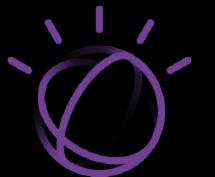


The Future of AI: Transforming Our World Over the Next 5 Years

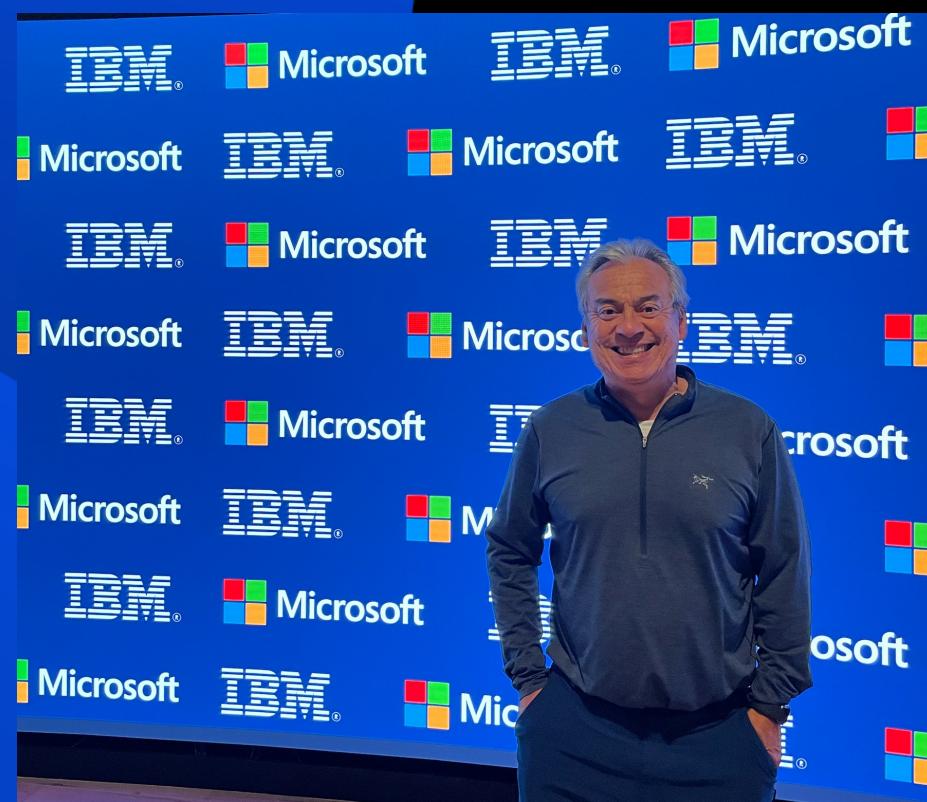
AI Fundamentals



Ivan Portilla
Portilla@gmail.com
github.com/jiportilla/giveback



RICOH



Objectives of This Talk

Upon completion of this lecture, you will understand:

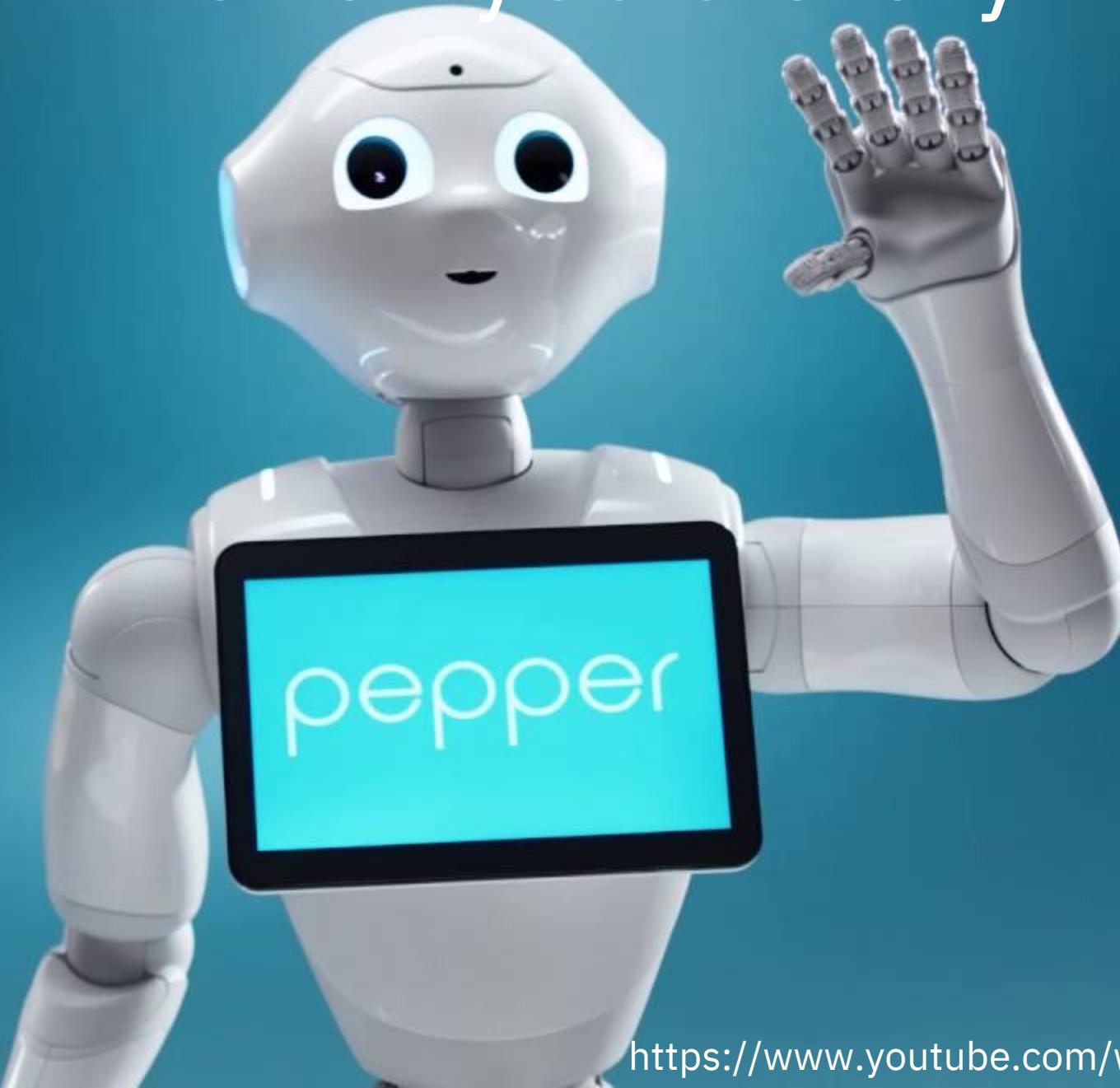
- Origins of Modern Artificial Intelligence (AI)
 - ✓ Primer on AI, Machine Learning (ML), Deep Learning (DL)
 - ✓ Generative AI & Large Language Models (ChatGPT)
- Current Landscape
- Long-term Vision: Where is AI headed next

<https://github.com/iportilla/lowcode>

Agenda

1. Artificial Intelligence
 - GenAI (ChatGPT)
2. Current & Next AI use cases
3. Closing Remarks & Q&A

Let me tell you a story



<https://www.youtube.com/watch?v=i9ZF9EYHyDE>



Robo del siglo

<https://www.bbc.com/news/world-latin-america-28783027>

Entity Resolution

Solution at Degrees of Difficulty

<https://senzing.com>

Exactly
Same

Bob Jones
123455

Bob Jones
123455

Fuzzy

Bob Jones
123455

Robert T Jonnes
000123455

Incompatible
Features

Bob Jones
123455

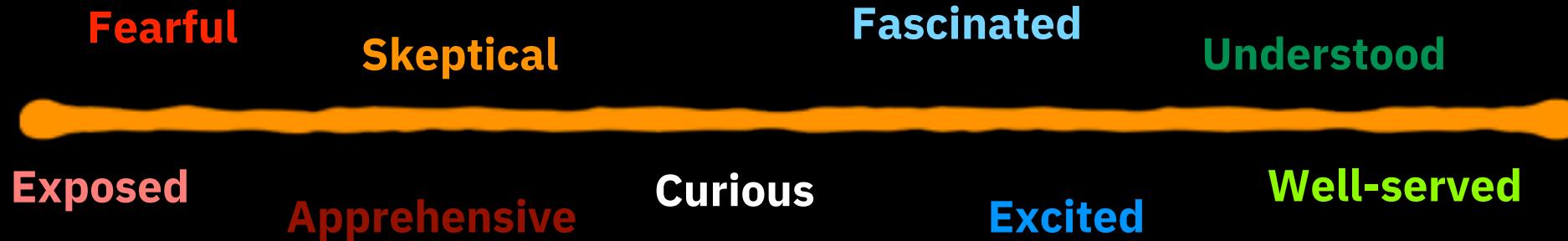
What is AI?

