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SABAIDEE

AI for Development in Lao PDR

Presented by UN-Habitat Lao PDR

Agenda

1. Welcome Address
2. Theoretical Foundations of Generative AI
3. Coffee Break
4. Generative AI for Urban Development
5. AI for Smart Cities
6. Q&A

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Welcome Address

Avi Sarkar

AI for Smart Urbanization

- Pragmatic Implementation of AI
- Cautious Optimism Towards AI
- AI as Part of a Larger Solution

Source: AI-Generated with DALLE-3

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Theoretical Foundations of Artificial Intelligence

Presented by Rhys Evans

Rhys Evans

- **BSc, Data Science and Artificial Intelligence**
  - Maastricht University, The Netherlands

- **MSc, Engineering and Policy Analysis**
  - Delft University of Technology, The Netherlands

linkedin.com/in/rhyswe/

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FOR A BETTER URBAN FUTURE

What is Data Science?

- Excel?
- Trend analysis?
- Graphs and charts?

Source: AI-Generated with DALLE-3

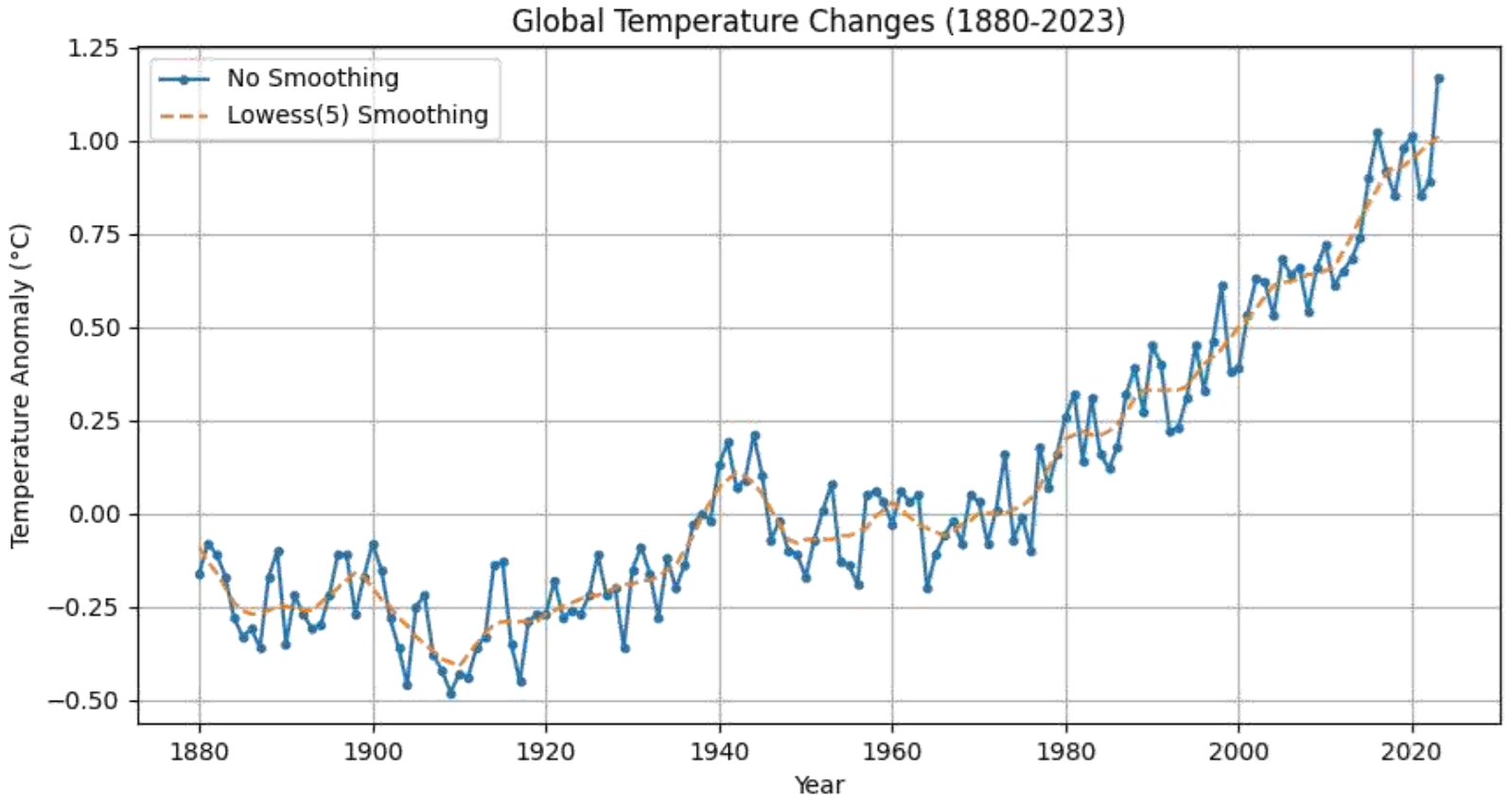
Data Science attempts to help us better understand the world

- Data Exploration & Discovery (**Exploratory Data Analysis**)
- Insightful Storytelling (**Statistical Analysis & Visualization**)
- Strategic Decision-Making (**Predictive Analytics**)

Data Exploration & Discovery (**Exploratory Data Analysis**)

