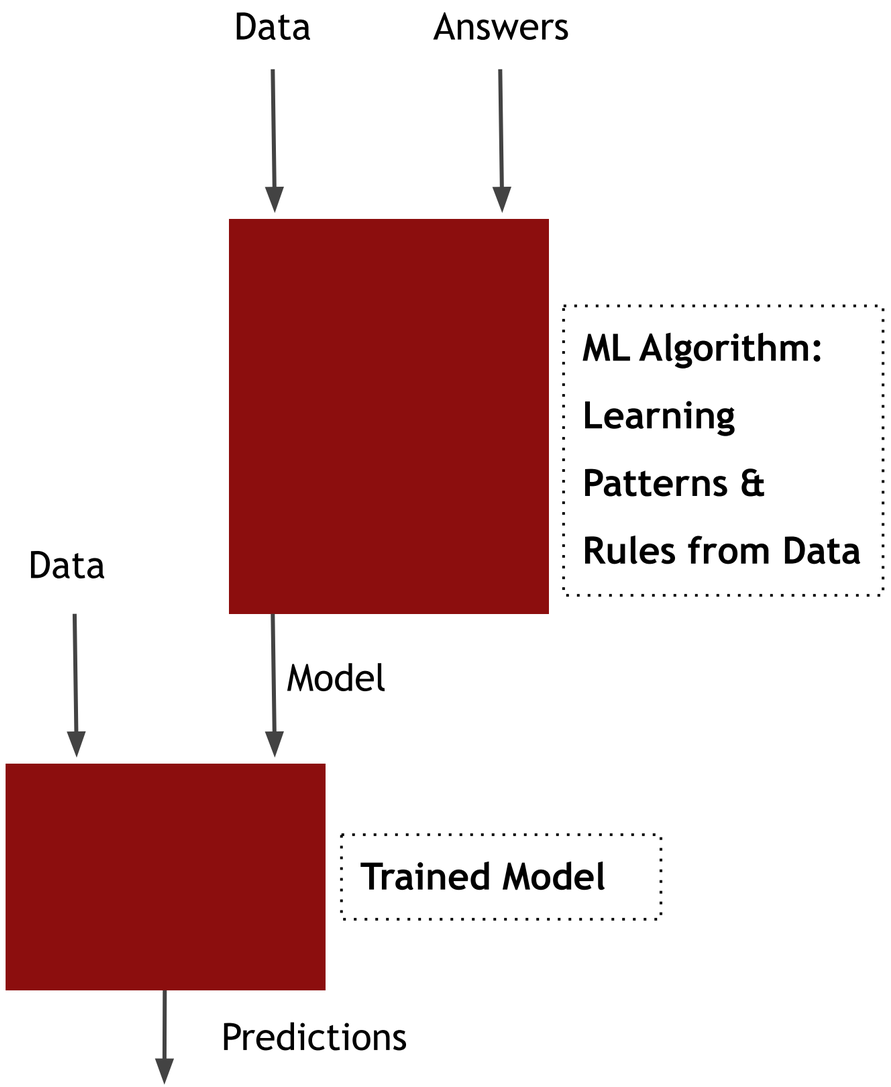


Machine learning allows computers to learn without explicit programming

- In traditional programming, the programmer writes the code to perform a task
- In machine learning, algorithms are trained to make predictions using historical data
  - Computers iterate over the algorithm making adjustments to find the best solution

Traditional Systems vs Machine Learning based AI Systems



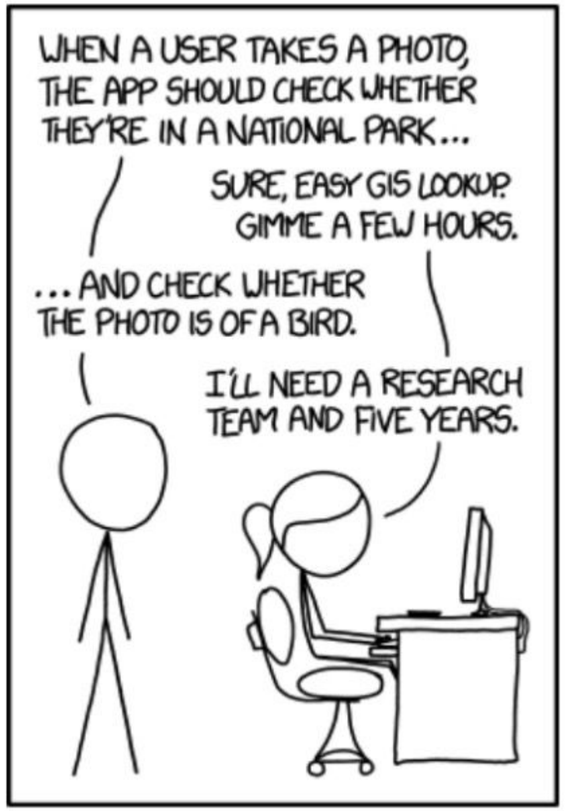


Example of Spam Classification using Traditional Systems

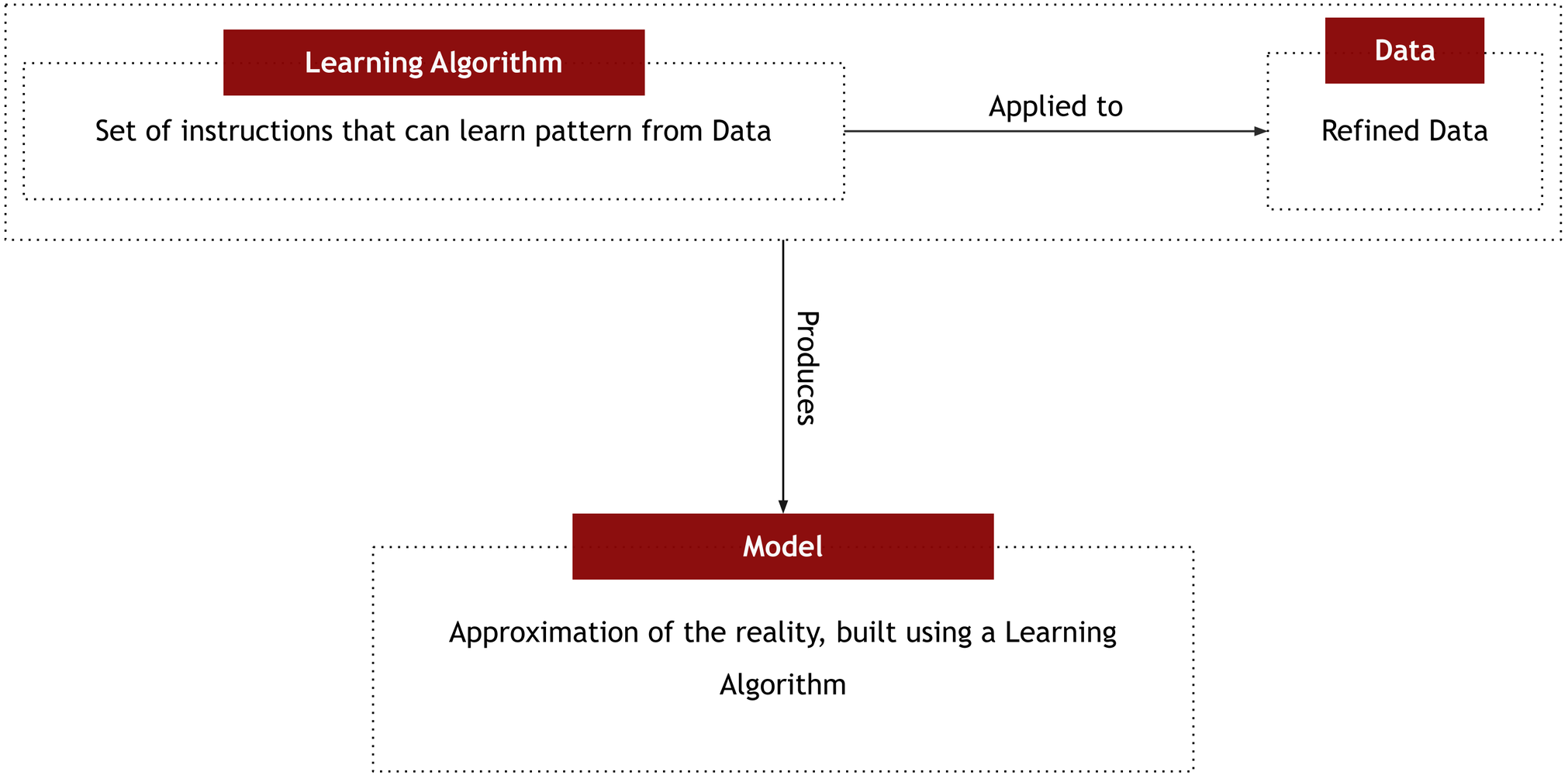
```
#!/usr/bin/env python

import sys
for line in sys.stdin:
  if "Make MONEY Fa$t At Home!!!" in line:
      print("This message is likely spam")
  if "Happy Birthday from Aunt Betty" in line:
      print("This message is probably OK")
```

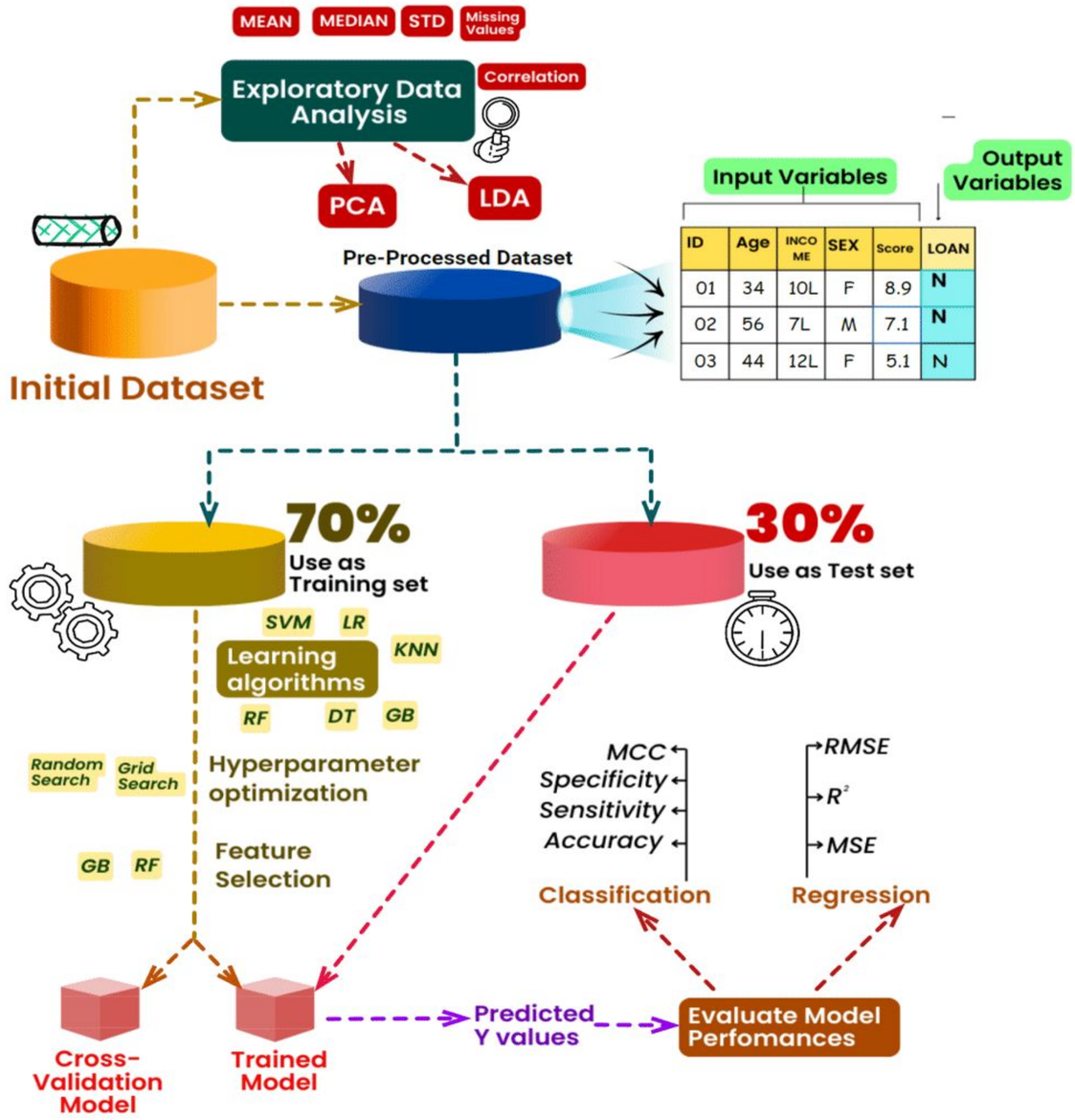
Impossible to solve Computer Vision Problems using Software Engineering based approach