poll

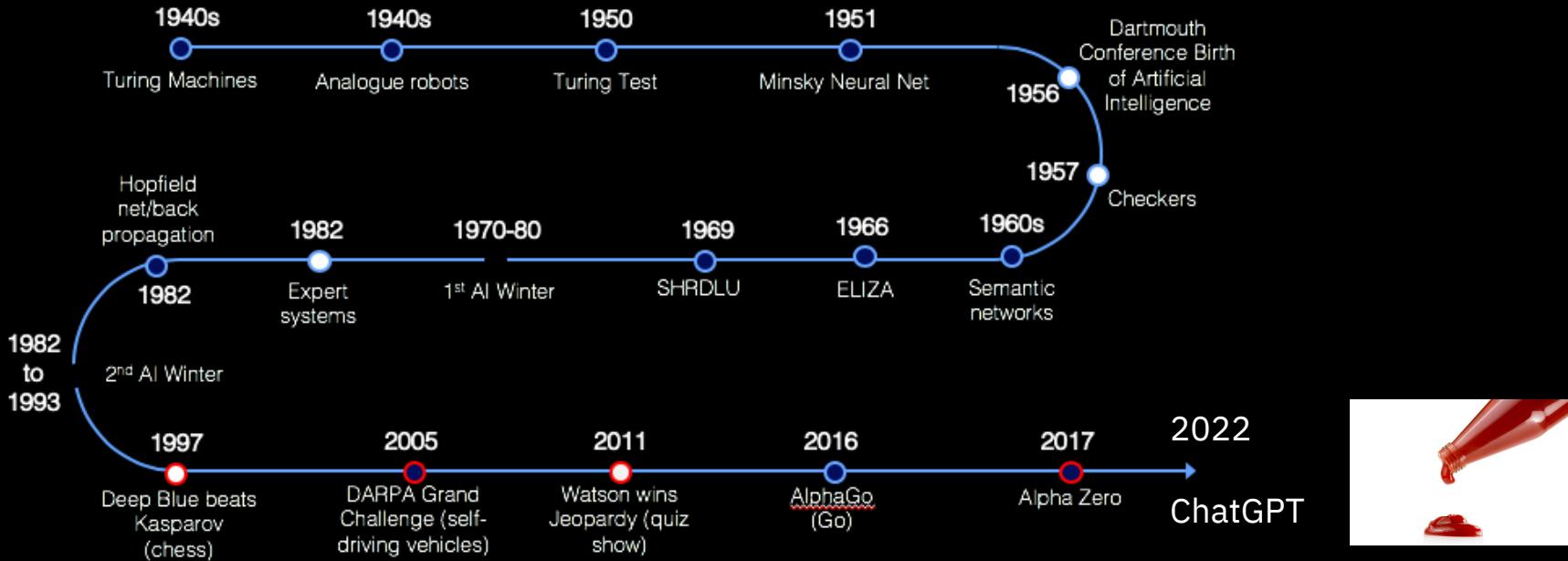
Participants can vote
at [Slido.com](https://www.slido.com) with
#3650243

AI Perception

What do people feel about AI?



A brief history of AI



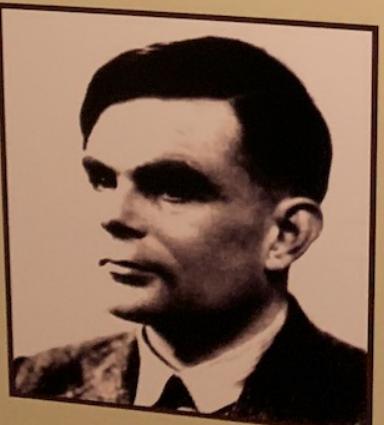
ALAN TURING'S OFFICE

Here at his desk in Hut 8, Turing took the lead on breaking naval Enigma ciphers – something few thought could ever be done. His mathematical skills also enabled him to break other ciphers, including the complex Lorenz cipher where he used a method that became known as Turingy. Together with his fellow Codebreaker Gordon Welchman, he developed the Bombe machine to help speed up the codebreaking process.

IN THEIR WORDS

If anyone was indispensable to Hut 8 it was Turing. The pioneer work always tends to be forgotten when experience and routine later make everything seem easy, and many of us in Hut 8 felt that the magnitude of Turing's contribution was never fully realised by the outside world.

Hugh Alexander, Codebreaker, Hut 8



What is AI?

Artificial Intelligence | noun

An area of computer science that emphasizes the creation of intelligent machines that work and react like humans.

What led to the prominence of AI?

- ✓ Data explosion
- ✓ Computing power
- ✓ Deep learning algorithms

What is AI?

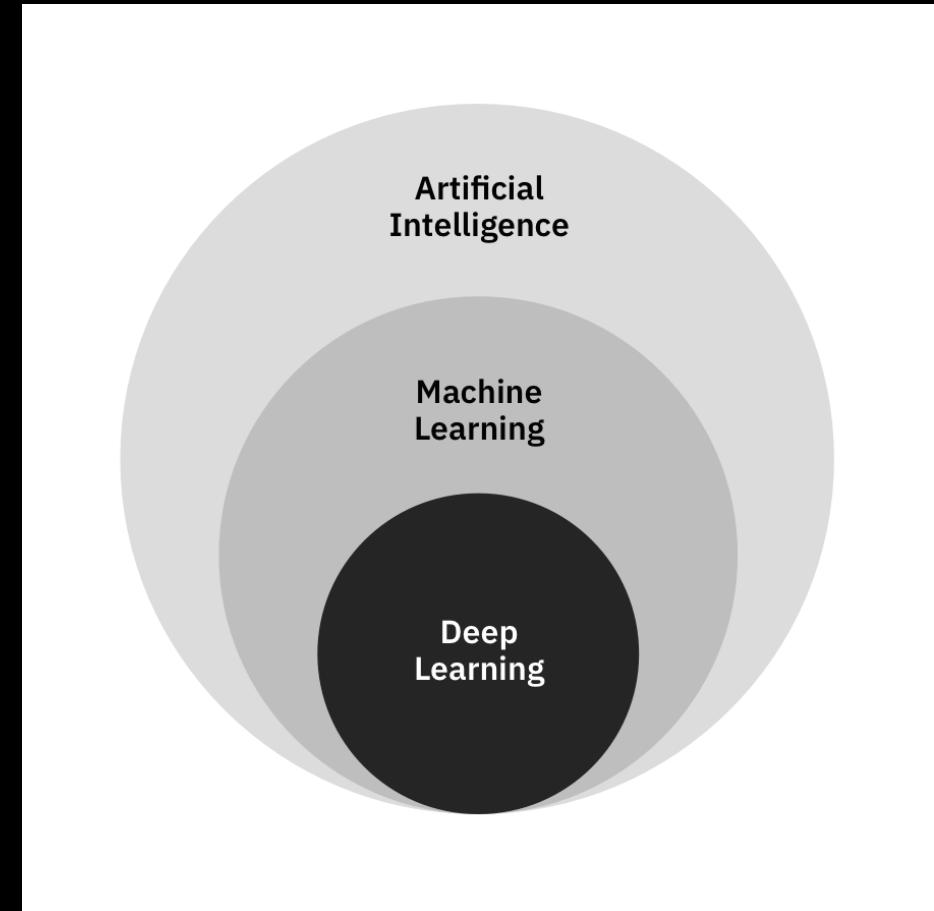
Artificial Intelligence | noun

An area of computer science that emphasizes the creation of intelligent machines that work and react like humans.

Intelligence demonstrated
by machines

Definitions

- AI: Intelligence demonstrated by machines
- ML: Set of algorithms that allow computers to learn from (big) data
- DL: Set of learning techniques focused on models and neural networks

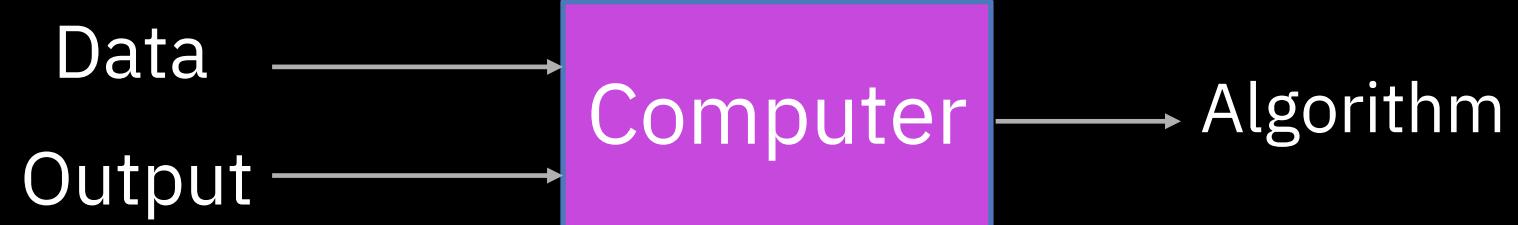


Why Machine Learning?

Traditional Programming



AI-Machine Learning



ML provides systems the ability to automatically learn from experience
(without being explicitly programmed)

Intelligence demonstrated
by CU Graduate Students

Exercise 2

Lab 1

Calculate Reaction Rates

Objective: Write a program to calculate the reaction rate for a given chemical reaction using the Arrhenius equation.

Arrhenius Equation:

$$k = A \cdot e^{-\frac{E_a}{RT}}$$

Example

1. Define Constants:

- A (pre-exponential factor)
- E_a (activation energy)
- R (universal gas constant = 8.314 J/(mol·K))

2. Take Input:

- Temperature (T) in Kelvin

3. Calculate the Reaction Rate Constant

- Implement the Arrhenius equation

4. Output:

- Print the reaction rate constant

python

```
import math

# Define constants
A = 1.0e12 # Pre-exponential factor in s^-1
E_a = 75.0 # Activation energy in kJ/mol
R = 8.314 # Universal gas constant in J/(mol·K)

# Convert activation energy to J/mol
E_a_J = E_a * 1000

# Input temperature in Kelvin
T = float(input("Enter temperature in Kelvin: "))

# Calculate reaction rate constant using Arrhenius equation
k = A * math.exp(-E_a_J / (R * T))

# Output the reaction rate constant
print(f'Reaction rate constant (k) is: {k:.2e} s^-1')
```

PB&J Recipe

Exercise 1

Program how to make a Peanut Butter & Jelly sandwich

1. Get ingredients (PB, Jelly, Bread)
2. Get cooking utensils (plate, knives)
3. Get two slices of bread
4. Open PB, Jelly jars
5. With a knife spread 2 Tablespoons of peanut butter on one piece of bread
6. With a different knife, spread 2 Tablespoons of jelly on the other slice of bread
7. Put the slices together
8. Toddler adaptation: cut off crusts before serving.
9. Place on plate & serve



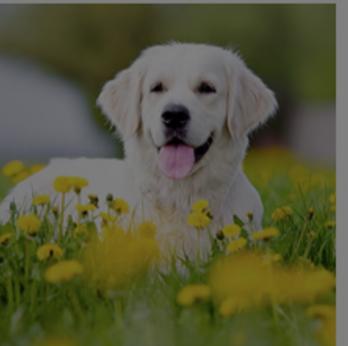
Exercise 3

Machine Learning.