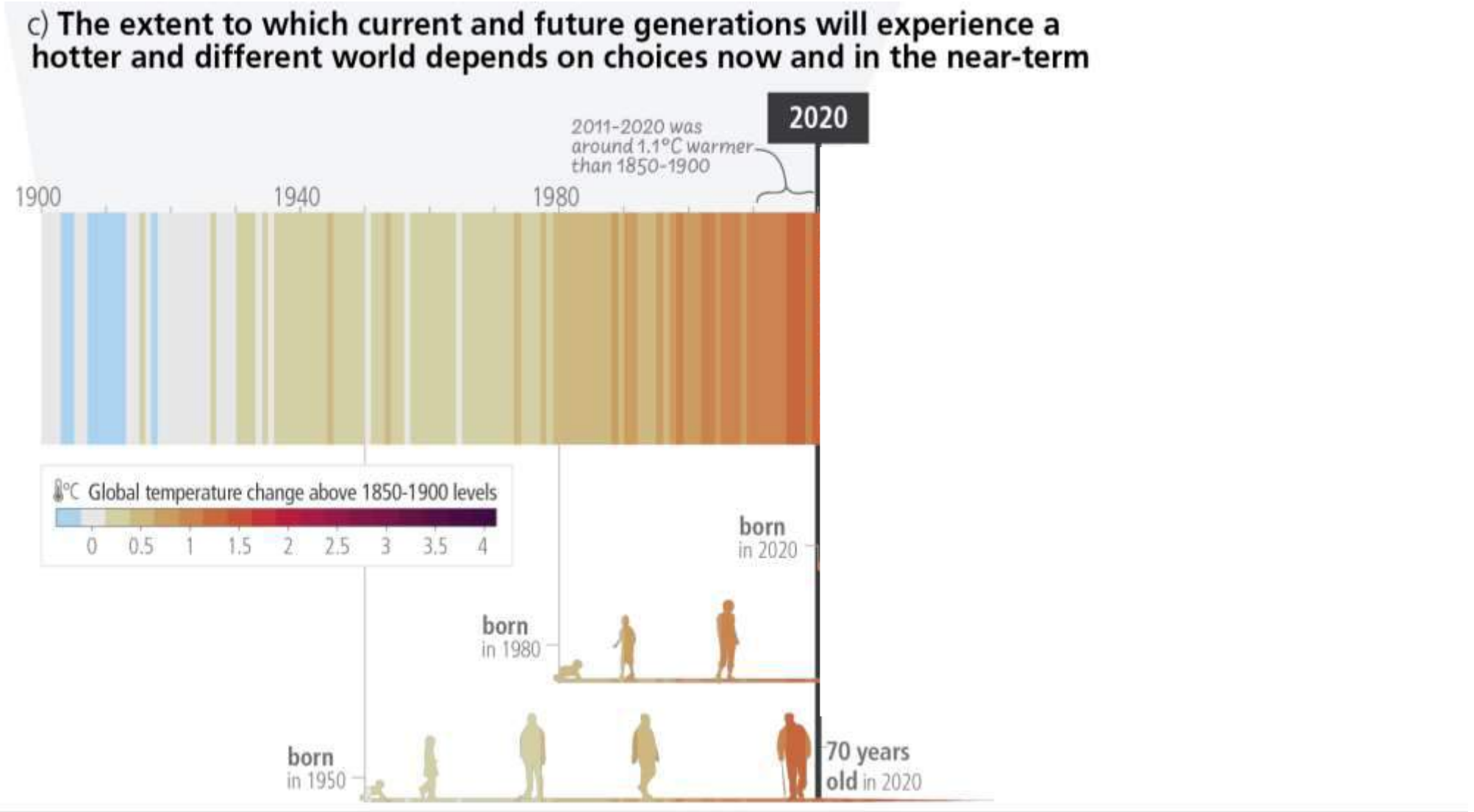
	Year	No_Smoothing	Lowess(5)
0	1880	-0.16	-0.09
1	1881	-0.08	-0.13
2	1882	-0.11	-0.16
3	1883	-0.17	-0.20
4	1884	-0.28	-0.24
...	...	...	...
139	2019	0.98	0.93
140	2020	1.01	0.95
141	2021	0.85	0.97
142	2022	0.89	0.99
143	2023	1.17	1.01

144 rows × 3 columns



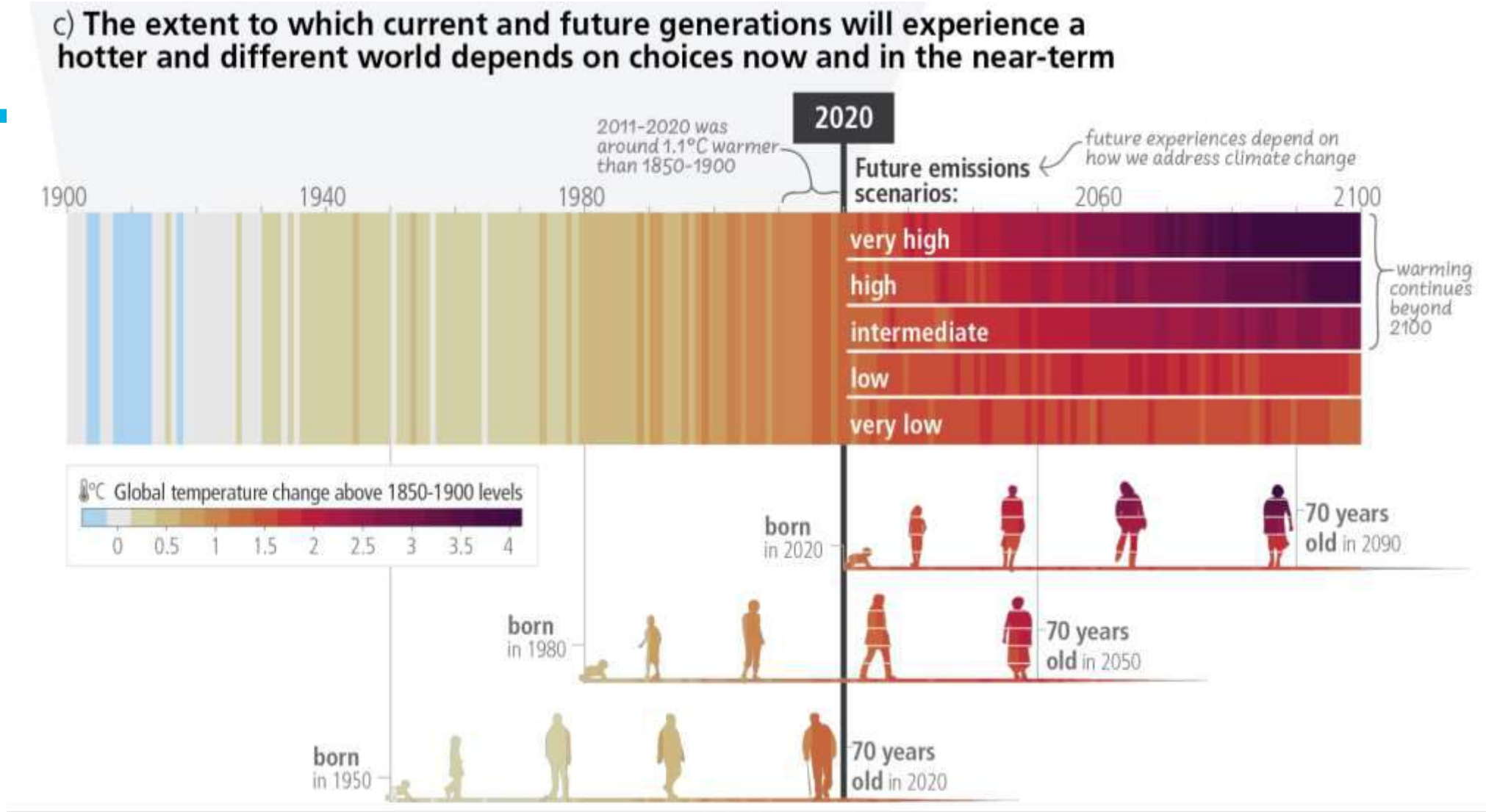
Source: Global Temperature Data from NASA
https://climate.nasa.gov/vital-signs/global-temperature/

Insightful Storytelling (**Statistical Analysis & Visualization**)



Source: Figure SPM.1, AR6 Synthesis Report: Climate Change 2023, Intergovernmental Panel on Climate Change https://www.ipcc.ch/report/ar6/syr/

Strategic Decision-Making **(Predictive Analytics)**



Source: Figure SPM.1, AR6 Synthesis Report: Climate Change 2023, Intergovernmental Panel on Climate Change https://www.ipcc.ch/report/ar6/syr/

What is AI?