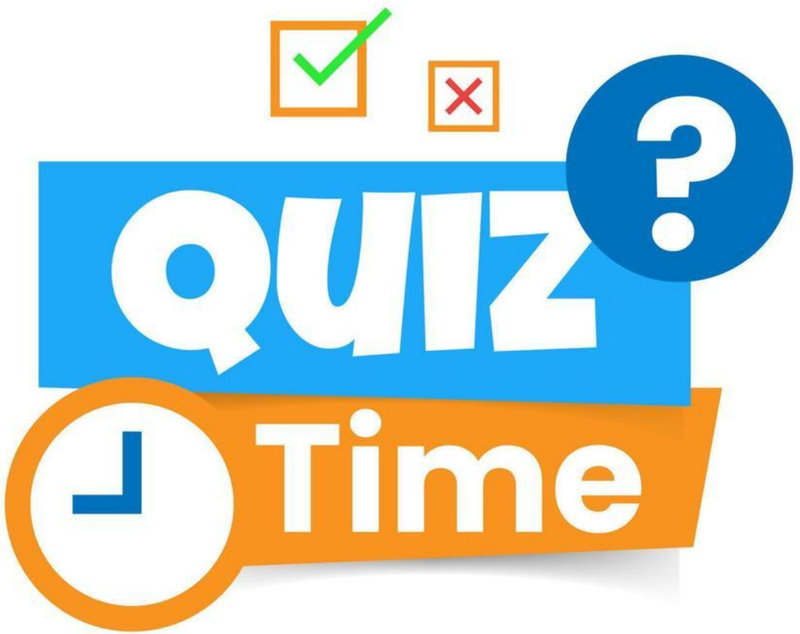


Learning Algorithm vs Model



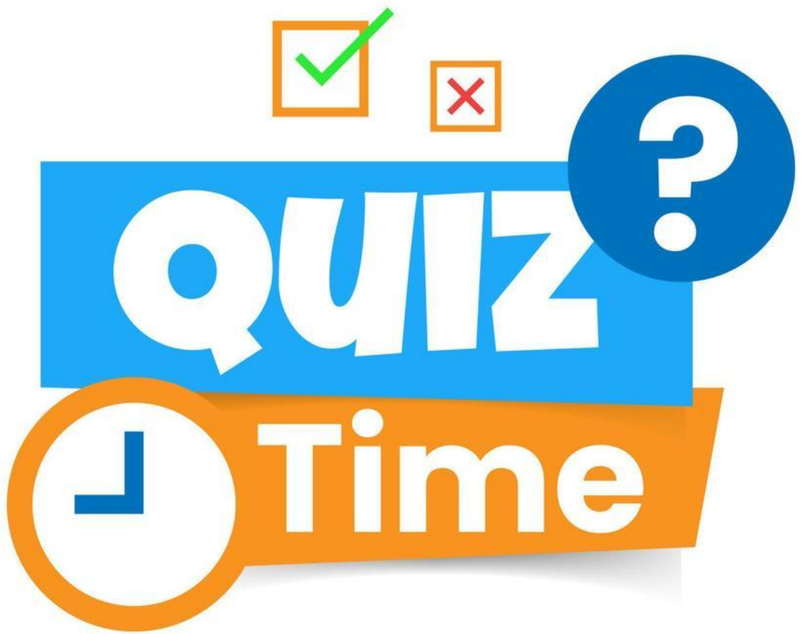
Supervised Machine Learning at a glance!





You are a data scientist at SocialNet, a fictitious social media company similar to Facebook. The company receives millions of comments daily and wants to classify them automatically into categories such as "positive", "negative", or "neutral". Which approach would be best suited to handle the immense volume and variability of these comments?

A	Designing a conventional programming algorithm that classifies comments based on predefined rules and keywords.
B	Implementing a machine learning based system that can be trained on labeled examples and adapt to new patterns over time.



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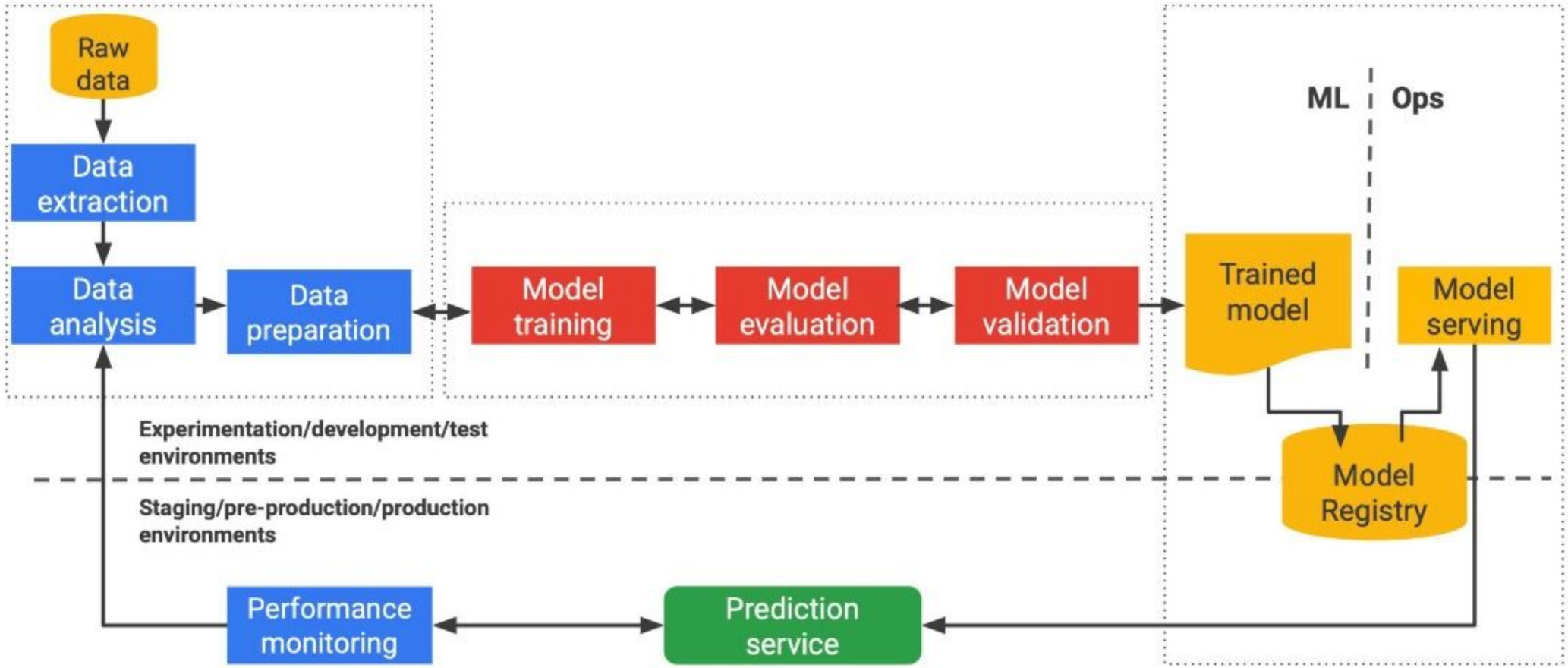
Machine Learning Pipeline



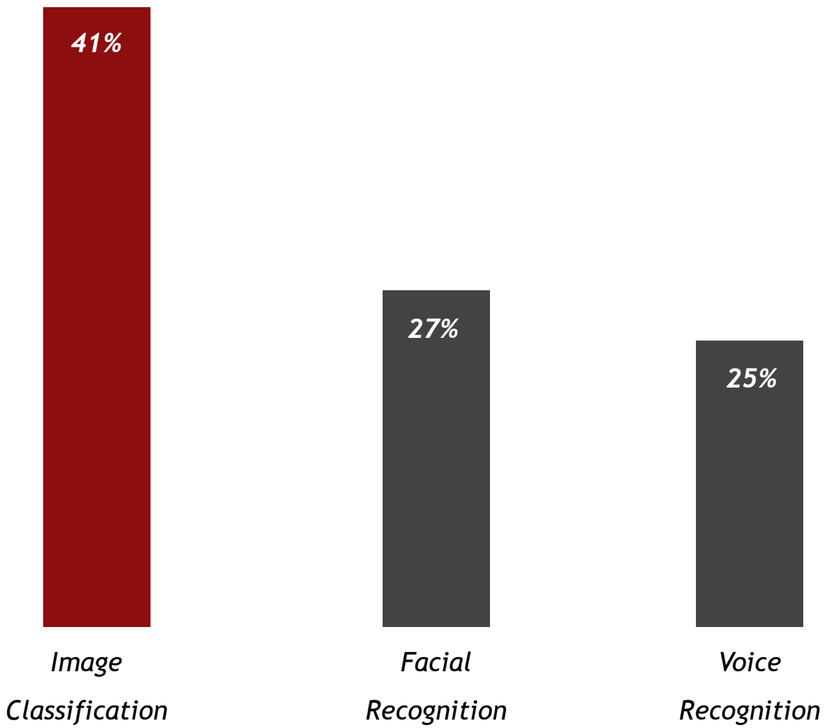
Machine learning use cases include:

- Image recognition
- Sentiment analysis
- Speech recognition
- Fraud detection
- Customer segmentation
- Recommendation systems
- Content Generation
- Text Summarization

Deep Learning

Deep Learning often outperforms traditional ML methods

% reduction in error rate achieved by deep learning vs. traditional ML methods

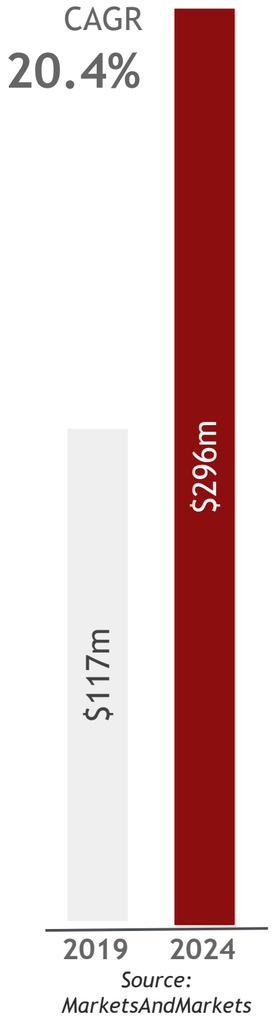


Deep Learning can find complex patterns from the data and produce more accurate results than traditional ML approaches

Source: Mckinsey

Deep Learning - Artificial Neural Network

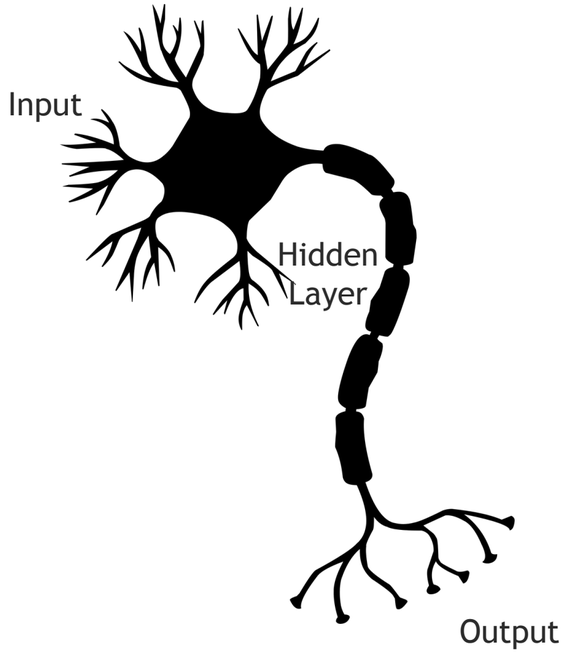
The Global market for ANN applications is projected to grow from $177m to $296m by 2024, at a CAGR of 20.4%.