Sample



Label



dog



cat



horse

Human Learning:

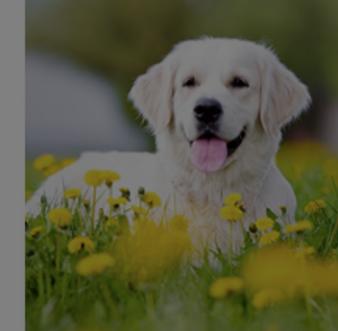
We learn through



Cat or Dogs

Long Ear Black nose

dog



Machine Learning:

Sample



Label



dog



cat



horse

Human Learning:

We learn through



Long Ear Black nose

dog



Examples

Diagrams

Comparisons

Predicting Reaction Outcomes with ML

Use a machine learning model to predict the yield of a chemical reaction based on various input parameters

	temperature	pressure	concentration	yield
0	487.2700594	1.282862671	0.677828482	69.096296
1	775.3571532	6.727693701	0.175725968	97.14156
2	665.9969709	3.82920383	0.245465843	98.734019
3	599.3292421	5.57713622	0.90869877	85.391087
4	378.0093202	9.168098265	0.645786154	51.759268
5	377.9972602	3.243630062	0.108277346	59.853813
6	329.0418061	4.693446307	0.191324389	51.441971
7	733.0880729	7.799960247	0.697151592	100.97095
8	600.5575059	3.059183489	0.104555425	77.122739
9	654.0362889	1.692819188	0.244727246	85.176356
10	310.2922471	3.607763076	0.59386041	54.858043
11	784.9549261	2.450991585	0.722705678	103.54976
12	716.2213204	9.367278871	0.686765134	89.804289
13	406.1695553	8.273083416	0.301842379	62.580991
14	390.9124836	6.700633809	0.740961299	59.566839
15	391.7022549	8.843145312	0.313524179	59.825152
16	452.1211215	8.233048692	0.392859728	77.655908
17	562.3782158	2.67913053	0.771842265	79.102295
18	515.9725093	9.033030986	0.684669609	69.309347

Exercise 4

A photograph of a highway scene. In the foreground, the side of a white semi-truck is visible, showing its trailer and rear wheels. The road is a two-lane highway with a solid yellow line on the left and a dashed white line on the right. In the distance, another truck and a car are visible on the road. To the left, there is a yellow diamond-shaped road sign with a black silhouette of a car on a winding road. The background consists of a dense forest of green trees under a clear sky.

Passing truck in
highway

Passing truck in highway

Don't Follow Closely Behind Prior to Passing

- As you prepare to pass, keep a healthy distance between your car and the truck in front of you. At minimum, 30 feet should separate the two vehicles. Signal clearly to indicate your next move.

Pass in the Left Lane

- The left lane is referred to as the 'passing lane' for a reason; it's the safest place to pass any vehicle, but particularly trucks and buses. It's frustrating to be stuck behind a slow truck in the left lane, but resist the urge to pass on the right side.

Don't Linger in the Truck's Blind Spot

- Trucks have huge blind spots on both sides. Pass promptly while still abiding by the speed limit. Don't hang out in the blind spot area, which, in the left (passing) lane, constitutes the truck's entire front half.

Recognition

- With GPS navigation, HiRes cameras, Laser-radar cameras: Location, speed of trucks, road conditions, emergency lane
- With Image Recognition: Turn signal (!lamp), paper or debris on the road

Insights

- Data is fed into multiple CPUs + collected data + rules
- Manufacturer knows who has the right of the way, when trucks can pass + MM miles driven have feedback on different driving style

Action (Cognitive Decision)

- Assist (alerts driver)
- Act (Pass or Not pass, Measure decision effects, feedback loop, and share w other cars)

Where is AI going?

AI is Everywhere

Everyone working with information technology is already relying on AI, and if not, will be soon.

AI is Everywhere

AUTOMATION



Automating actions, processes, and alerts

CONVERSATION



Understanding text and answering questions in natural language

OPTIMIZATION



Analyzing data for patterns and outliers and deriving insights

RECOMMENDING AND INSIGHTS



Understanding needs and recommending solutions

PERSONALIZING



Personalizing experiences

VISUAL RECOGNITION



Recognizing objects in images and videos

AI Means Business Across All Industries

E-COMMERCE:
Recommender
Systems

EDUCATION:
Research Insight

FINANCE:
Fraud Detection

GOVERNMENT:
Smarter Services

HEALTHCARE:
Patient Diagnosis

- **Opportunity Identification**
- **Competitive Advantage**
- **Intelligent Content**
- **Sales Growth**

MANUFACTURING:
Anomaly Detection

MEDIA:
Interaction & Speed

NETWORKS:
Intrusion Detection

RETAIL:
Inventory
Optimization

TRANSPORTATION:
Demand
Forescating

Pre LLMs Demonstration

Future of AI Example (Semantic Analysis)

The Wining Shot

The soccer game was nearly over. The two teams were tied, one to one.

Alice kicked the ball. Oops! She kicked it the wrong way.

"What a bad kick," Alice thought.

But wait!. Her teammate John jumped to stop the ball. The ball went off John into the goal!.

Alice's team won the game. Hooray! It was not a bad kick, after all.

Who won the game?

Why?

Future of AI Example

The Wining Shot

The soccer game was nearly over. **The two teams were tied, one to one.**

Alice kicked the ball. Oops! She kicked it the wrong way.

"What a bad kick," Alice thought.

But wait!. **Her teammate John** jumped to stop the ball. **The ball went off John into the goal!!**

Alice's team won the game. Hooray! It was not a bad kick, after all.

Who won the game?

Answer: Alice's team
✓ **Correct**

Explanation: Alice's team won the game because Alice's team had more points than the other team

✓ **Correct**

GenAI

Slido.com with
#1257417

Artificial Intelligence

Machine Learning

Deep Learning

Generative AI



Artificial Intelligence

Intelligence demonstrated by machines



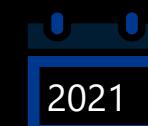
Machine Learning

Learn from data



Deep Learning

Model after the human brain (Neural Networks)



Generative AI

Create new written, visual, and auditory content

Generative AI

The best thing about AI is its ability to ...

Adapt = 30%

Process = 22%

Analyze = 7%



GTP-4

Why is the sky blue?

OpenAI GPTx Answer:

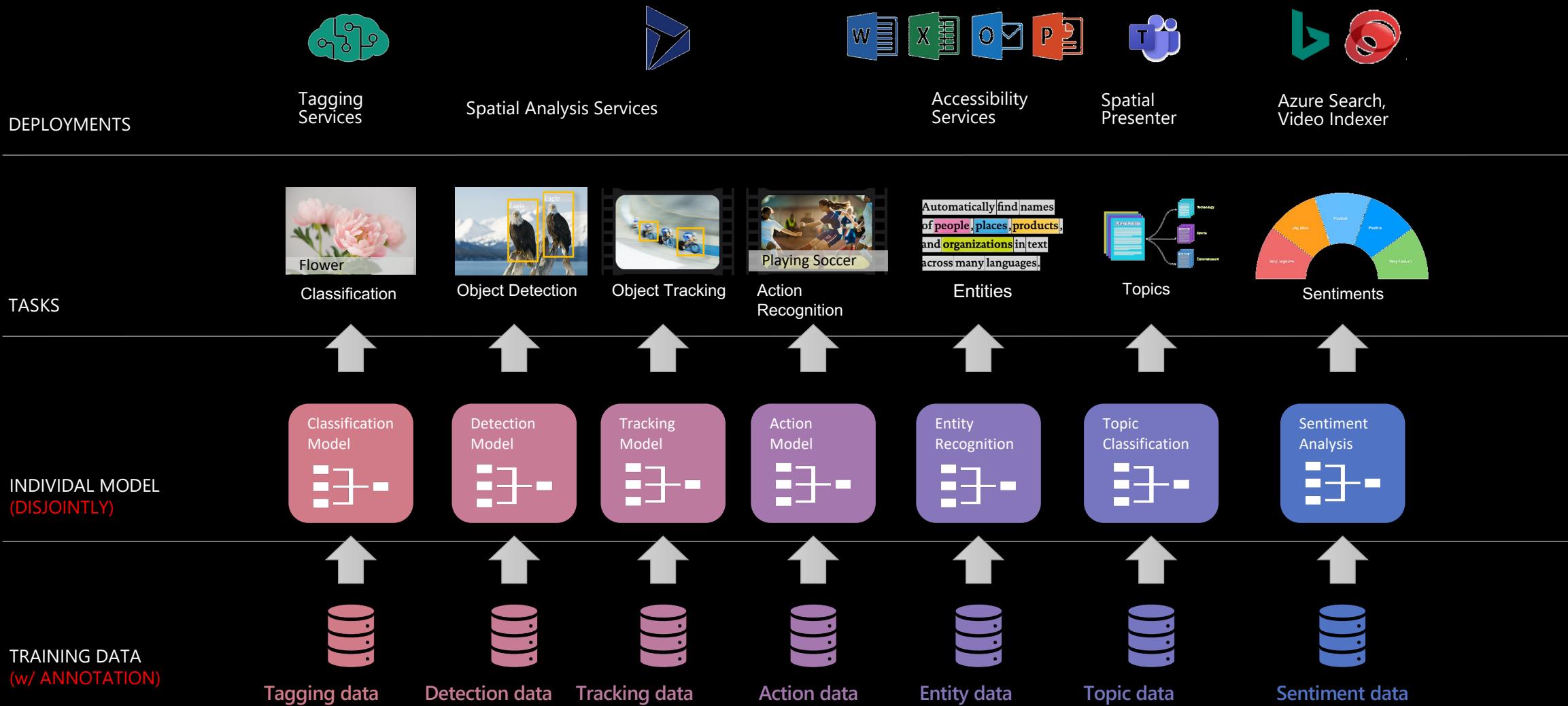
The screenshot shows the OpenAI Playground interface. At the top, it says "Playground" and has a "Your presets" dropdown and a "Save" button. The conversation is as follows:

SYSTEM	USER	ASSISTANT
you are a science professor	why is the sky blue	The sky appears blue because of a phenomenon called Rayleigh scattering. Essentially, when sunlight enters Earth's atmosphere, the shorter blue wavelengths are scattered more effectively by the gases and particles in the air compared to the longer red wavelengths. This scattering causes the blue light to be diffused in all directions, giving the sky its blue appearance to our eyes.