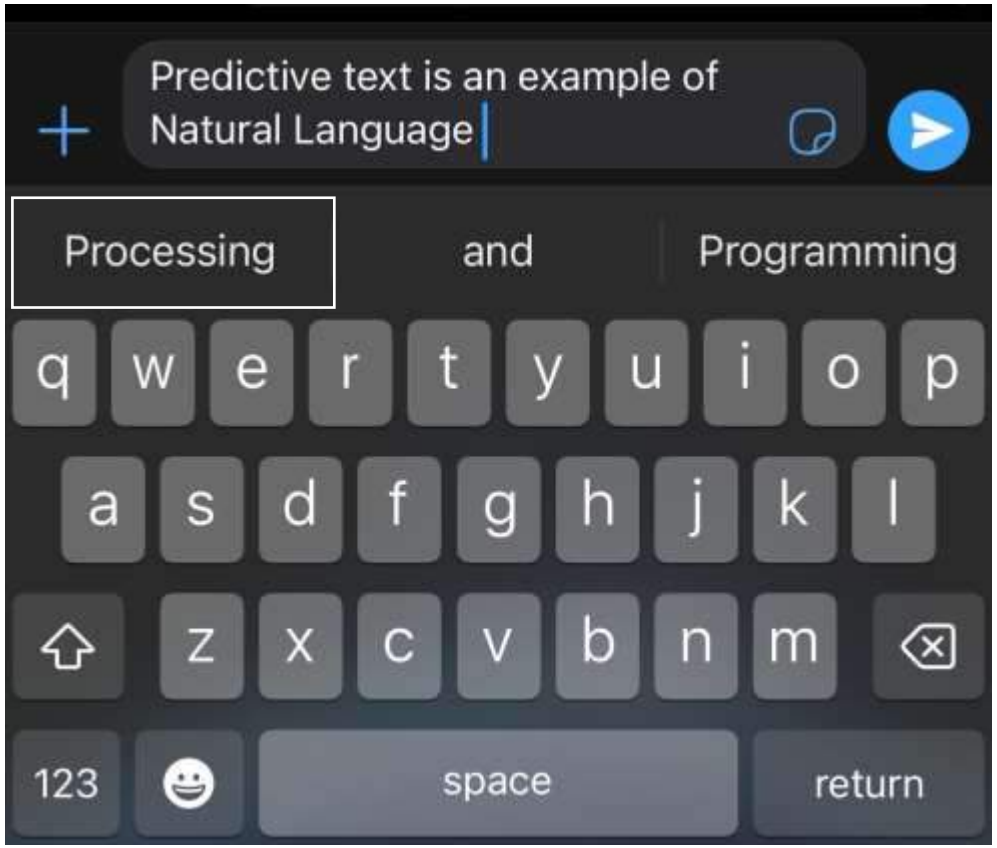
- Data Science?
- Computer Science?
- The Matrix?

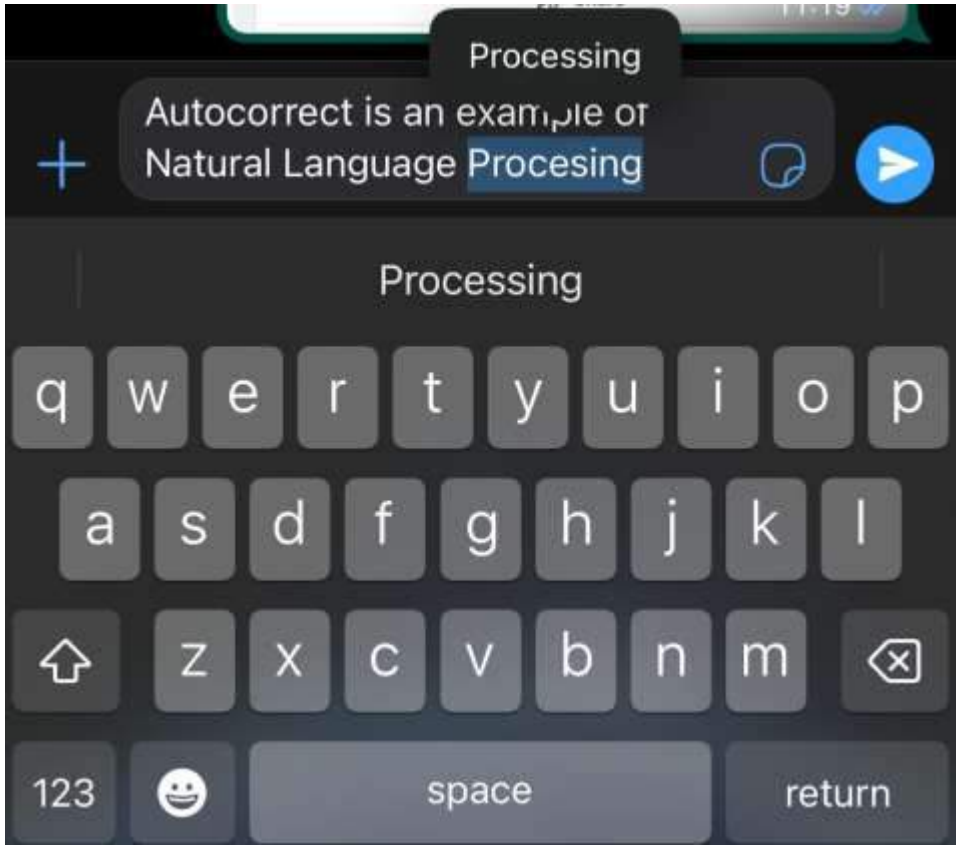
Source: AI-Generated with DALLE-3

AI attempts to mimic human intelligence

- Understanding Language (**Natural Language Processing**)
- Recognizing Objects (**Computer Vision**)
- Learning from Experience (**Machine Learning**)

Understanding Language (**Natural Language Processing**)





Source: UN-Habitat

Recognizing Objects **(Computer Vision)**

Source: Xylobot: How a closed-loop system plays an instrument; E. Demeur, R. Dijkstra, R. Evans, K. Hokstam, V. Maican, B. Rodrigues de Miranda, C. Teeuwen; https://github.com/hkstm/xylobot