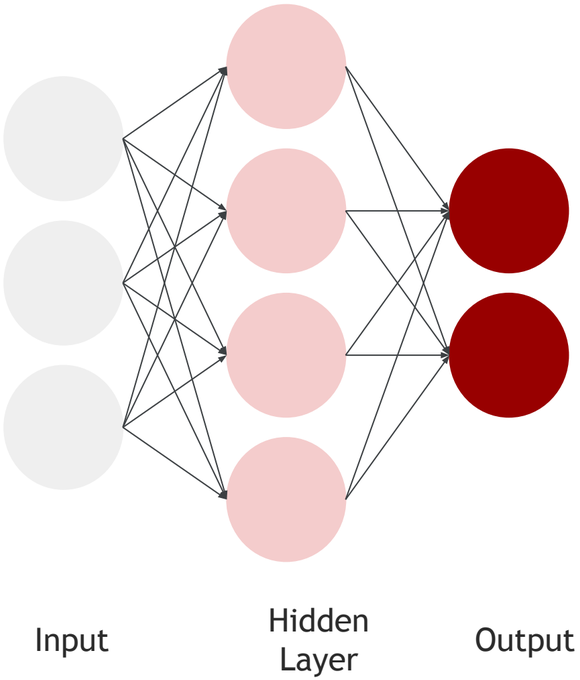
Source: MarketsAndMarkets

Artificial Neural Networks are a very rough imitation of the brain's structure

Human Brain Neuron

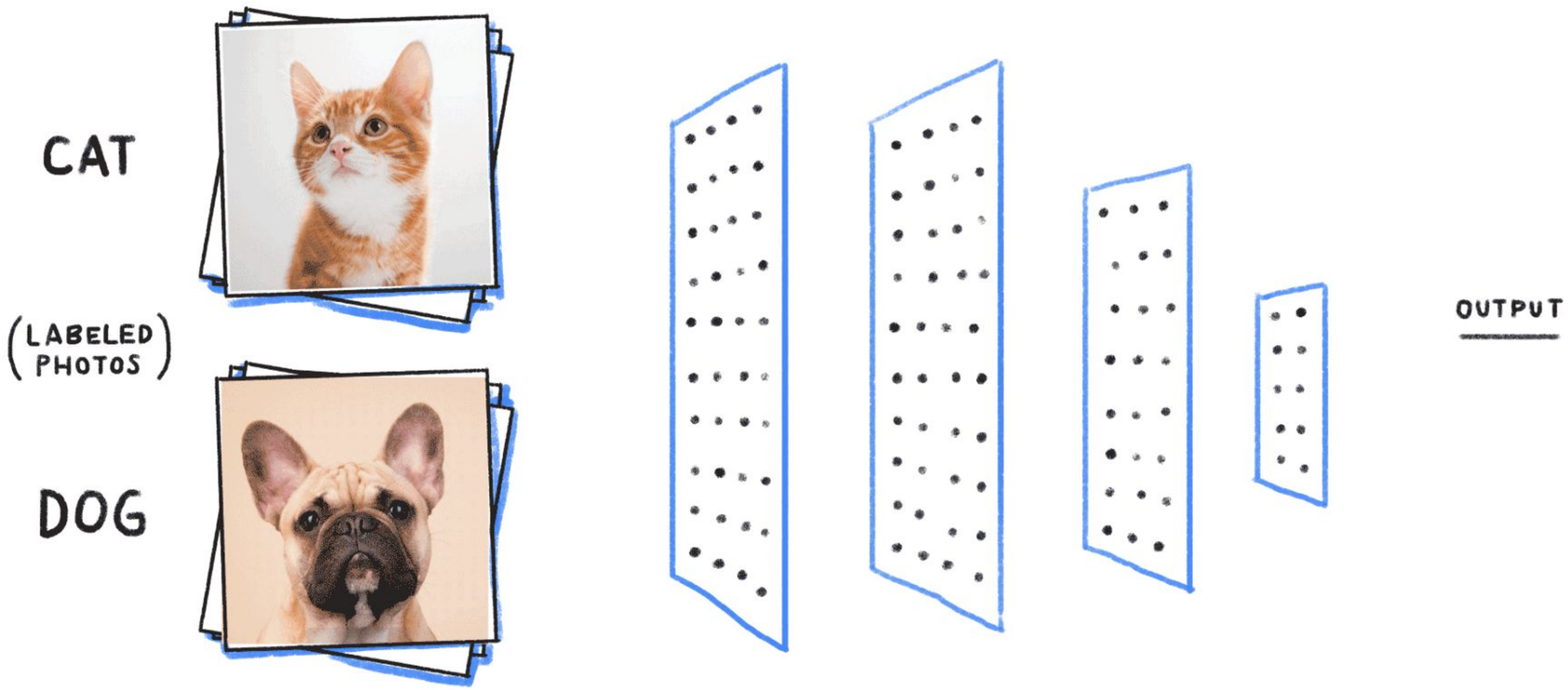


Artificial Neural Network

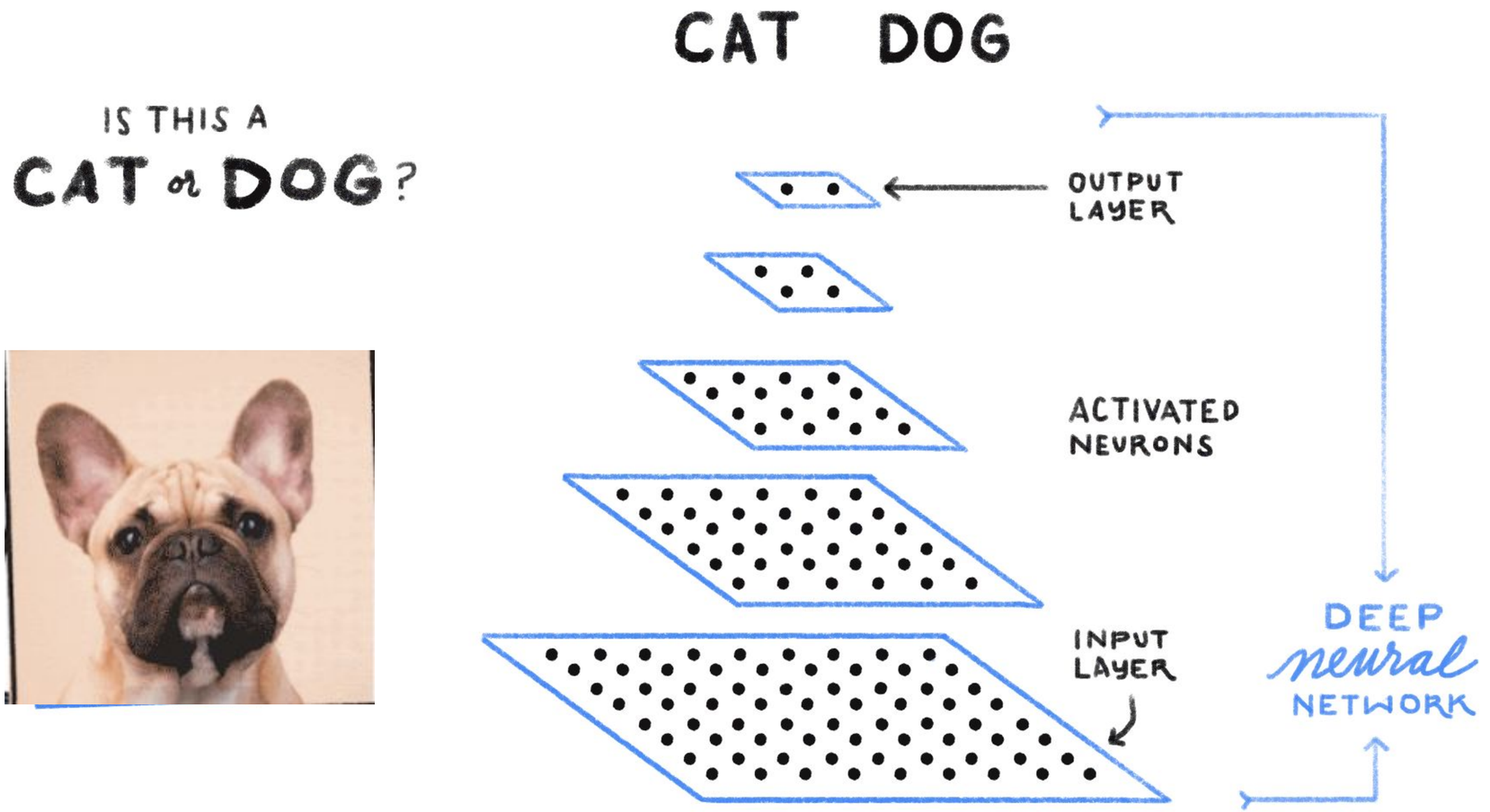


Deep Learning - Artificial Neural Network

"Profound Learning and Artificial Neural Networks (ANN) have fueled the adoption of AI in several industries, such as aerospace, healthcare, manufacturing, and automotive. ANN is substituting conventional machine learning systems to evolve precise and accurate versions" - Grand View Research



Deep Learning - Artificial Neural Network



Ways to perform AI/ML

Requirements, Skillset, Compute, & Availability of Data influence the choice of approach

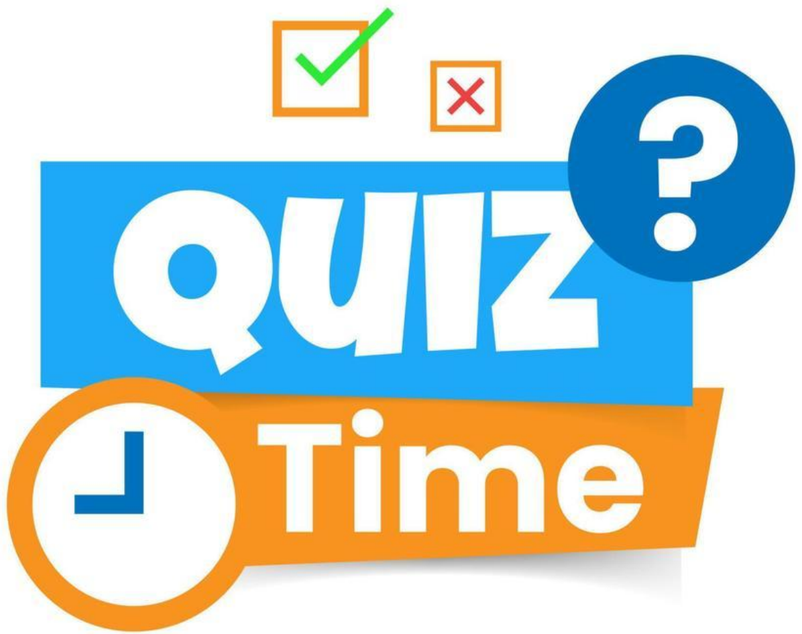
Less Flexible

More Flexible

Easiest Approach

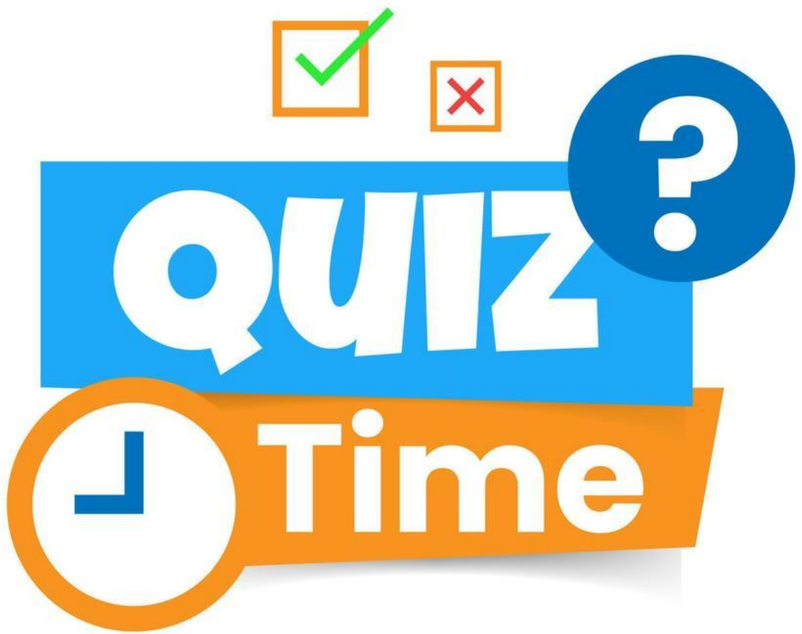
Most complex Approach

Cognitive API	Auto ML	Transfer Learning	Build your own Model (BYOM)



You are the CTO of UrbanDrive, a ride-hailing company that operates in several large cities around the world. With traffic congestion becoming a major issue in urban areas, you are considering leveraging AI to optimize routes for your drivers, reduce commute times, and enhance the overall customer experience. Which of the following AI-based solutions would be the most effective in achieving these goals?