The sky blue because the Earth's atmosphere scatters sunlight in all directions and blue light is scattered more than the other colors because it travels as shorter, smaller waves

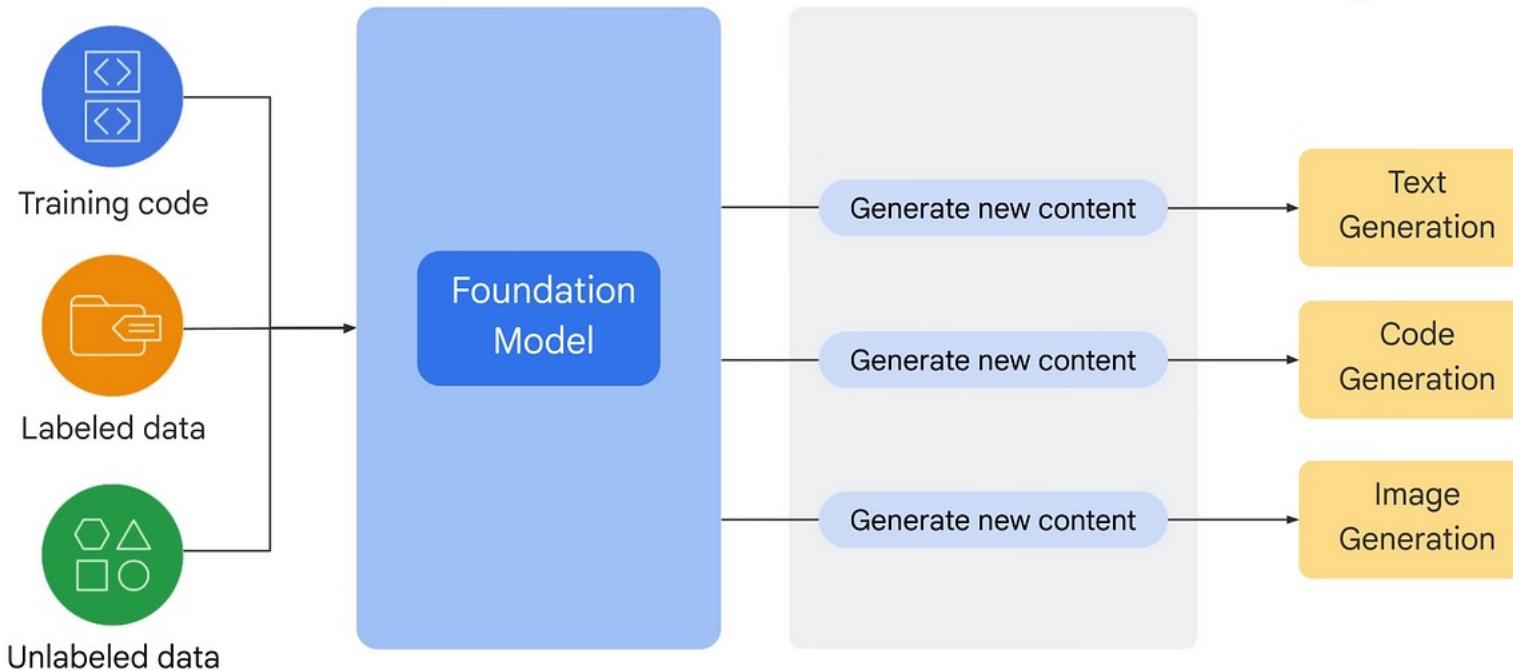
Traditional model development

High cost & slow deployment - Each service is trained disjointly



Foundation Models

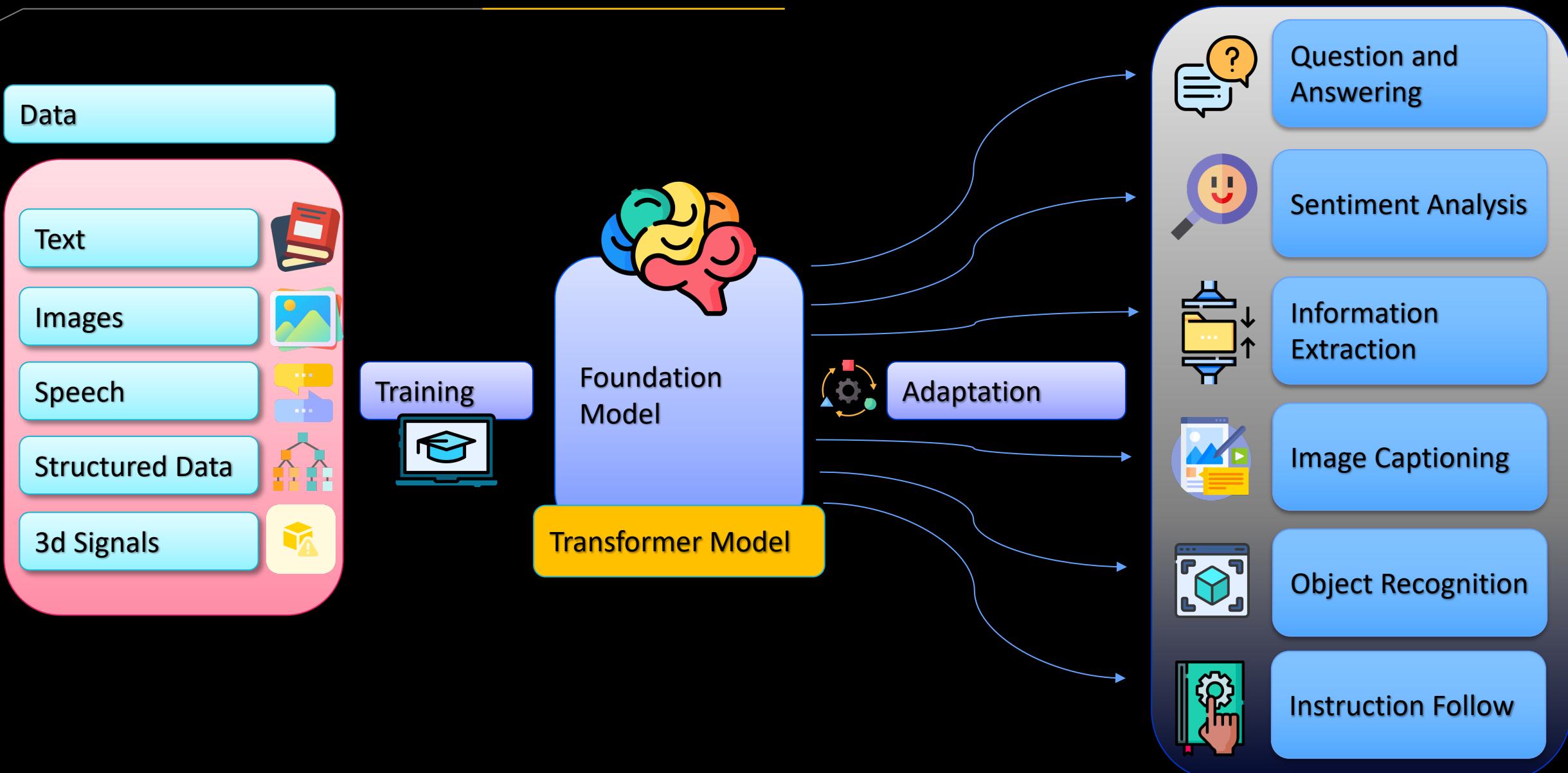
Gen AI Supervised, Semi-Supervised & Unsupervised Learning



Attention is all you need-> <https://arxiv.org/abs/1706.03762>



Foundation Models



[https://platform.openai.com/playground?
mode=complete](https://platform.openai.com/playground?mode=complete)

Prompt Engineering

Text Classification

Named Entity Recognition (Zero-Shot)

Extract the name and mailing address from this email:

Dear Kaylee,

It was great to talk to you at the seminar. I thought Jane's talk
was quite good.

Thank you for the book. Here's my address 2111 Ash Lane,
Boulder, CO 80301

Best,
Marilú

Name: Marilú

Mailing Address: 2111 Ash Lane, Boulder, CO 80301

Text Classification

Custom Named Entities (Few-Shot)

Extract job titles from the following sentences.

Sentence: Jane Doe has been working for Microsoft for 20 years as a Linux Engineer.

Job title: **Linux Engineer**

###

Sentence: Jane Doe has been working for Microsoft for 20 years and she loved it.

Job title: **none**

###

Sentence: Marc Simoncini | Director | Meetic

Job title: **Director**

###

Sentence: Damien is the CTO of Platform.sh, he was previously the CTO of Commerce Guys, a leading ecommerce provider.

Job title: **CTO**

Text Classification

Multi-Label Text Classification (Few-Shot)

The following is a list of movies and the **categories** they fall into:

Topgun: As students at the United States Navy's elite fighter weapons school compete to be best in the class, one daring young pilot learns a few things from a civilian instructor that are not taught in the classroom.

Category: **Drama, Action**

Hustle: A basketball scout discovers a phenomenal street ball player while in Spain and sees the prospect as his opportunity to get back into the NBA.

Category: **Comedy, Drama, Sport**

The Northman: From visionary director Robert Eggers comes The Northman, an action-filled epic that follows a young Viking prince on his quest to avenge his father's murder.

Category: **Action, Adventure, Drama**

Abstractive Summarization

Contact Center Summarization

Summarize this for a call center agent:

Agent: Thank you for calling ADM. Who am I am speaking to?

Customer: Hello, my name is Peter Smith. I own a small business and have some questions regarding payroll processing.

Agent: Good morning, Peter, before we get started may I ask you a few questions so that I better answer your questions today?

Customer: Thank you that is quite helpful. Are there specific regulations that I need to follow?