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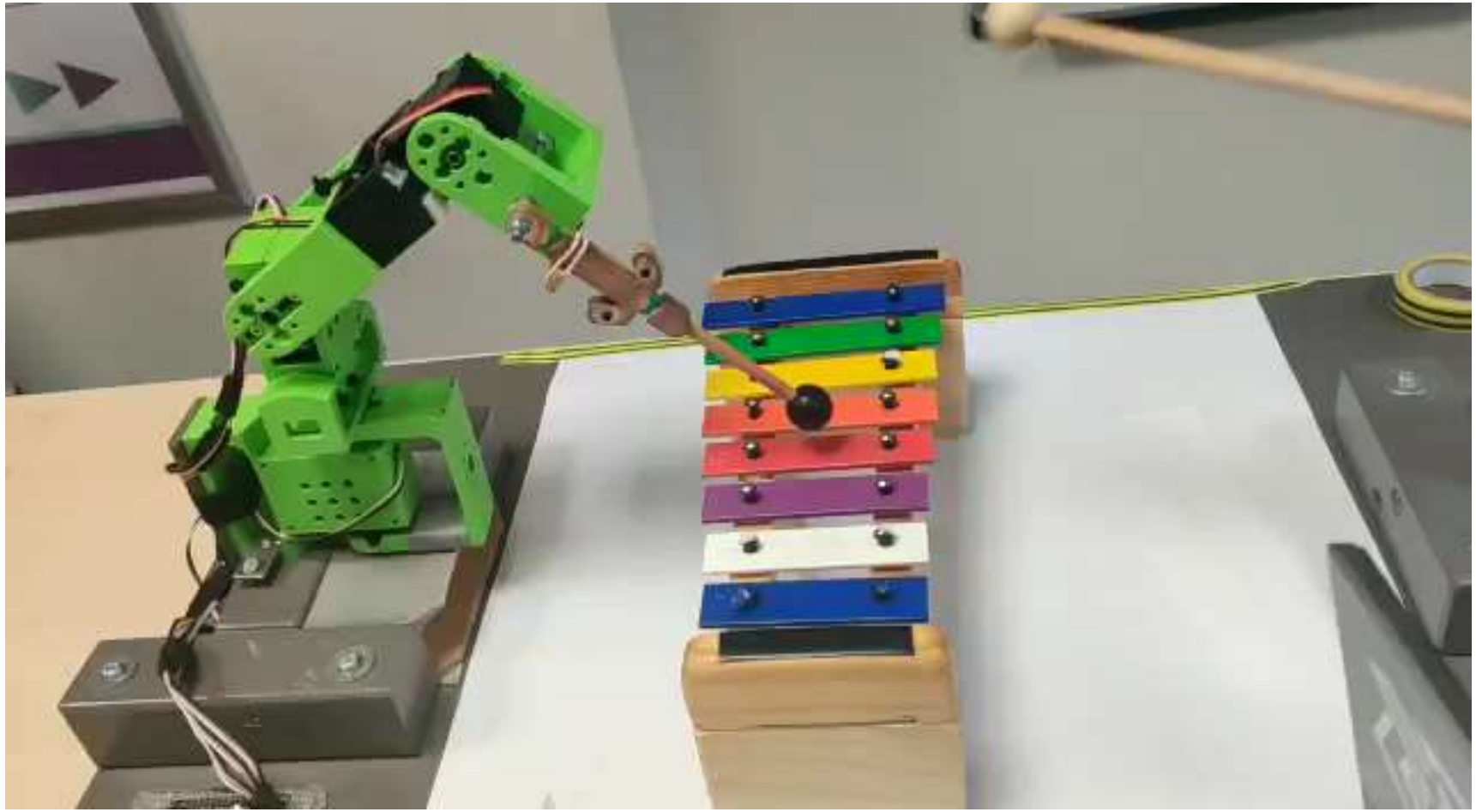

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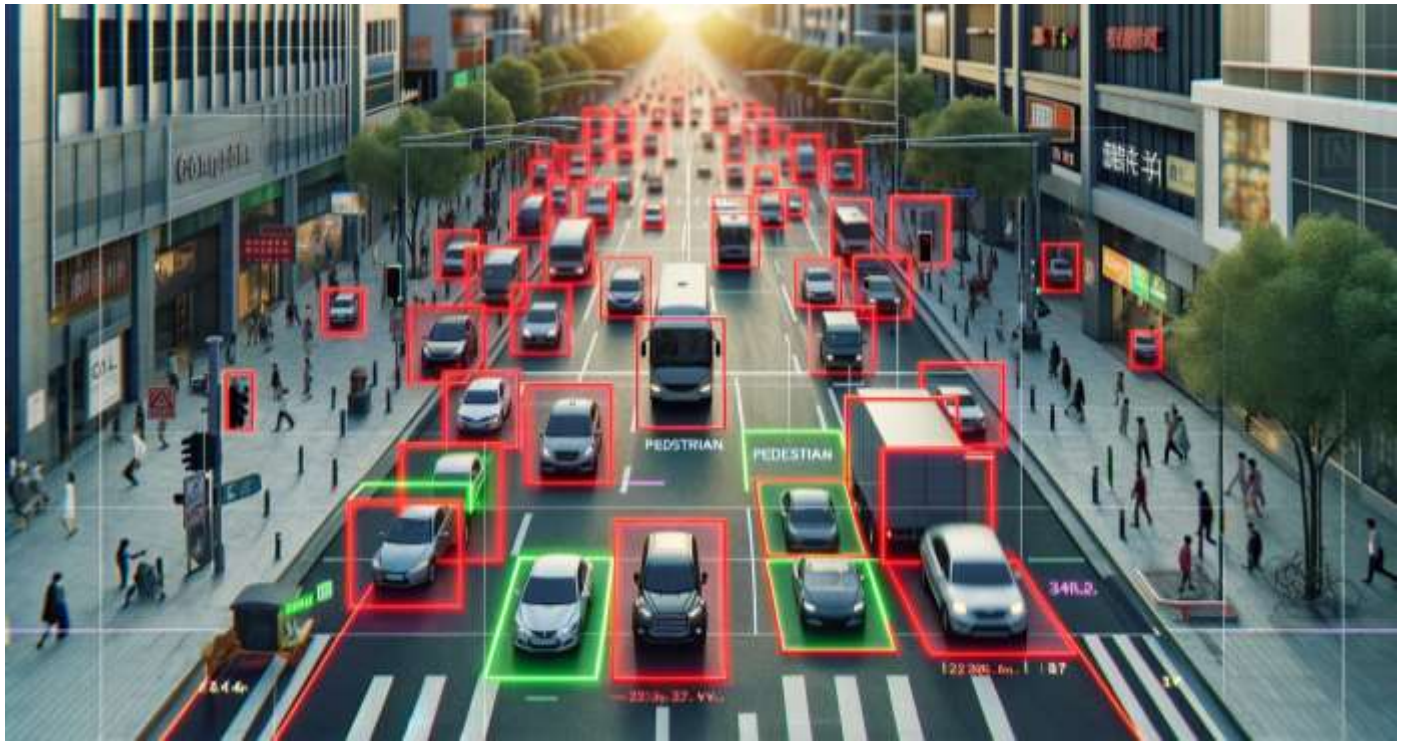
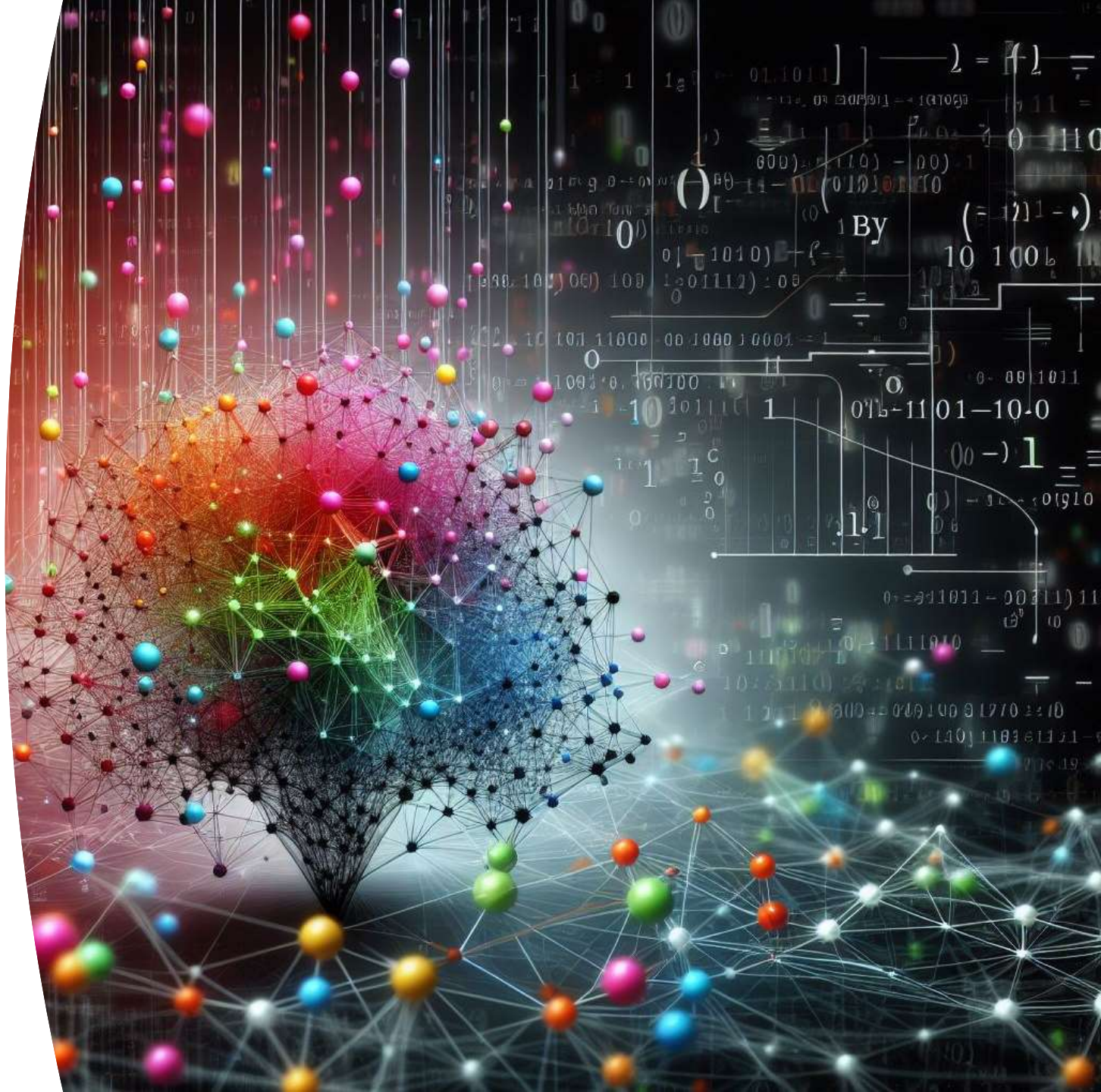