A	An AI chatbot that can communicate with drivers and provide them with traffic updates.
B	A rule-based system that suggests routes based on fixed traffic patterns and historical data.
C	A deep learning model that predicts real-time traffic congestion and dynamically adjusts routes for drivers.
D	A recommendation system that suggests drivers the best times to work based on previous trip data.



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Today’s Topics

01	Understanding the fundamentals
02	Generative AI & it’s usecases
03	An Introduction to LLMs
04	Github Co-Pilot

Generative AI

An overview of what generative AI is and its significance in the field of artificial intelligence

- Generative AI is a type of artificial intelligence that can create new content, such as text, images, or music
- It works by learning from large datasets of existing content and then using that knowledge to generate new content that is similar to the training data

https://www.thispersondoesnotexist.com

Generative AI for Developers

Write code faster, Solve more complicated problems, and Build experiences not possible before

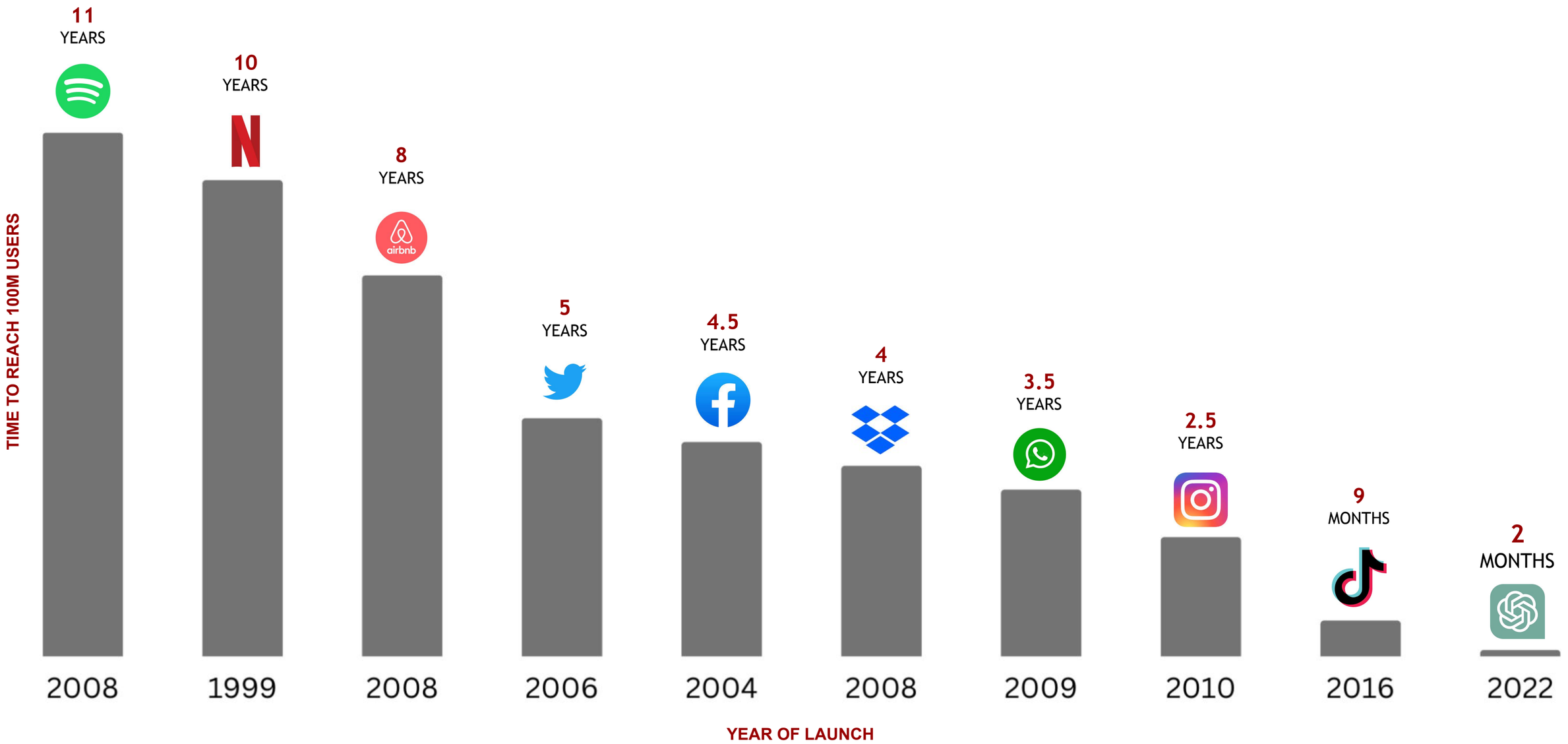
How much of your work involves these things?

- **Finding Information** - Googling errors, Debugging
- **Explaining Concepts** - Learning new technologies
- **Generating and Fixing Code** - Writing scripts, tests, functions, components etc
- **Building new applications** - Natural language processing, speech to text

So, it's great at...

- *Finding Information*
- *Explaining Concepts*
- *Generating and Fixing Code*
- *Building new applications*

A New Wave!



Source: World of Statistics

A New Wave!

Kent Beck 🌻
@KentBeck

I've been reluctant to try ChatGPT. Today I got over that reluctance. Now I understand why I was reluctant.

The value of 90% of my skills just dropped to $0. The leverage for the remaining 10% went up 1000x. I need to recalibrate.

1:21 AM · Apr 19, 2023 · **1.4M** Views

195 1,060 5,910 1,105

A New Wave!

90% of My Skills Are Now Worth $0

...but the other 10% are worth 1000x

KENT BECK

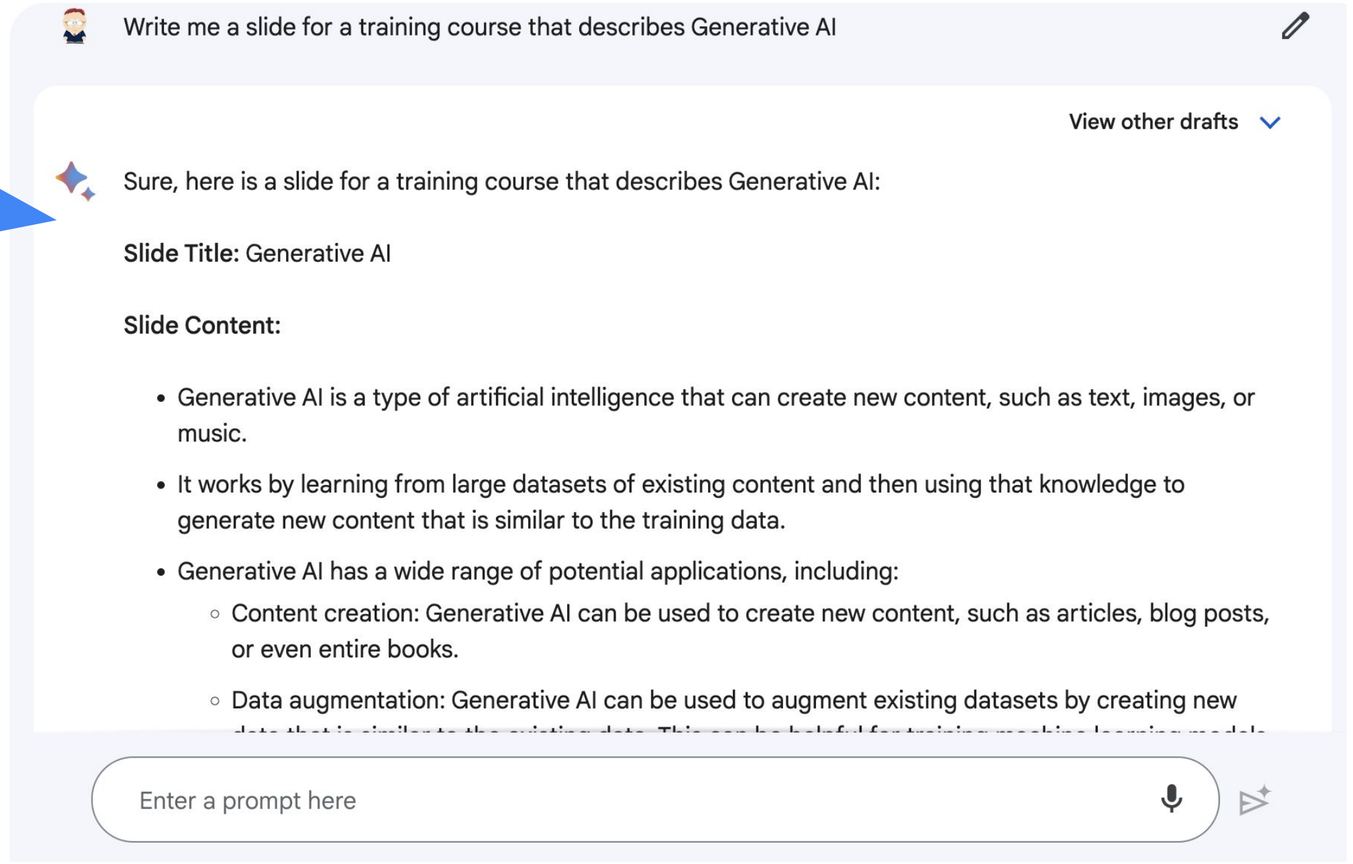
19 APR 2023

In my experience, the most successful software development projects are those that are driven by a combination of human creativity and expertise, as well as the efficient use of tools like ChatGPT. **Rather than seeing the rise of AI technology as a threat to our skills, we should view it as an opportunity to enhance and augment our abilities as software developers.**

Rather than allowing our skills to become obsolete, we should focus on finding ways to integrate AI tools like ChatGPT into our work **in a way that complements our human expertise and creativity.**

Bard is a Google consumer-oriented generative AI tool for creating custom text-based content

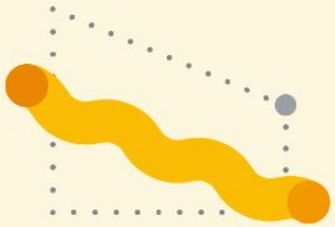
The slide!



https://bard.google.com/

There are huge benefits of generative AI

Increase in efficiency & productivity



Reduce costs for your organization

Automate monotonous tasks

There are also challenges with generative AI

- Can be difficult to control the quality of generated content
- Can be difficult to ensure that generated content is accurate
  - Untrue statements can be presented in a confident manner
  - These are known as hallucinations in generative AI terms
- Can be difficult to ensure that generated content is not offensive or harmful