Agent: Certain aspects of payroll processing are regulated by the Internal Revenue Service (IRS) and the Department of Labor (DOL)

The agent is speaking to a customer named Peter Smith. Peter is asking for tips on manual payroll processing. The agent also informs Peter that certain aspects of payroll processing are regulated by the Internal Revenue Service (IRS) and the Department of Labor (DOL).

Business Examples

Text – to - Text

Generation, Summarization,
Extraction, Translation,
(Re)Search, Editing, Rewriting

Text – to – Image/Video

Image generation, Image
editing, Video generation and
editing, Game assets.

Text – to - Task

Software agents, Virtual
assistants, Automation

Text – to - Audio

Text-to-Speech, Audio
generation.

Education

The screenshot shows a digital education platform interface. On the left is a sidebar with icons for TA (Teaching Assistant), Modules (selected), New Chat, and Conversations. The main area displays a "Welcome to CSCI-128 2024 Spring!" message. A search bar at the top right says "Search lessons". Below is a vertical timeline of four weeks:

- Week 00: Intro** (2 LESSONS)
 - Slides - Introductions
 - Runestone Book
- Week 1: Variables & Operators** (4 LESSONS, 9 HOMEWORK)
 - Week 1: Variables & Operators
- Week 2: Types & Binary Representations** (7 LESSONS, 8 HOMEWORK)
 - Week 2: Types & Binary Representations
- Week 03: Branching, Algorithmic Thinking, & Basic Debugging** (6 LESSONS, 8 HOMEWORK)
 - Week 3: Branching, Algorithmic Thinking, & Basic Debugging

<https://www.aiedu.org/teach-ai>

Healthcare



Healthcare



Reimagining target assessment in drug discovery using generative AI

Drug discov

Target assess

Lead genera

Novel bioma
discovery

Protein fold
and desig



Use large language model (LLM) tools to quickly analyze vast amounts of scientific literature and databases



Identify relevant research related to potential drug targets



Significantly speed up the initial stages of target identification and validation

Law

Copilot

10:01 AM

How can I help you today?

Search options

Case Law Research

Summarize

Correct Grammar

Draft Email or Letter

Brainstorm Content

Emotional Support

Translate

Citation Check

Prompt Creator

Freeform Prompt

Feedback

Tech Support



Case Law Research

Research case law, brief cases, summarize and query them.



Summarize

Summarize text. Just copy and paste what you would like to summarize.



Grammar Check

Correct grammar. Just copy and paste what you would like to grammar check.



Draft Email or Letter

Draft email or letter. Guided drafting of emails or letters.



Brainstorm

Brainstorm content ideas with this guided prompt.



Emotional Support

Emotional support. Having a stressful day? Let's talk.



Translate

Translate. Copy and paste text to translate into multiple languages.



Citation Checker

Citation Checker. Check your legal citations using the Indigo Book.



Freeform Prompt

Freeform Prompt. Enter your freeform prompt into GPT-4 directly.



Prompt Creator

Prompt Creator. Assisted custom prompt creation tool.

Finance



Transportation



moralmachine

Software Engineering

Technical preview

Your AI pair programmer

The screenshot shows a dark-themed code editor interface. At the top, there's a tab bar with files: 'fetch_pic.js' (active), 'push_to_git.py', 'JS d3_scale.js', 'JS fetch_stock.js', and 'JS material_ui.js'. Below the tabs, a code editor displays the following JavaScript code:

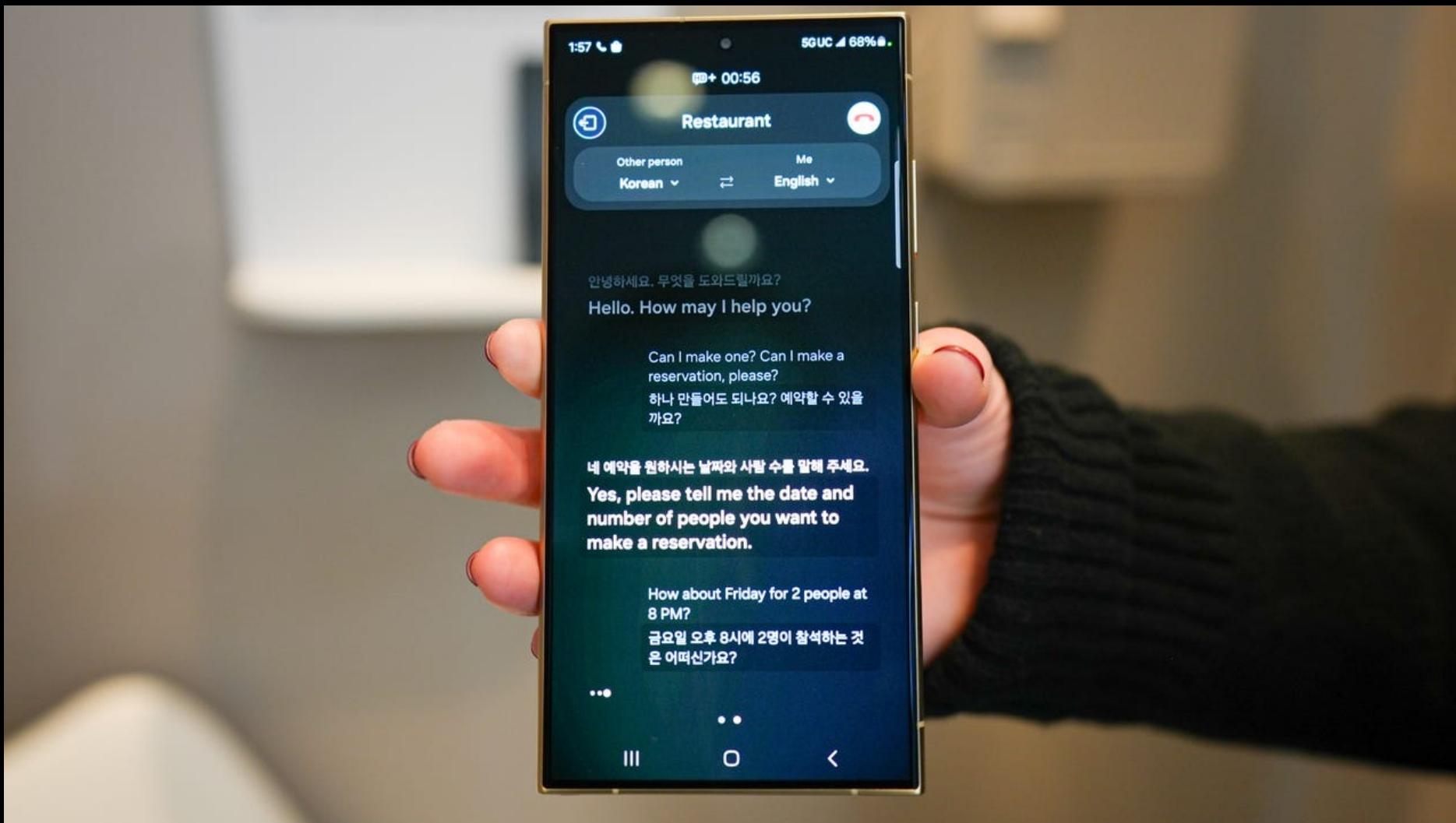
```
1 const fetchNASAPictureOfTheDay = () => {
2   return fetch('https://api.nasa.gov/planetary/apod?api_key=DEMO_KEY', {
3     method: 'GET',
4     headers: {
5       'Content-Type': 'application/json',
6     },
7   })
8     .then(response => response.json())
9     .then(json => {
10       return json;
11     });
12 }
```

A small 'Copilot' button is visible at the bottom left of the code editor. Below the code editor, the GitHub Copilot logo (a white icon with two people) and the text 'GitHub Copilot' are displayed.

Local AI
Ollama
LM Studio
Jan

Some interesting trends

Live Translate



<https://youtu.be/3hPoEmIBQdY?si=y0w6Qj9POCZnbc8w&t=51>

Rabbit.tech (LAM)



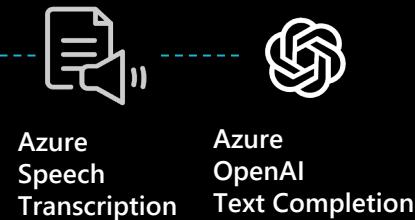
<https://www.youtube.com/watch?v=22wlLy7hKP4>

Media Example

News Analyses & Article Creations



News Broadcast (Global Warming)



Search
SEO
Virtual Agent
Analytics
Reporting
Knowledge Mining

Content Analysis

Topic Classification

Global warming, Deforestation,
Carbon footprint

Entity Extraction

Organizations: IPCC, UNFCCC, Green Peace
Geography: Canada, USA

Key Word Extraction

Human activities, fossil fuels,
earth atmosphere

Question and Answer

What is the Intergovernmental Panel on Climate Change (IPCC)?

The IPCC is an international organization that studies climate change and the effectiveness ...

Content Creation

Ideation
Productivity
Personalization
Accessibility
A/B Testing

Video summarization

The article discusses about global warming and its effects on the Earth's atmosphere, wildlife, and human communities. It states that the primary cause of global warming is

News article generation (or blogs, social media)

Global warming is the gradual increase in the overall temperature of the Earth's atmosphere, primarily caused ...