Source: AI-Generated with DALLE-3

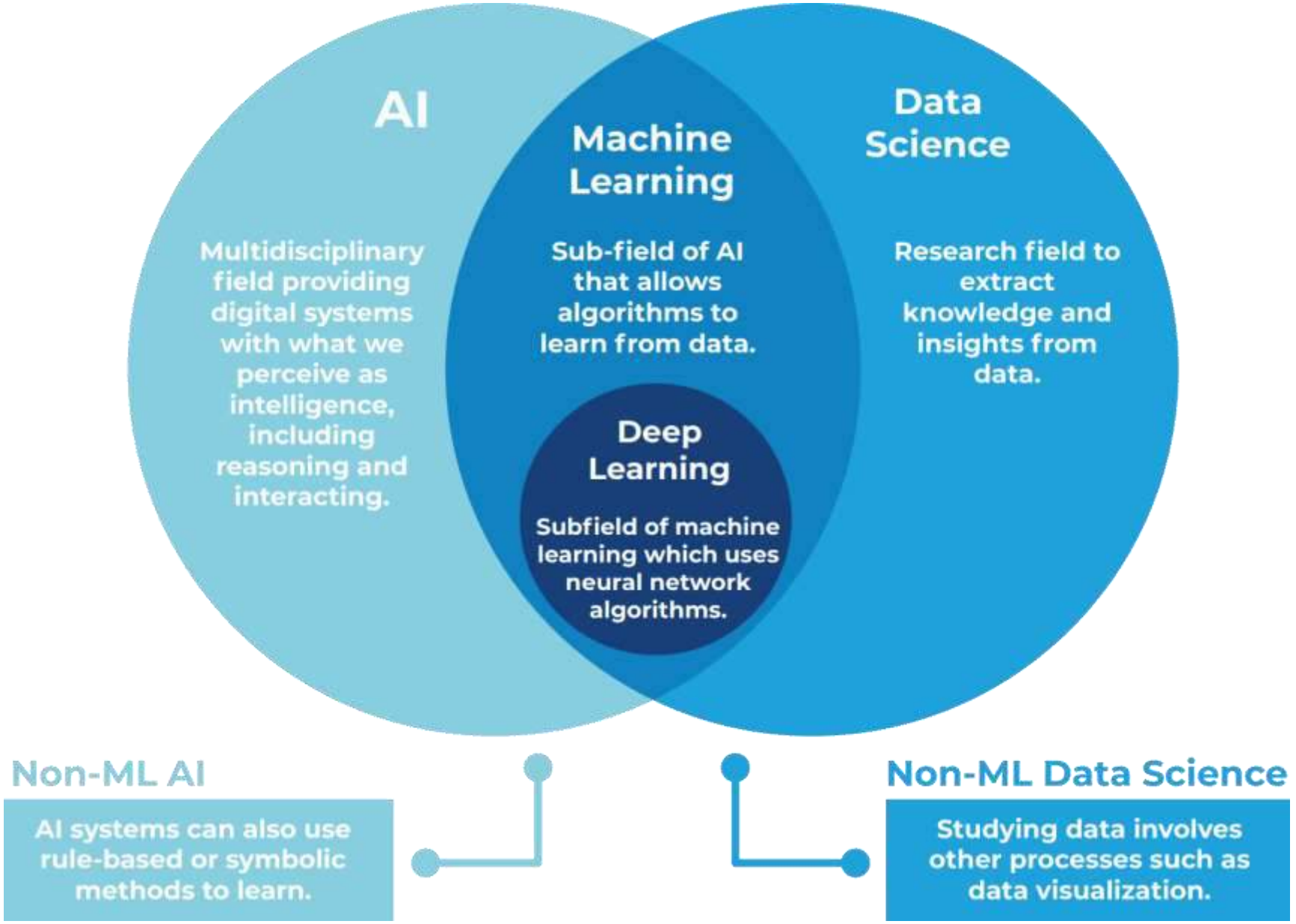
What is Machine Learning (ML)?

- Computer Science?
- Data Science?
- Robots?