Generative AI use cases with Azure AI

Language

Writing

Summarization

Ideation

Classification

Sentiment analysis

Extraction

Customer chat

Code

Code generation

Code completion

Code chat

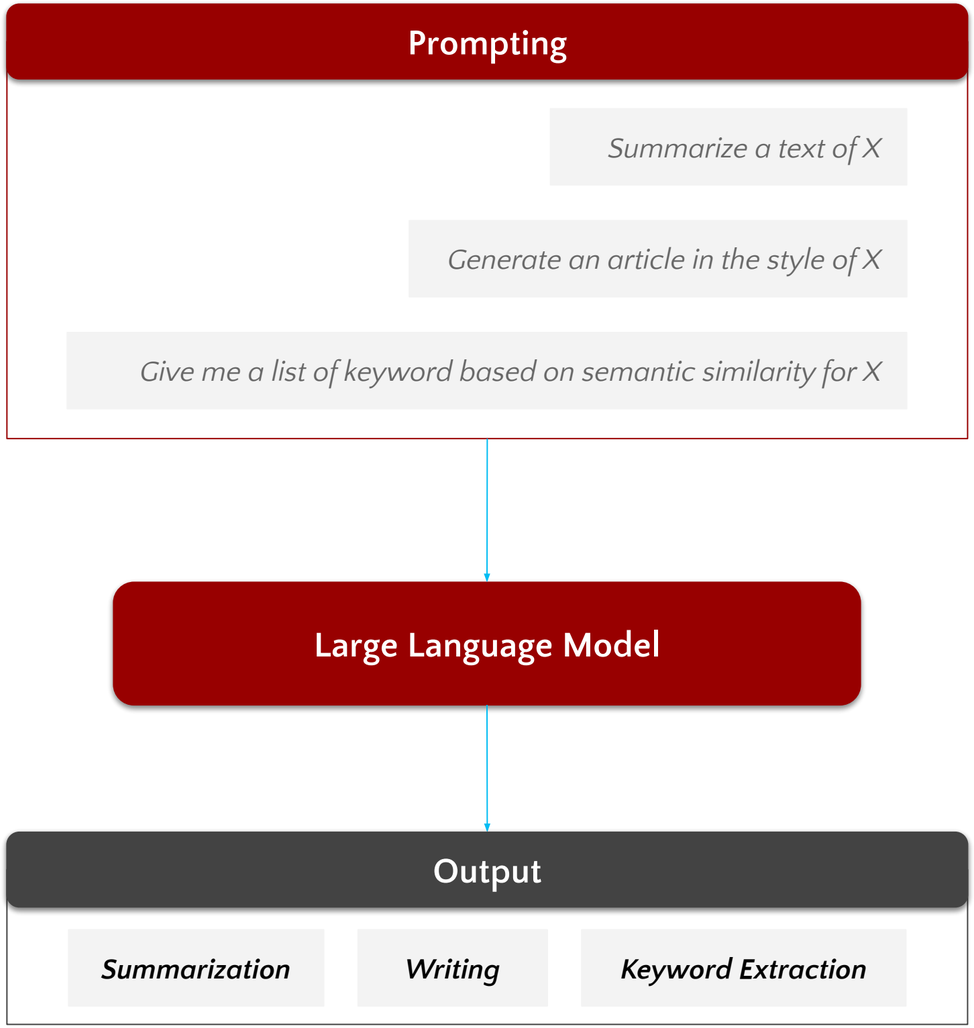
Code conversion

Speech

Speech to text

Text to speech

Generative Language Model



Key Concepts

Prompts

You give the model a prompt and it responds with a series of words that fits both the content and the style of the prompt and, in some cases, even the mood. The models try to predict what you want from the prompt. If you send the words "Give me a list of cat breeds," the model wouldn't automatically assume that you're asking for a list of cat breeds.

Key guidelines: Show and tell, provide quality data, check your settings e.g., Temperature

Tokens

Tokens can be thought of as pieces of words. Before the API processes the prompts, the input is broken down into tokens. 1 token = ~4char

Embeddings

An embedding is a special format of data representation that can be easily utilized by machine learning models and algorithms. It is a compressed format of document in a vectorization form. Each embedding is a vector of floating-point numbers, such that the distance between two embeddings in the vector space is correlated with semantic similarity between two inputs in the original format. For example, if two texts are similar, then their vector representations should also be similar. cosine similarity measures the cosine of the angle between two vectors projected in a multi-dimensional space. Used in search similarities, recommendation, clustering etc.

Completions

The completions endpoint can be used for a wide variety of tasks. It provides a simple but powerful text-in, text-out interface to any of supported models.

Responsible AI - Content Filtering

Azure OpenAI Service includes a content management system that works alongside core models to filter inappropriate contents.

Fine-tuning

Prompt Engineering vs Fine-tuning

Words vs Token

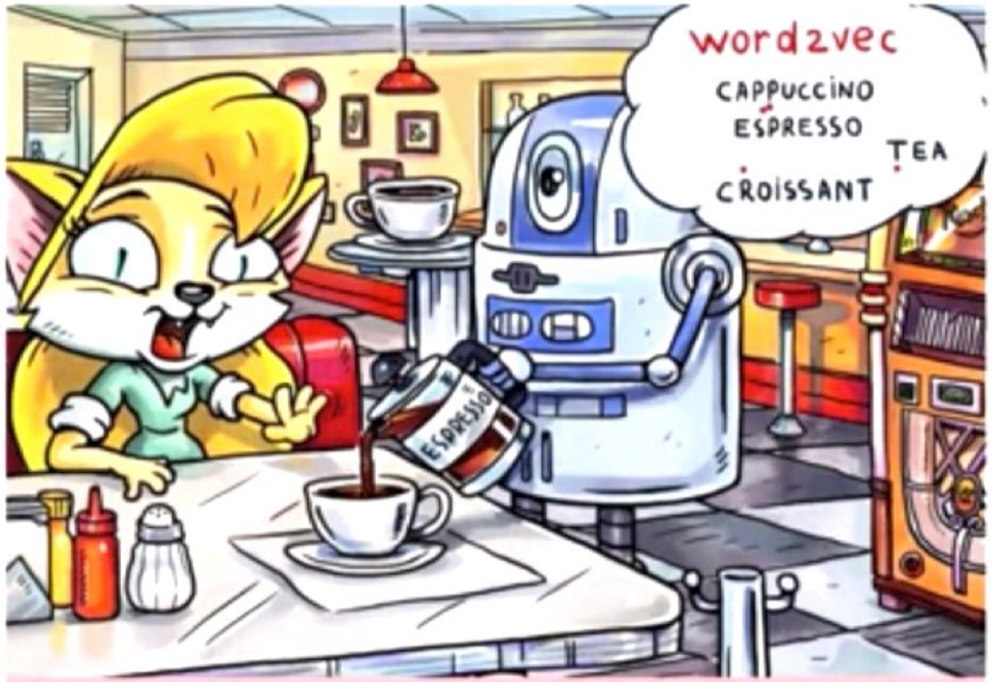
LLMs take tokens as inputs

Words	Tokens
Everyday	[Every, day]
Joyful	[Joy, ful]
I’d like	[I, ’d, like]

Embeddings

How to represent a meaning of a word, a sentence, or a text?

You shall know the word by the company it keeps. (Firth, 1957)



- Espresso? But I ordered a cappuccino!
- Don't worry, the cosine distance between them is so small that they are almost the same thing.

- Word embeddings
- Sentence embeddings
- Topic models

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Large Language Models (LLM)

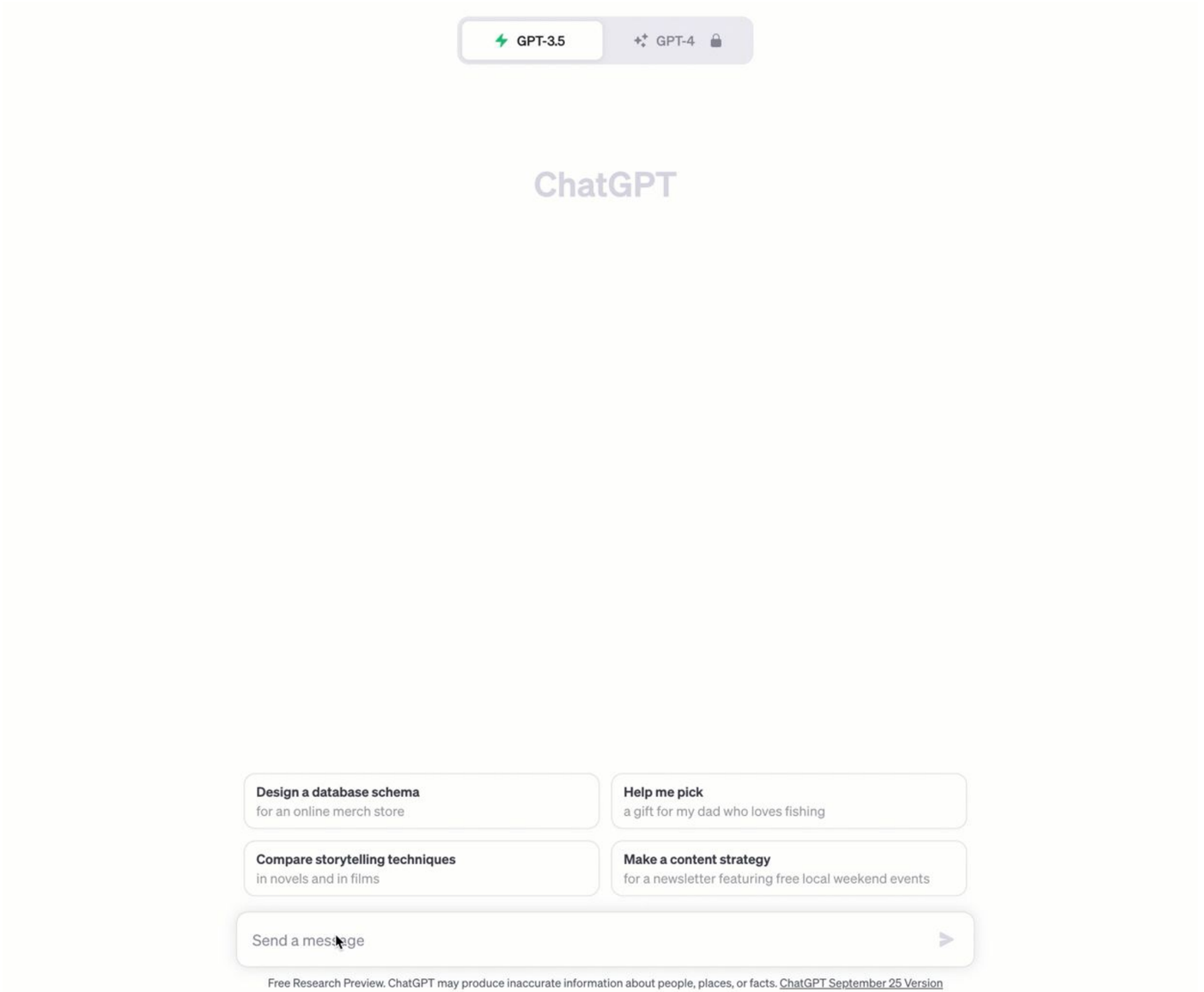
Models trained on large amounts of text data that can perform a wide variety of language tasks, including text summarization, generation, and categorization. These models can perform generative tasks like text generation and so there is some overlap between LLMs and generative Al.