Script Generation

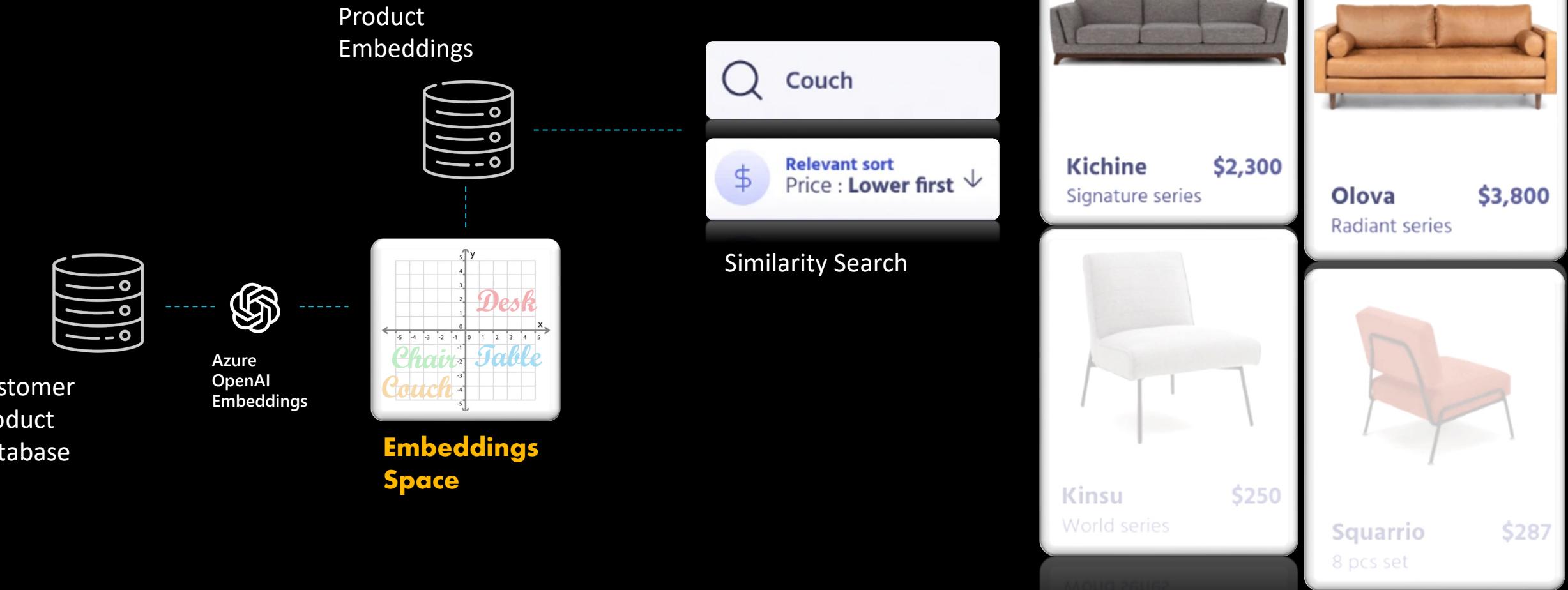
Act 1: The show opens with a shot of a beautiful coastal town
Act 2: As the town struggles to cope with the crisis ...

Personalized Content generation (or Advertising)

Simon, as someone passionate about global warming, you are aware of the urgent threat it poses to our planet ...

Retail Example

Similarity Search

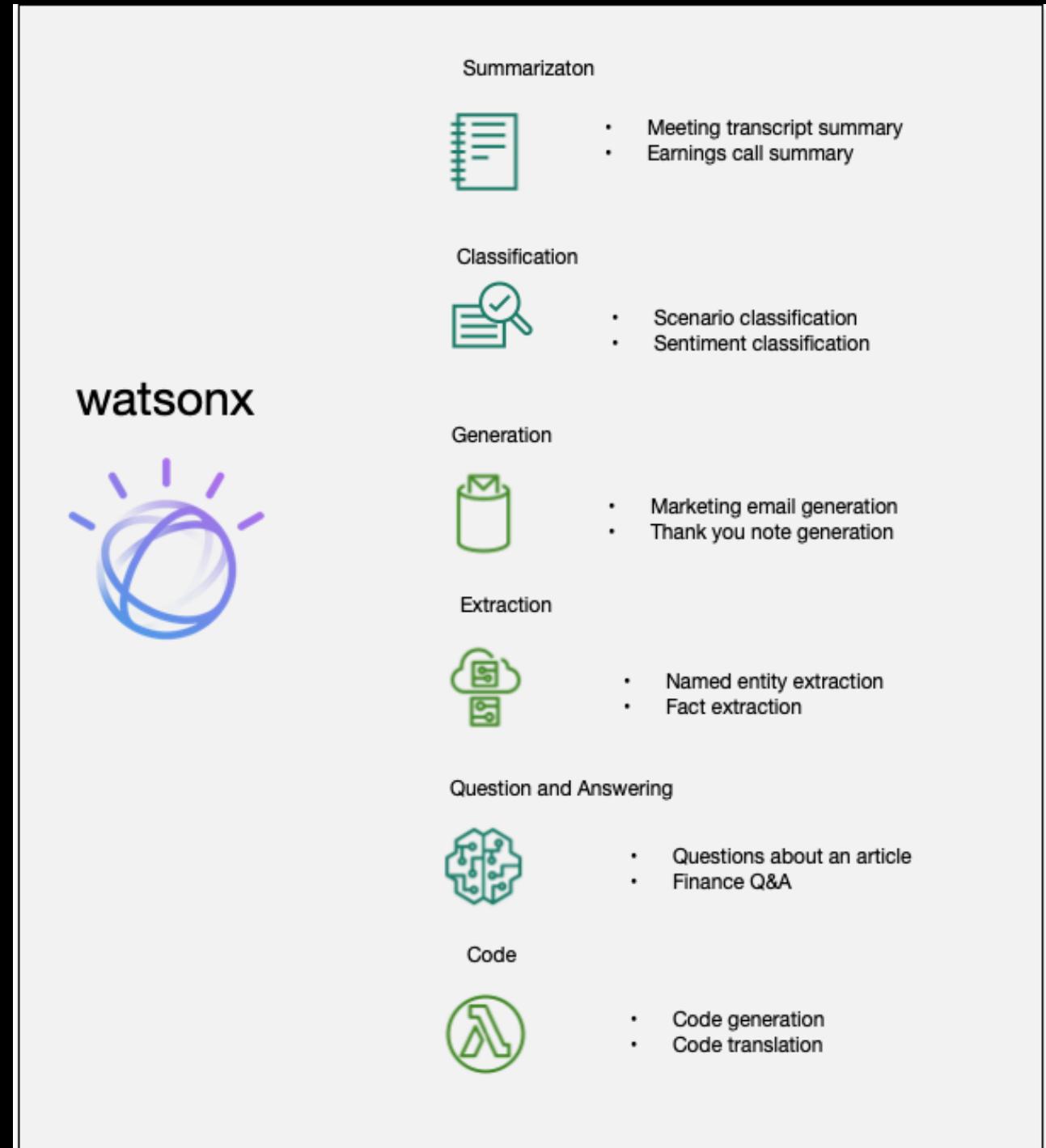
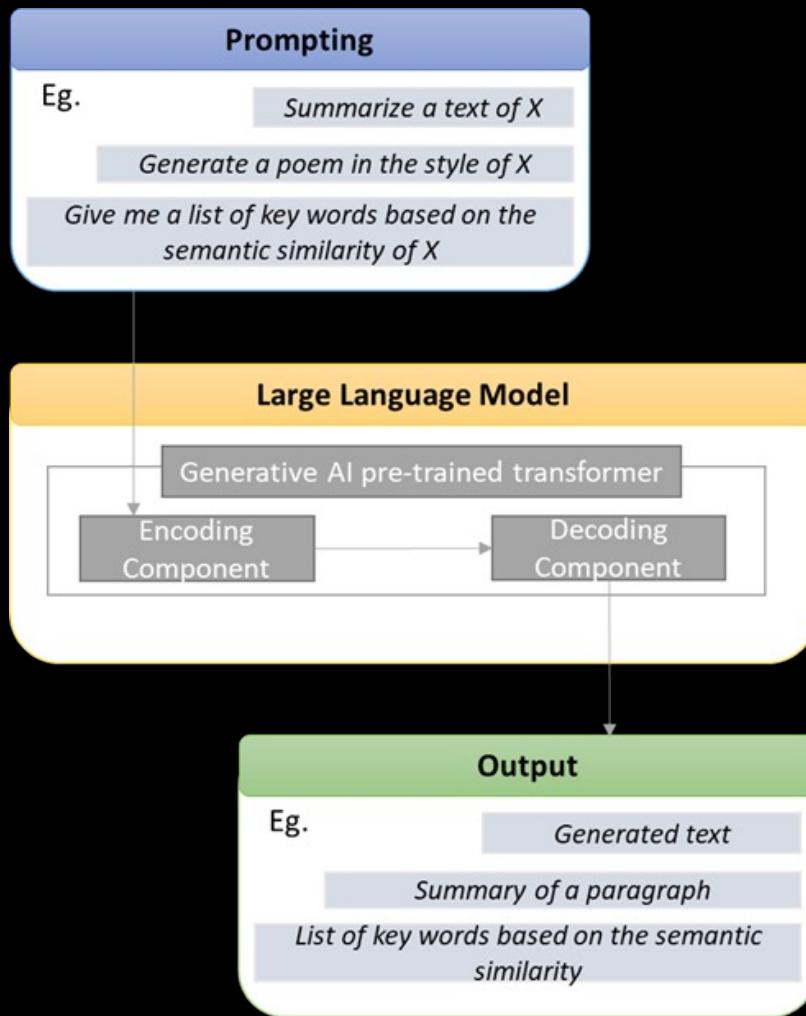