Source: AI-Generated with DALLE-3

Machine Learning is the intersection of Data Science and Artificial Intelligence



Source: UNICRI AI Toolbox

Examples of Machine Learning

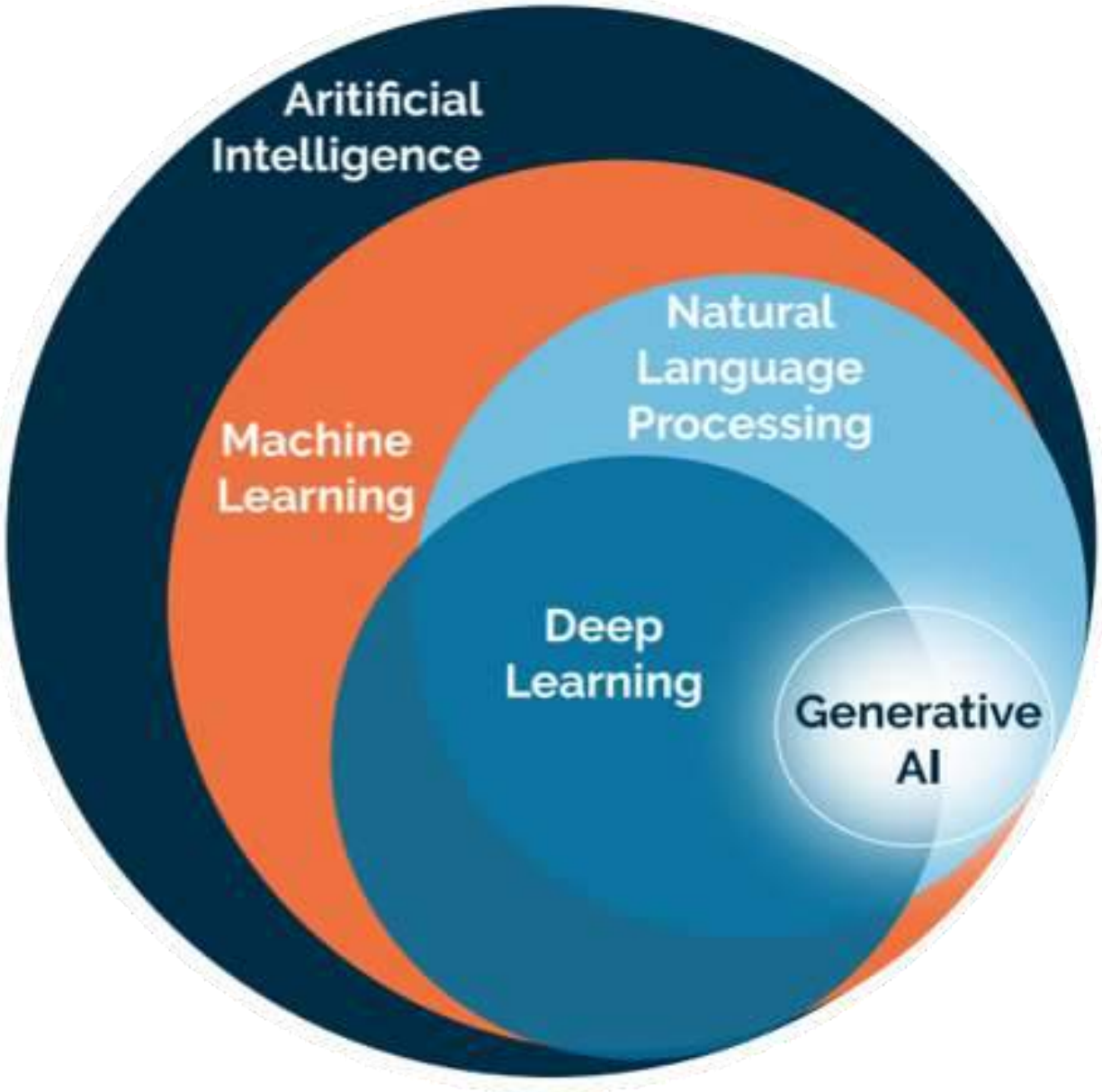
- Recommendation Systems
- Fraud Detection
- Predictive Maintenance

What about ChatGPT?

- ChatGPT uses **Generative AI** to produce output based on user input

Source: AI-Generated with DALLE-3

Generative AI is a subfield of artificial intelligence (AI) and machine learning (ML)



Source: UNOICT Generative AI Primer

What is Generative AI?

- Generative AI models are based on deep learning algorithms that learn to **recognize patterns** and relationships from vast amounts of input data, which then **generate new outputs** that are similar in style and structure to the data they were trained on.

- The ability of these models to self-formulate new and varied outputs represents a paradigm shift in the field of AI because they are **not explicitly programmed** to follow pre-determined rules, or generate specific outputs, like other AI systems.

Source: UNOICT
Generative AI Primer

What actually is ChatGPT?

- ChatGPT is a **Large Language Model (LLM)**
- Based on **Neural Network** architecture, specifically a Transformer architecture
- “**G**enerative **P**re-trained **T**ransformer”, hence Chat**GPT**

What is a Large Language Model (LLM)?

- A statistical AI model that is trained on massive amounts of text data
- Predicts the probability of words appearing to produce human-like text
- LLMs are based on **neural network** architectures

Source: AI-Generated with DALLE-3

Currently Notable LLMs

- OpenAI's GPT series of models
  - GPT-3.5 and GPT-4, which are used in **ChatGPT** and **Microsoft Copilot**
- Google’s Gemini and PaLM
- Mistral AI's open source models
- Meta's LLaMA family of open-source models
- Anthropic's Claude models