Examples of Language Models

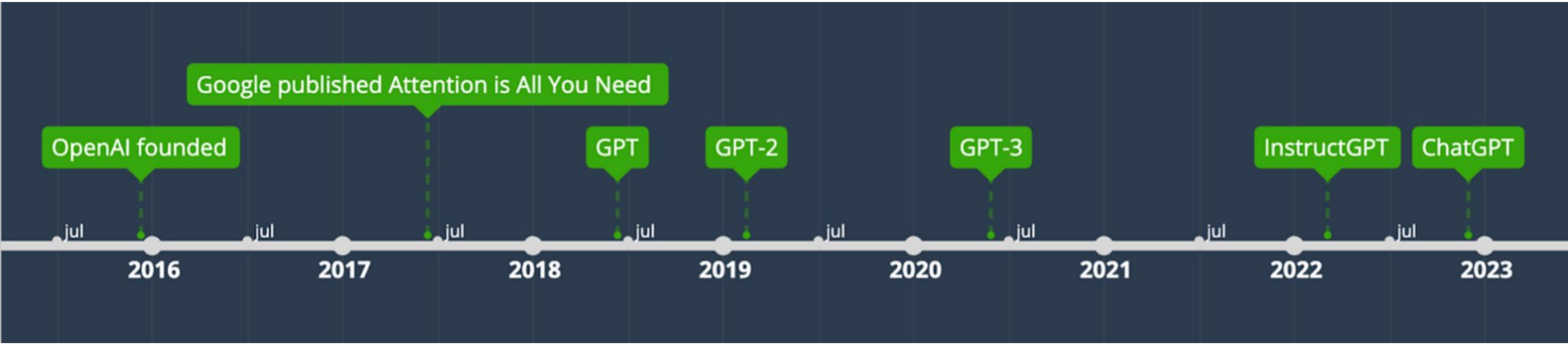
- GPT-1, GPT-2, GPT-3
- Jurassic
- GPT-J
- Dall-E, Midjourney,Stable Diffusion
- BERT
- Bard and LaMDA

Chat GPT

Example: Accessibility to React Application



ChatGPT Timeline



What does GPT mean?

Generative Pretained Transformer

Generative

means that the program can create new text. It's like having a virtual writer that can come up with sentences and paragraphs on its own.

PreTrained

means that the program has already learned a lot about how people use language. It has studied a huge amount of text from books, articles, and websites etc

Transformer

is the name of a special structure inside the program that helps it understand and generate text. It's like a powerful tool that helps the program organize and process information.

ChatGPT

What is ChatGPT?

- Human-like Responses
- Contextual Awareness
- Trained on large data

GPT-3.5 vs ChatGPT : Know the difference

GPT-3.5: Make smarter apps

An AI model accessible through an API for on-demand intelligence

ChatGPT: Get more productive

A GPT-3 model used to build Chatbots you can interact with and ask to perform tasks

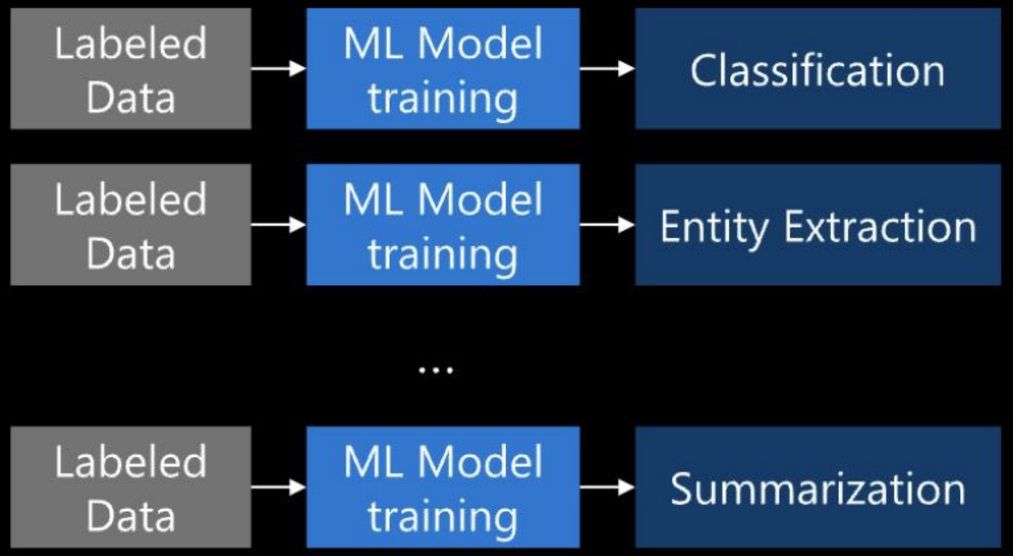
Can be used for:

- Implementing semantic text understanding
- Internal Information search & extraction
- Building copilot-like applications
- Can be used for a lot more including what ChatGPT can do

- Ideation for content creation
- General question answering
- Assistance in code generation and conversation

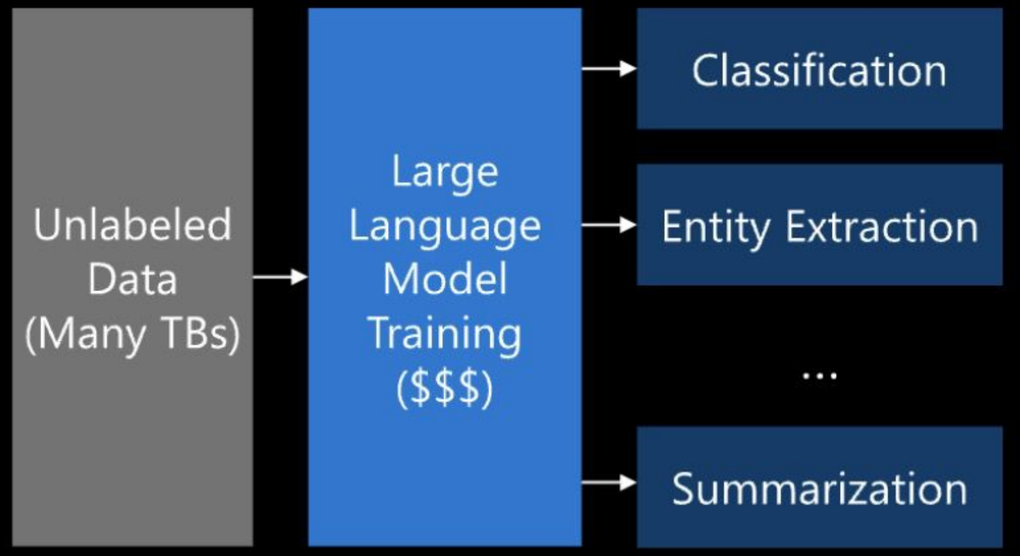
Large Language Models

Typical ML for NLP



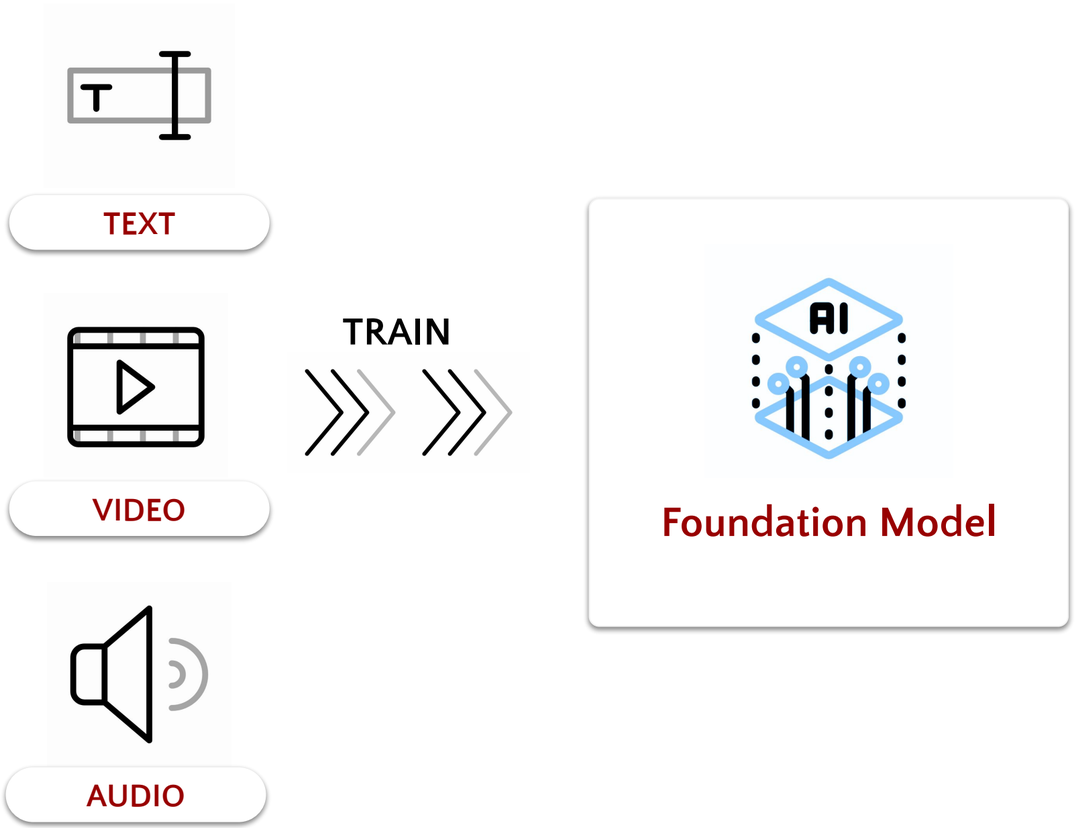
One model per capability
Labeled data to train
Highly optimized for use case

Large Language Models



Single model for all use cases
Describe in natural language what it should do

Foundation Model



LLMs can also "generate things"

"Classify this document"

Large Language Model

Class: Insurance document

LLMs can do typical ML tasks easily (often zero-shot learned)

"Write me a letter explaining why the markets are down, given these reasons: …"