Lab exercise

IBM watsonx studio

<https://dataplatform.cloud.ibm.com/>

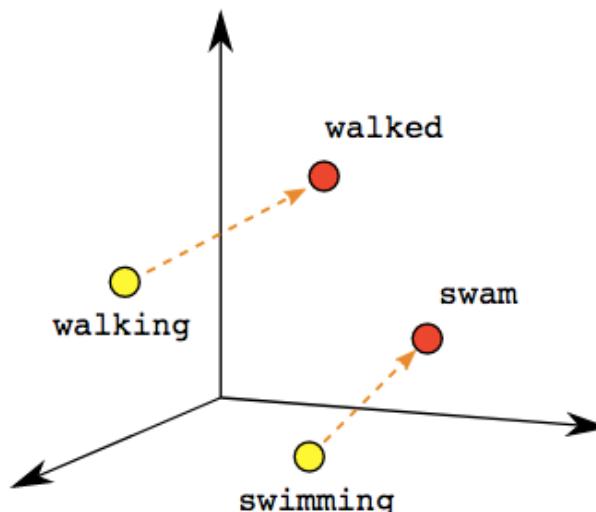
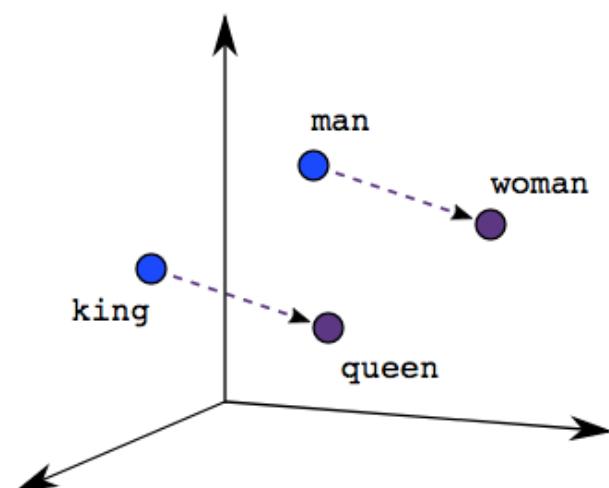
GenAI



Lab 2

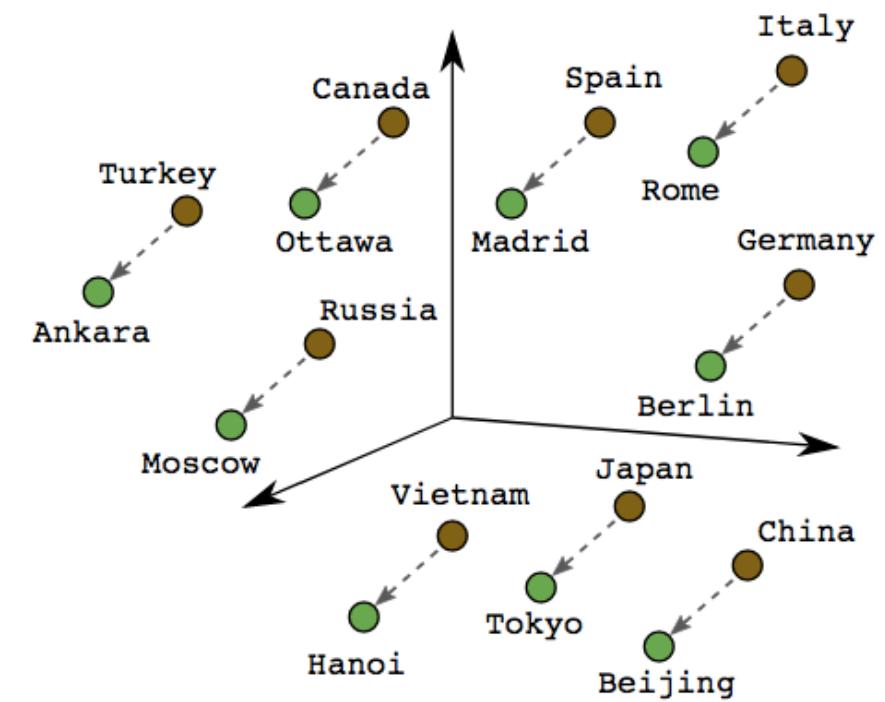
English – Code Translation

Lab Vector Search



Male-Female

Verb Tense



Country-Capital

Sports & Entertainment Example

Natural language to SQL to surface stats data (Fan Engagement)



Azure
OpenAI
Codex

"How many points did LeBron James score in 2023?"

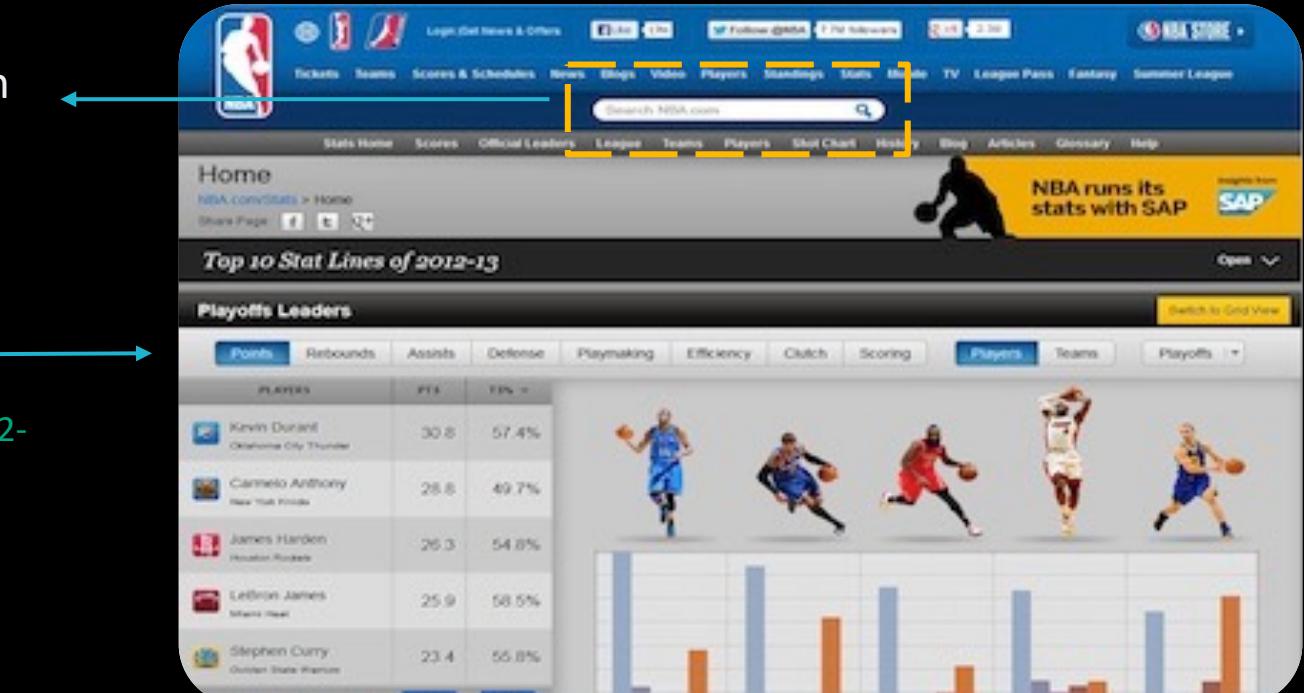
```
SELECT SUM(points) FROM basketball_stats WHERE player = 'LeBron James' AND game_date BETWEEN '2023-01-01' AND '2023-12-31';
```

basketball_stats (player, team, points, rebounds, assists, steals, blocks, turnovers, games_played)

("LeBron James", "Los Angeles Lakers", 25, 7, 10, 1, 0, 3, 82), ("Kevin Durant", "Phoenix Suns", 30, 7, 4, 1, 2, 3, 72)

basketball_games (home_team, away_team, home_score, away_score, game_date)

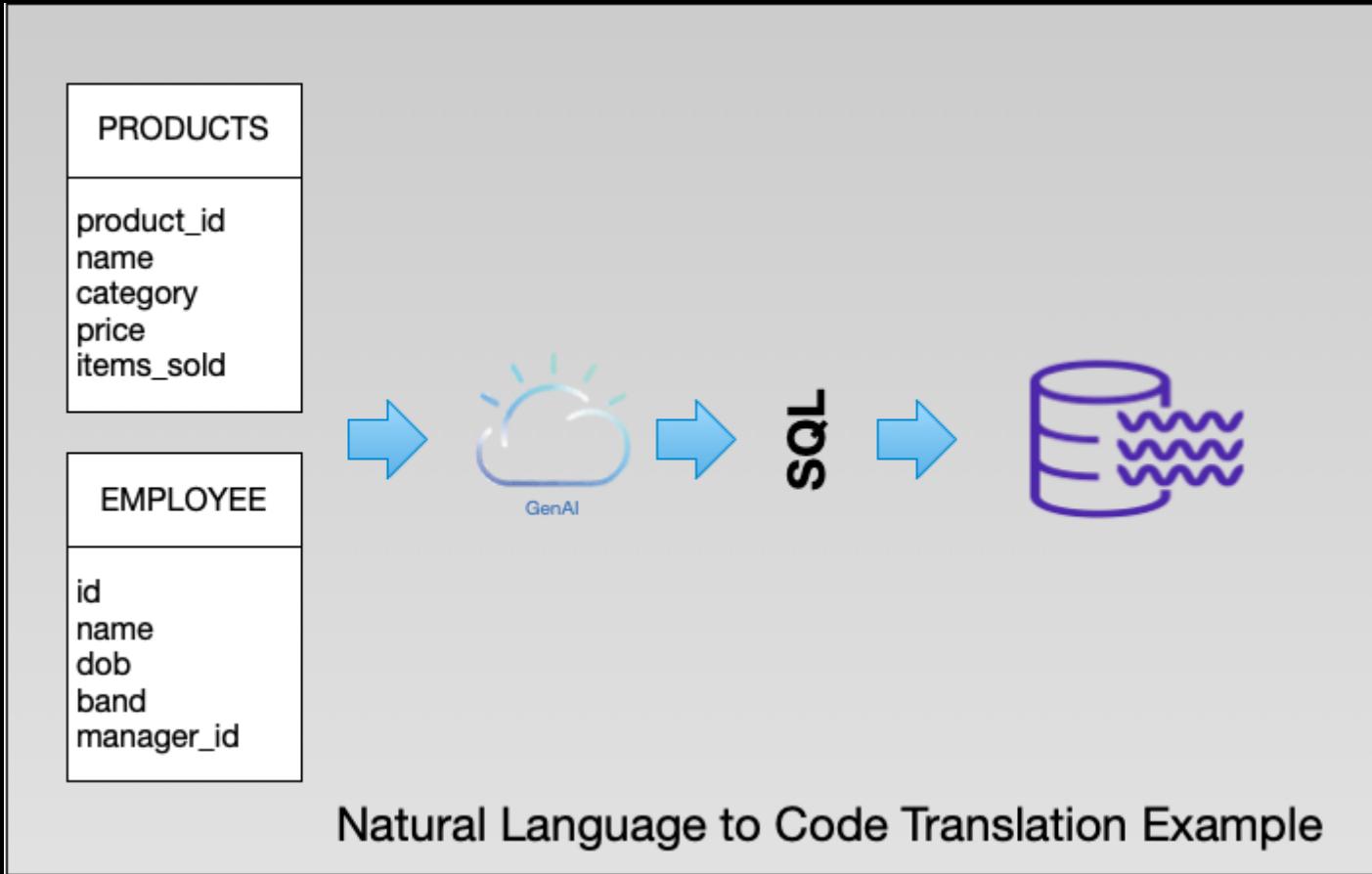
("Los Angeles Lakers", "Brooklyn Nets", 110, 105, '2023-12-01'), ("Milwaukee Bucks", "Golden State Warriors", 120, 115, '2023-12-02')



Query top five products based on the price and items sold

Query the count of employees in band L6 and with manager ID as 23079

Write SQL Query given the table name is {Table} and columns are {Columns} for the question : {question}.