Source: Logos from their respective companies

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https://chat.openai.com/

https://copilot.microsoft.com/

- Google’s Gemini and PaLM

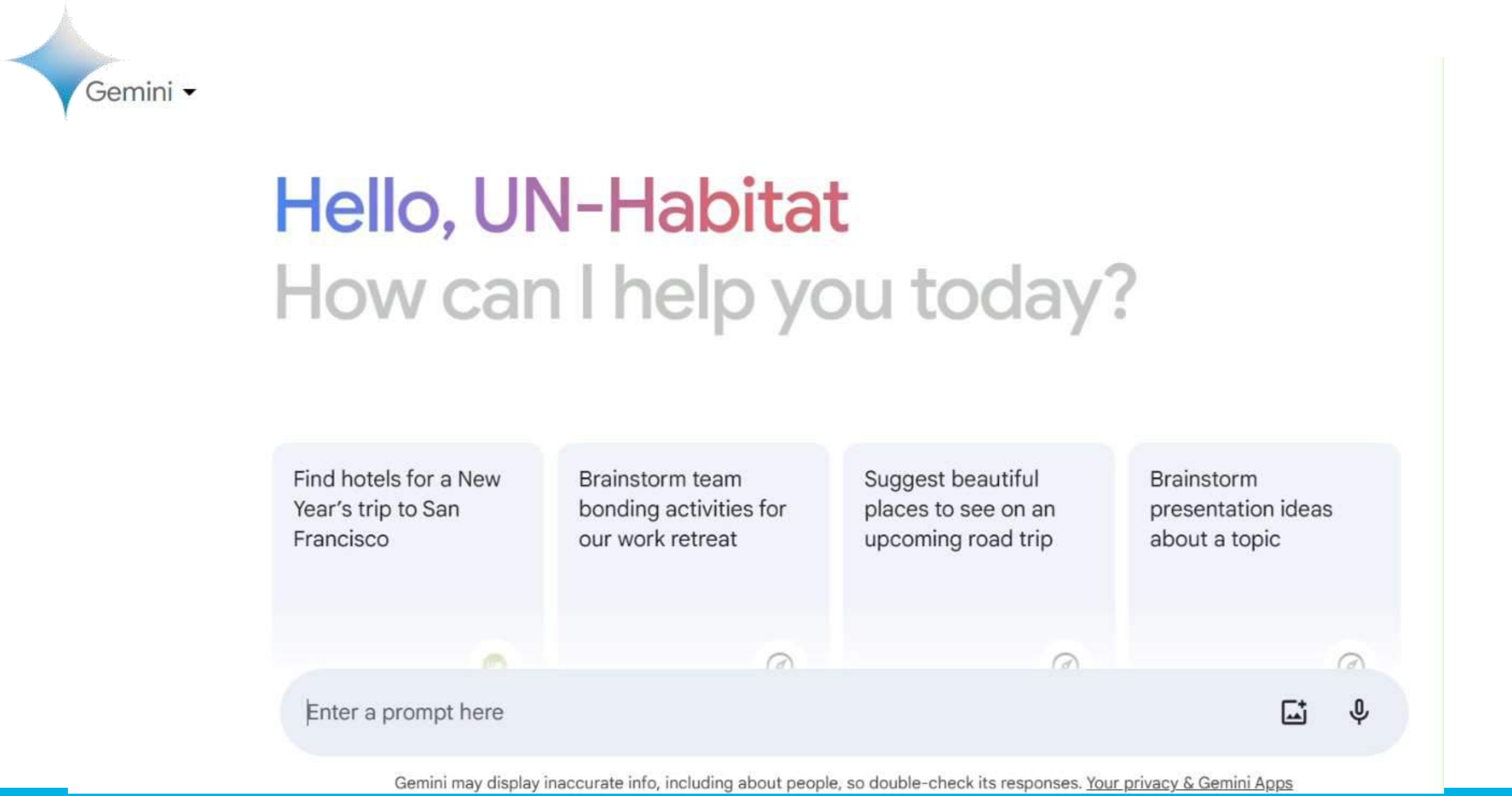
https://gemini.google.com/

- Mistral AI's open source models

https://chat.mistral.ai/

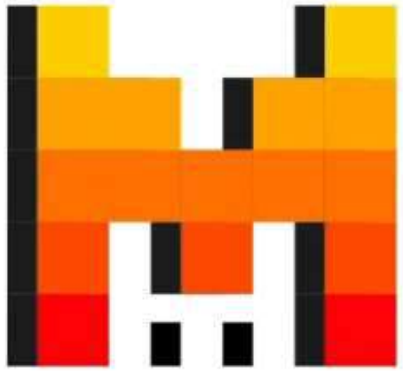
- ~~Meta's LLaMA family of open-source models~~