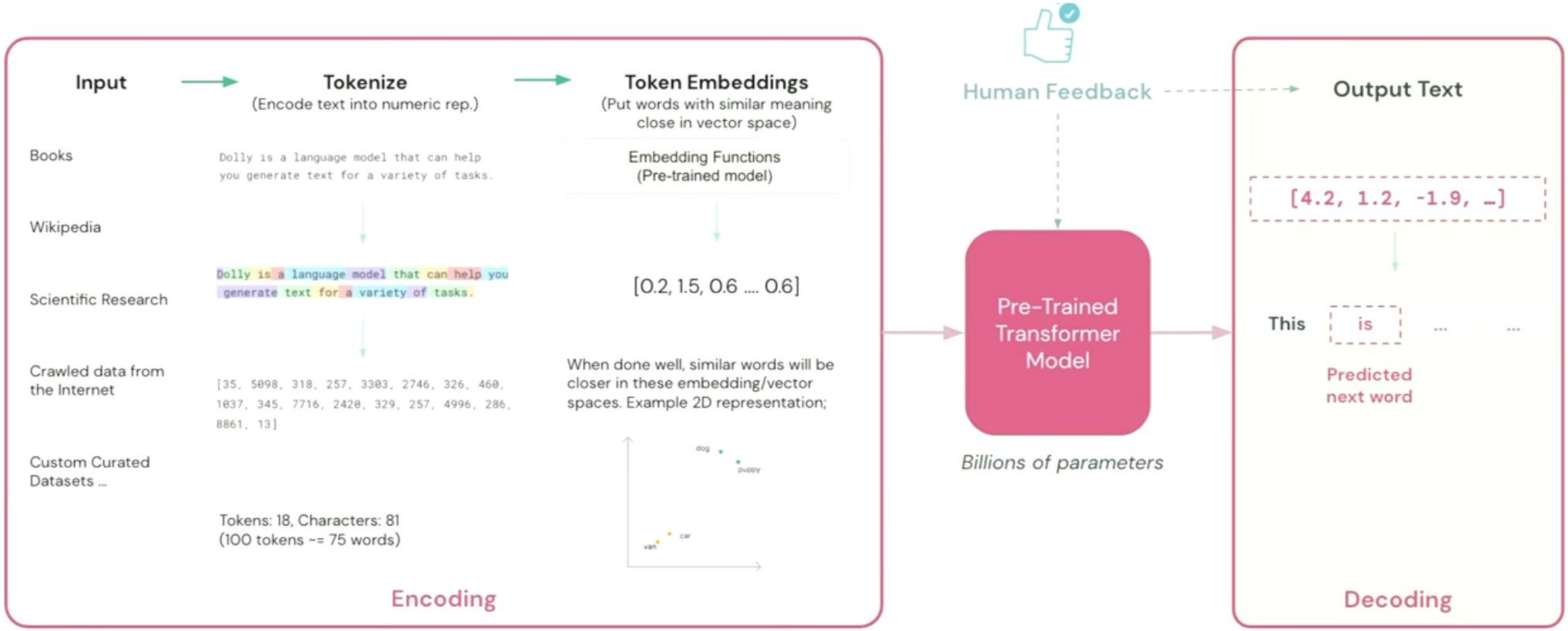
Large Language Model

New document, generated by the LLM

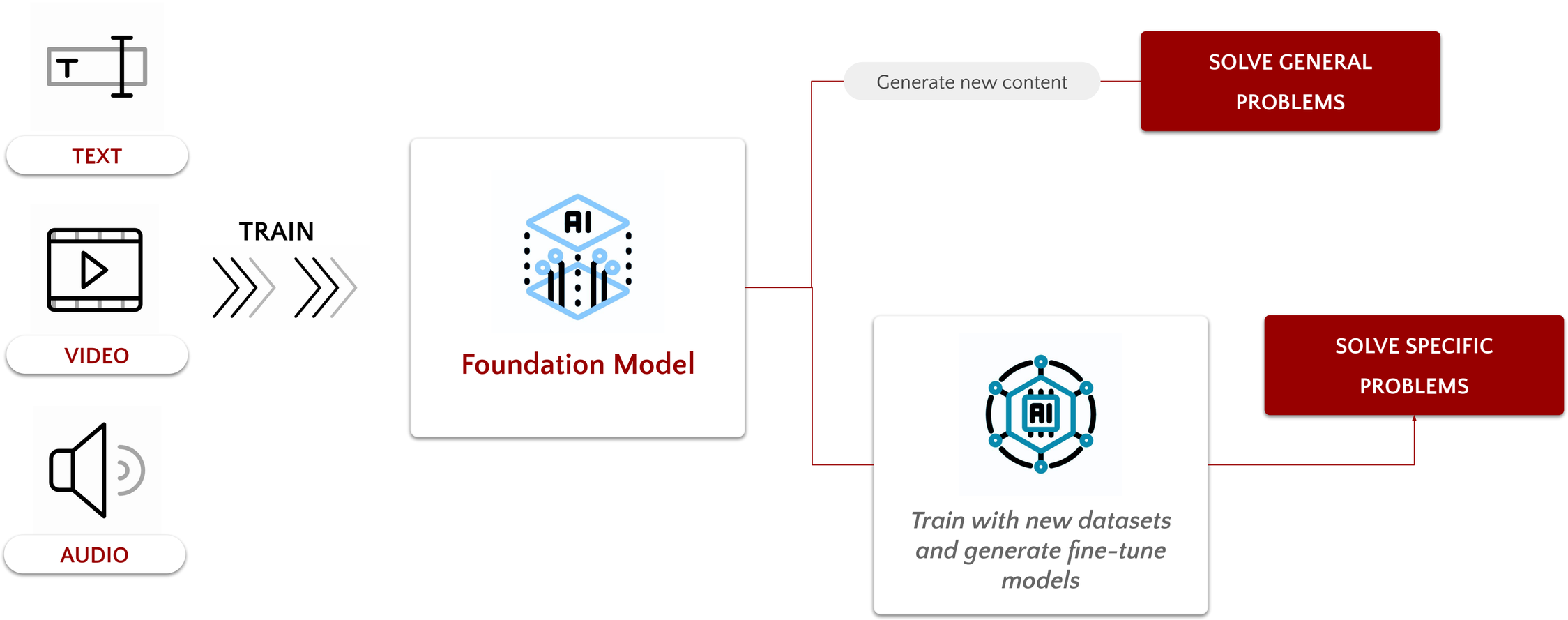
LLMs can also machine-read (understand) and generate new documents

How Do LLM's Work?

A Simplified version of LLM training process



Foundation Model



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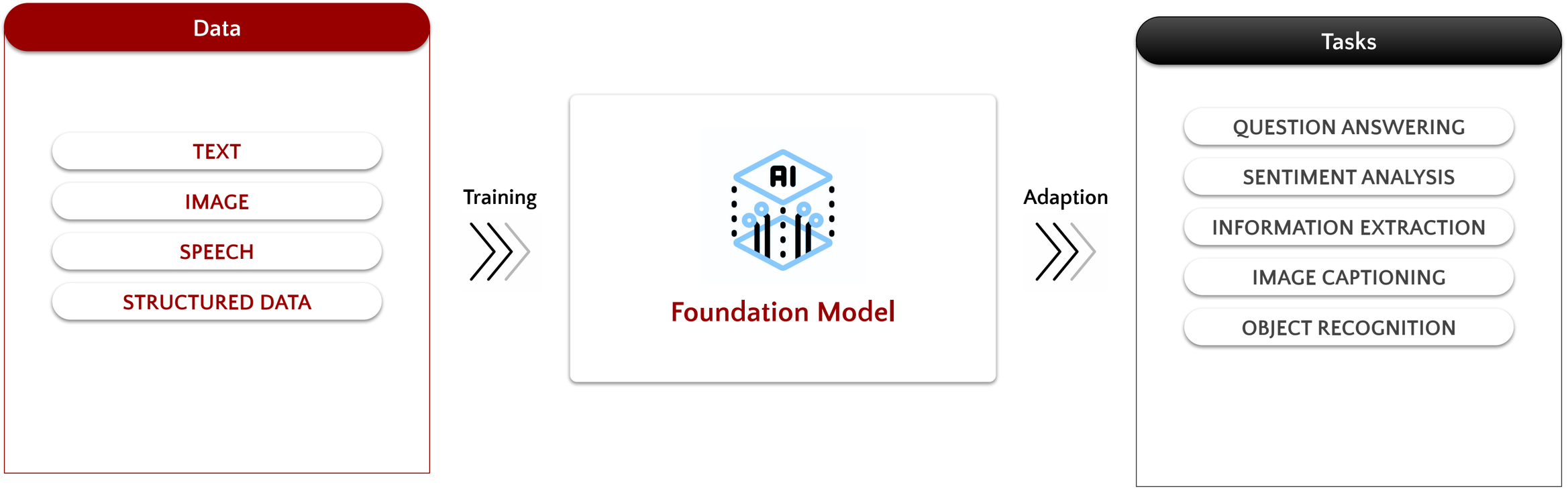
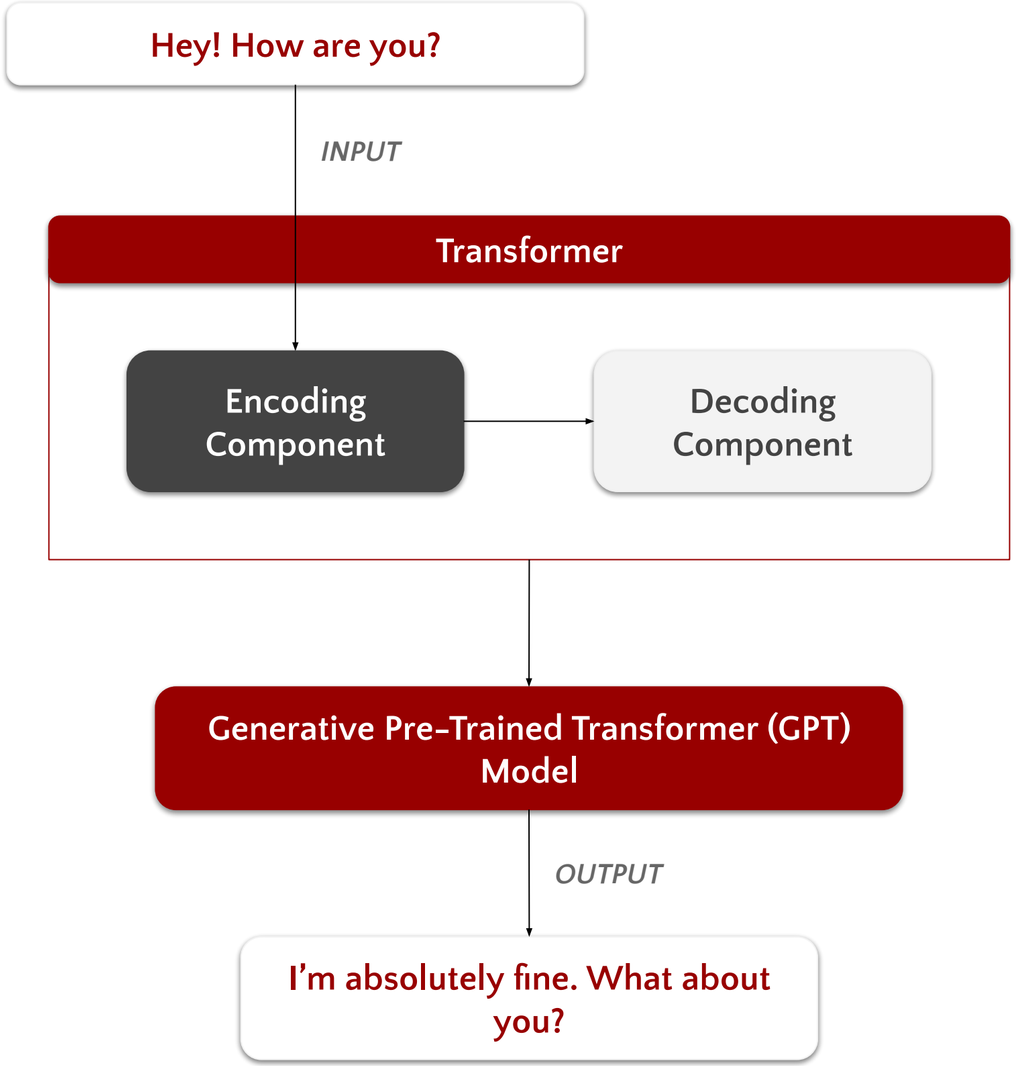


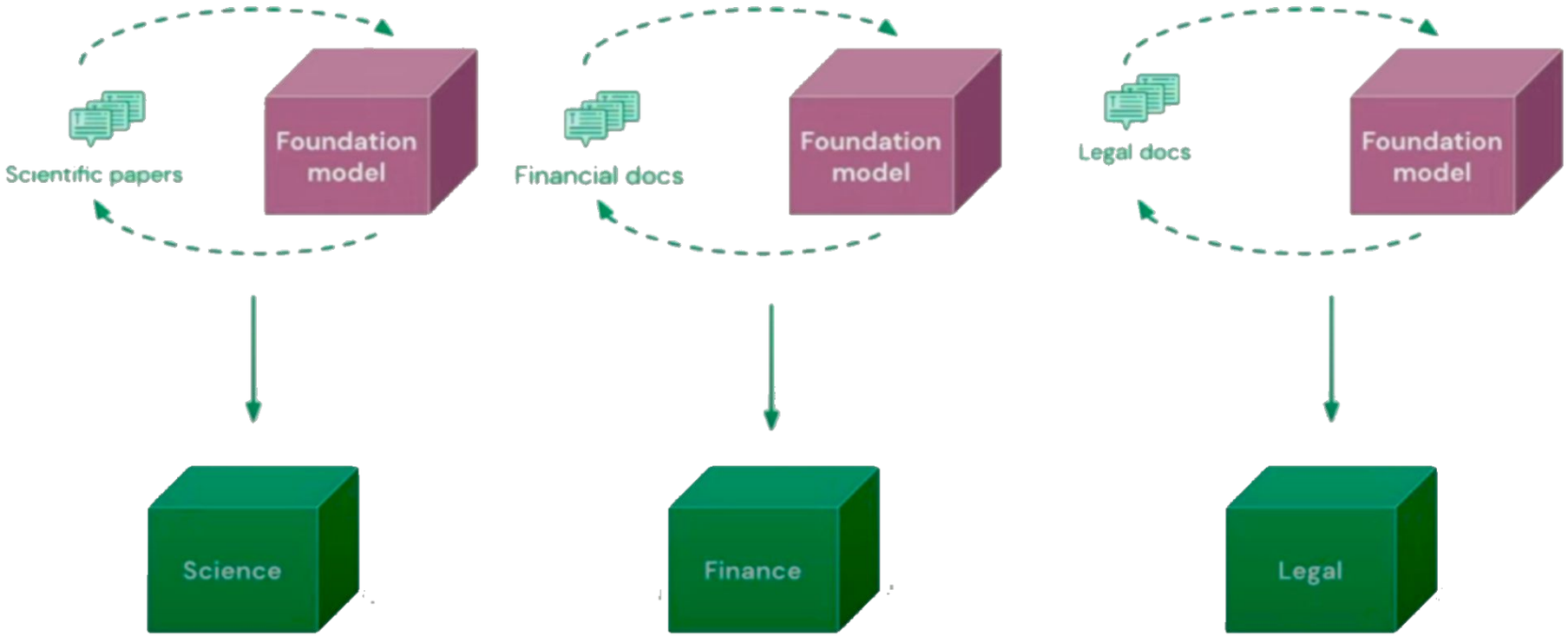
How it works?