Look ahead

AGI



The Evolution of AI

General AI
Revolutionary

Narrow AI
Emerging

Broad AI
Disruptive and
Pervasive

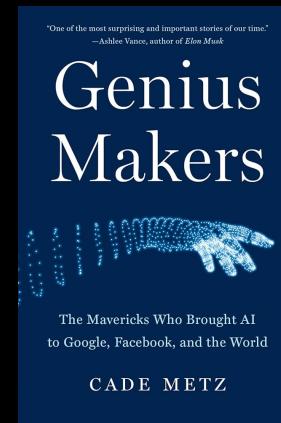
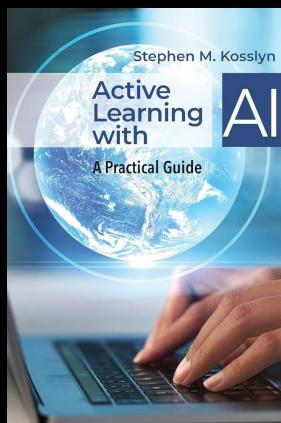
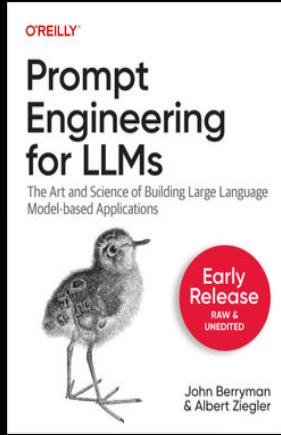
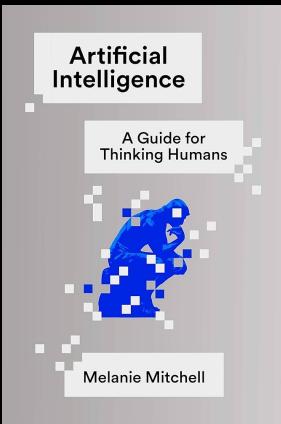
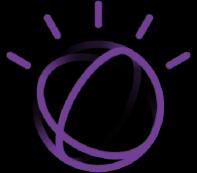
2050 and
beyond

▼ We are
here

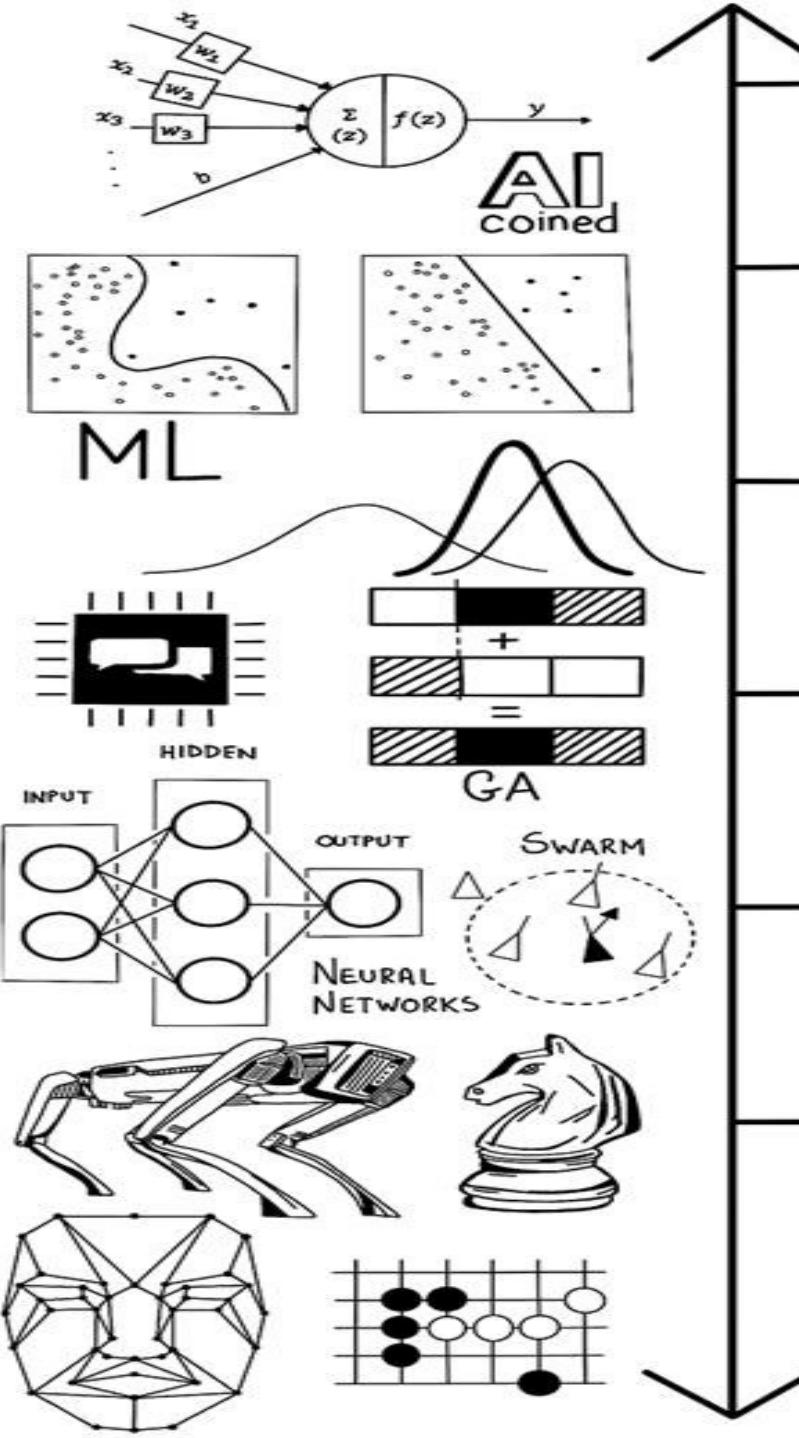
Q & A

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RECAP



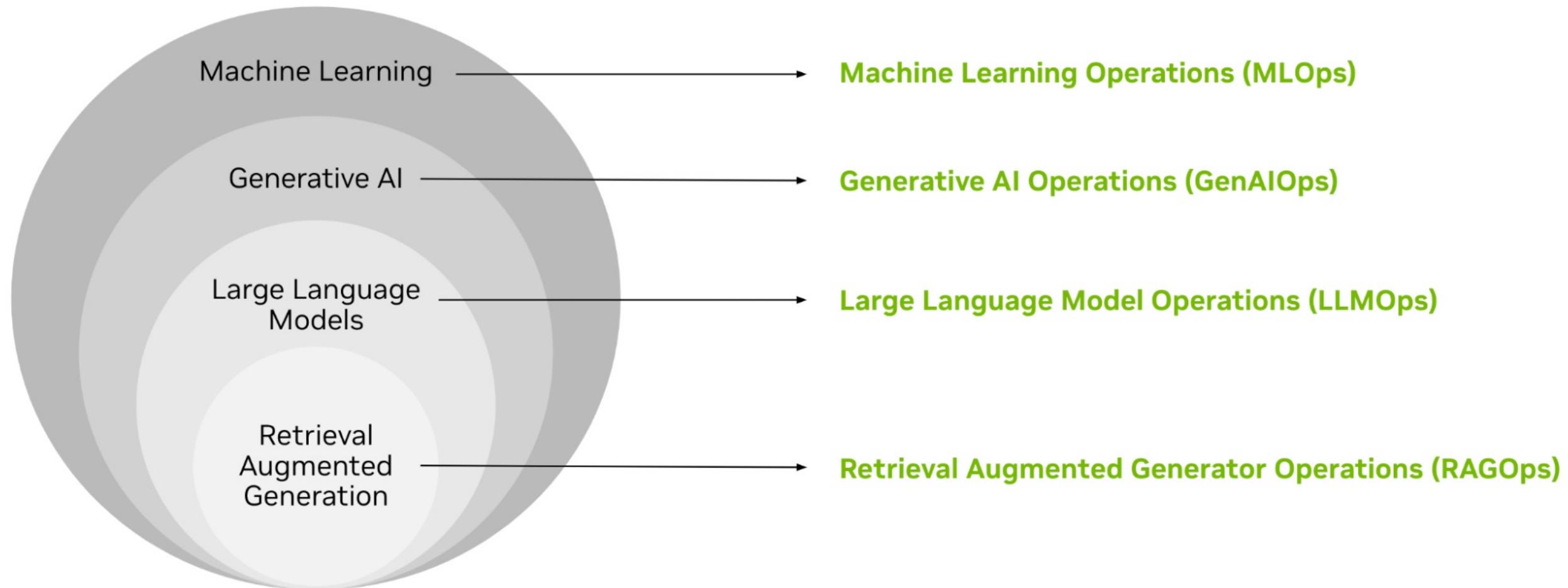
RECAP

Design for Artificial Intelligence

LLMOps

<http://github.com/iportilla/mlops>

Understanding GenAIOps, LLMOps, RAGOps



LLMOPS Essentials:

A Practical Guide to Operationalizing Large Language Models

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