Hey! How are you?
INPUT
Transformer
Encoding Component
Decoding Component
Generative Pre-Trained Transformer (GPT) Model
OUTPUT
I'm absolutely fine. What about you?

Fine Tuned Model

Foundation models can be fine-tuned for domain adaptation

Supervised training on smaller labeled datasets

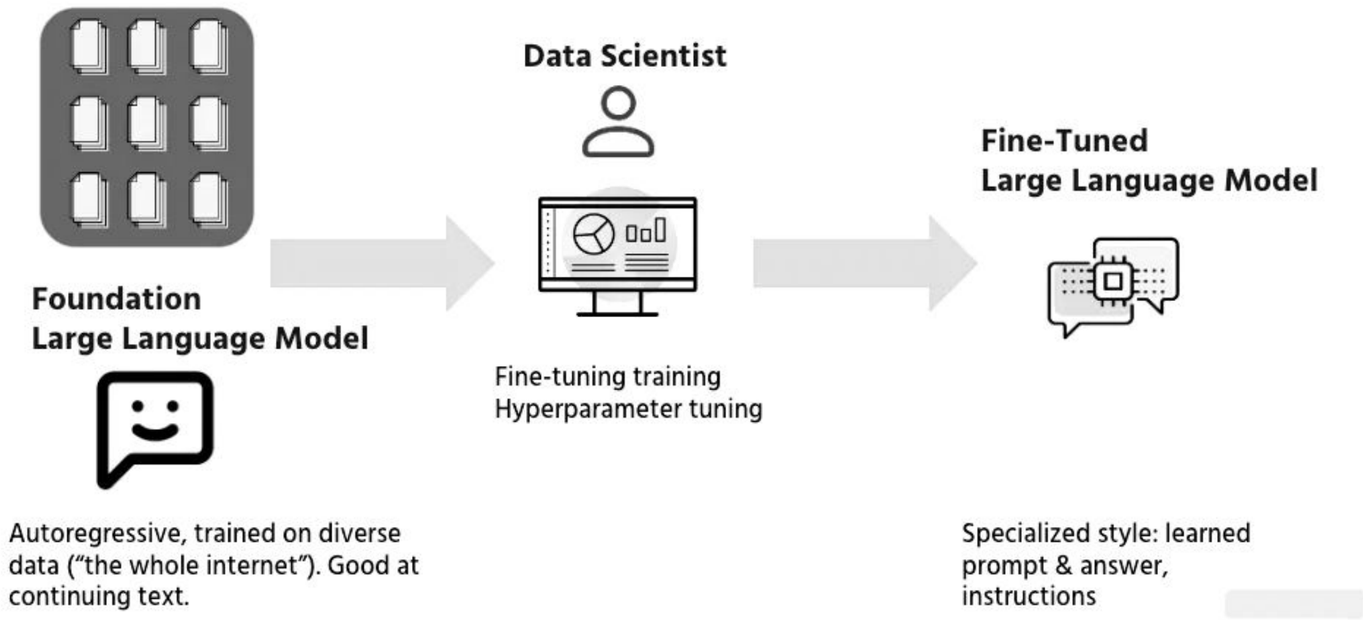


Domain-specific fine-tuned models

Fine Tuned Model

What is fine - tuning and how it works

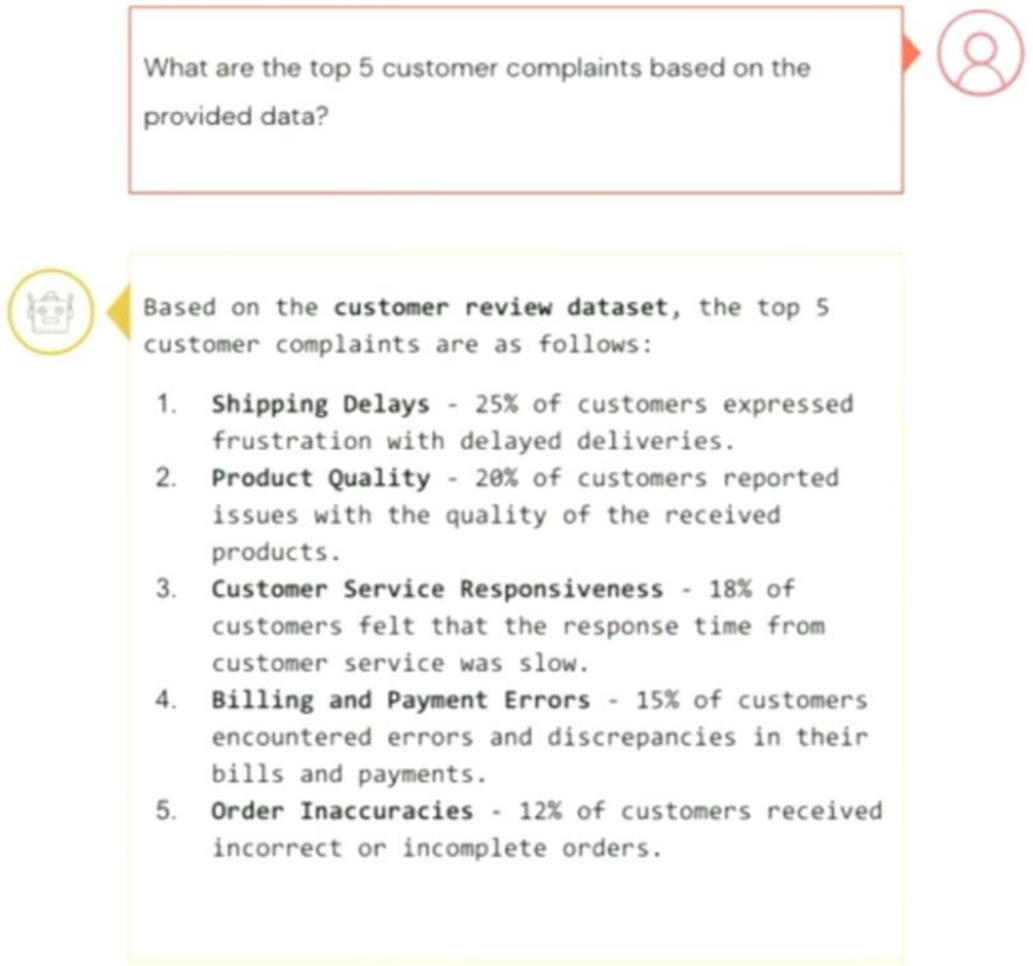
Fine-tuning: The process of further training a pre-trained model on a specific task or dataset to adapt it for a particular application or domain.



LLMs Business Use Cases

Customer Engagement

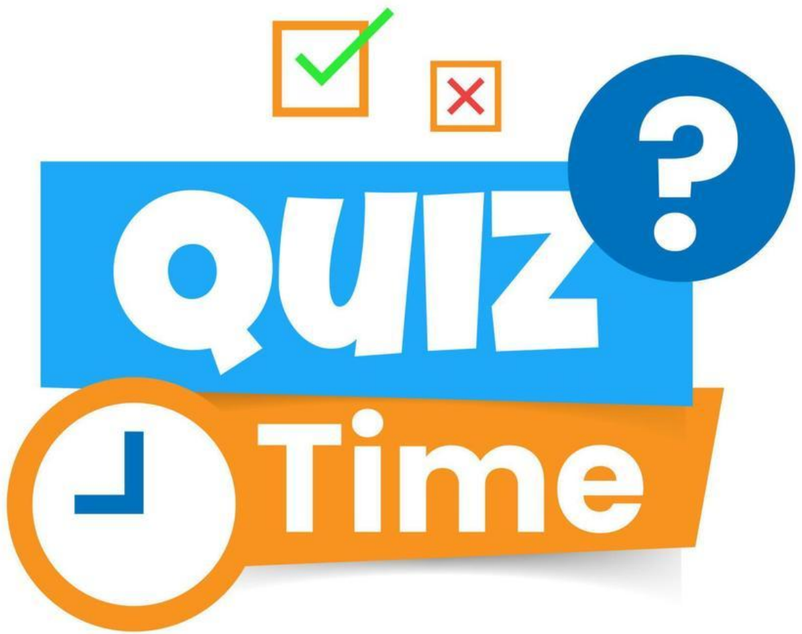
- Personalization and customer segmentation:
  - Provide personalized product/content recommendation based on customer behaviour and preferences
- Feedback Analysis
- Virtual assistants



LLMs Business Use Cases

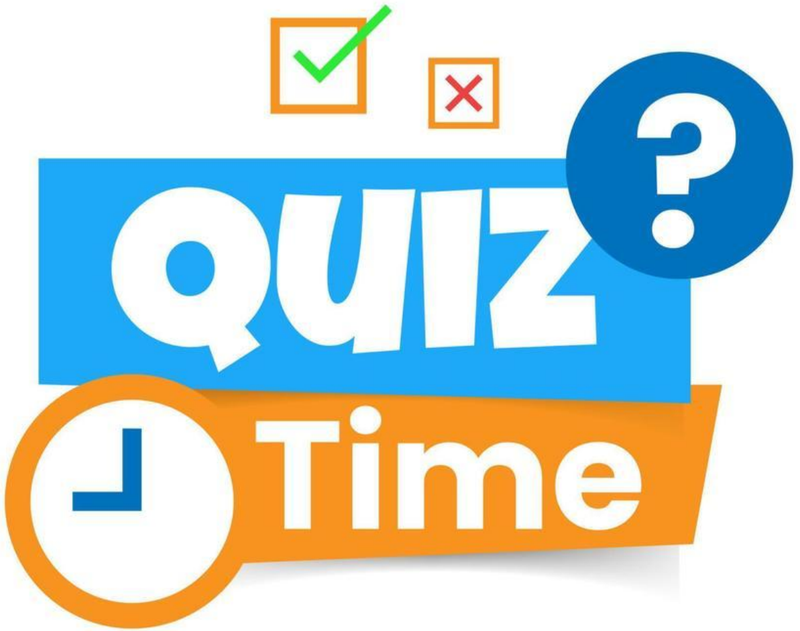
Code generation and developer productivity

- Code completion, boilerplate code generation
- Error detection and debugging
- Convert code between languages
- Write code documentation
- Automated testing
- Natural language to code generation
- Virtual code assistant for learning to code



Imagine you're an advisor at MedCorp, a leading healthcare institution. The company wants to leverage Large Language Models (LLMs) like ChatGPT to improve patient experience and administrative efficiency. How might MedCorp best utilize an LLM for its operations?

A	Implementing the LLM to autonomously diagnose patient illnesses based solely on the symptoms they describe.
B	Using the LLM to assist customer service representatives by providing real-time information and answers to common patient queries.
C	Deploying the LLM as a tool for doctors to generate comprehensive patient reports, taking raw data and translating it into understandable language.
D	Integrating the LLM to automate all managerial decisions based on the text data from past records.



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