- ~~Anthropic's Claude models~~



Source: ChatGPT, OpenAI

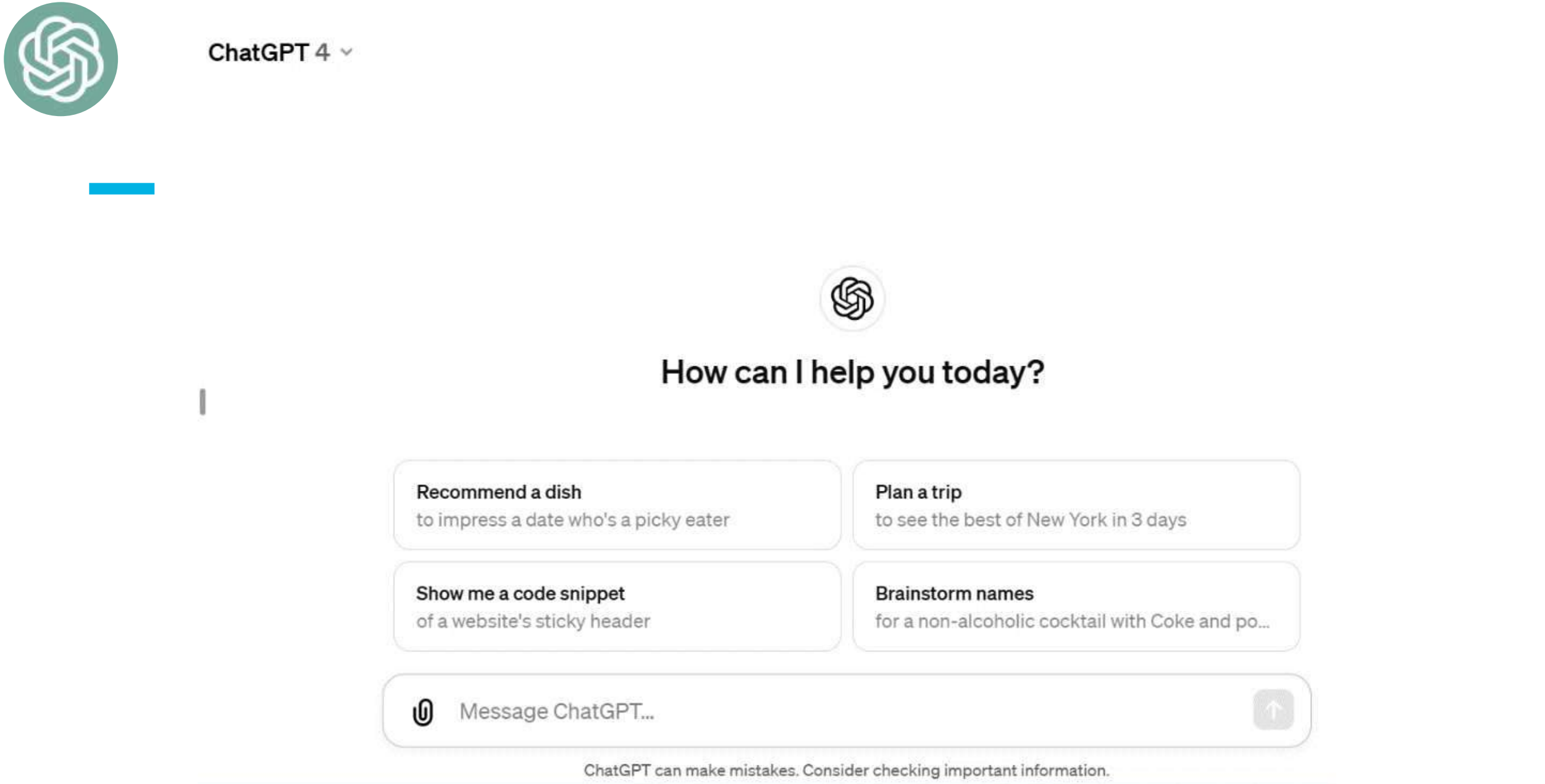
Large



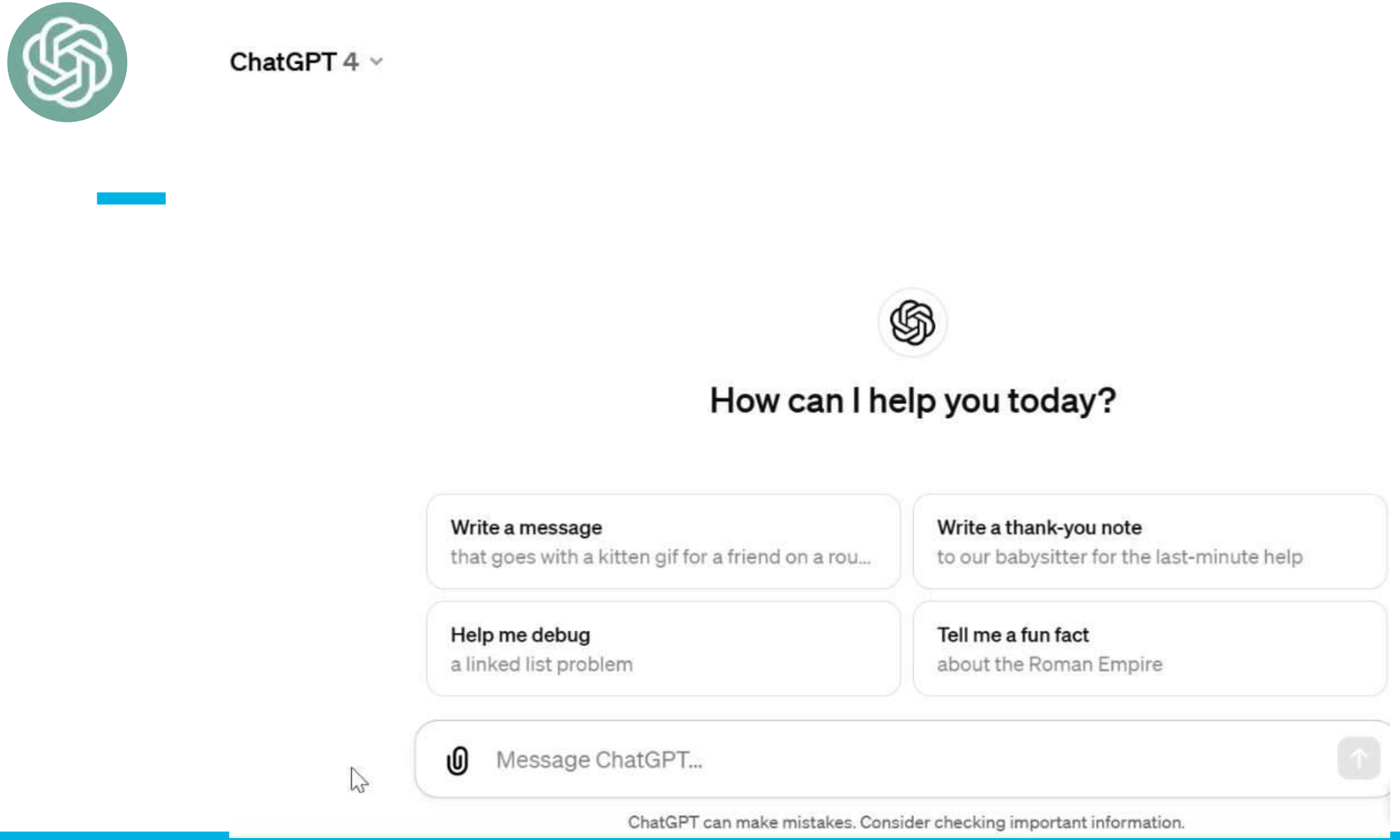
Ask anything!

This is a beta version. Responses may contain inaccuracies.

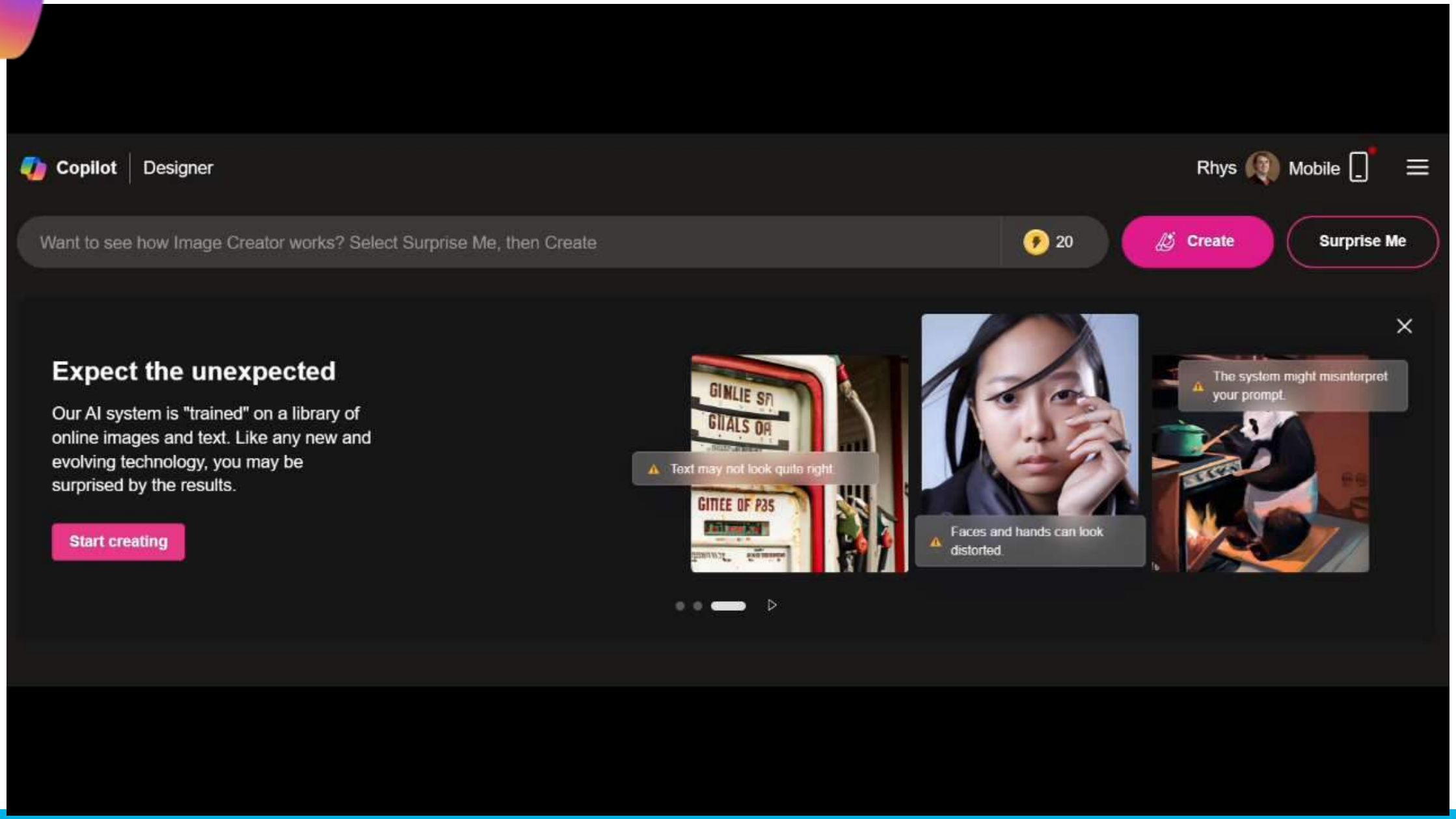
Source: ChatGPT, OpenAI



 Source: ChatGPT, OpenAI



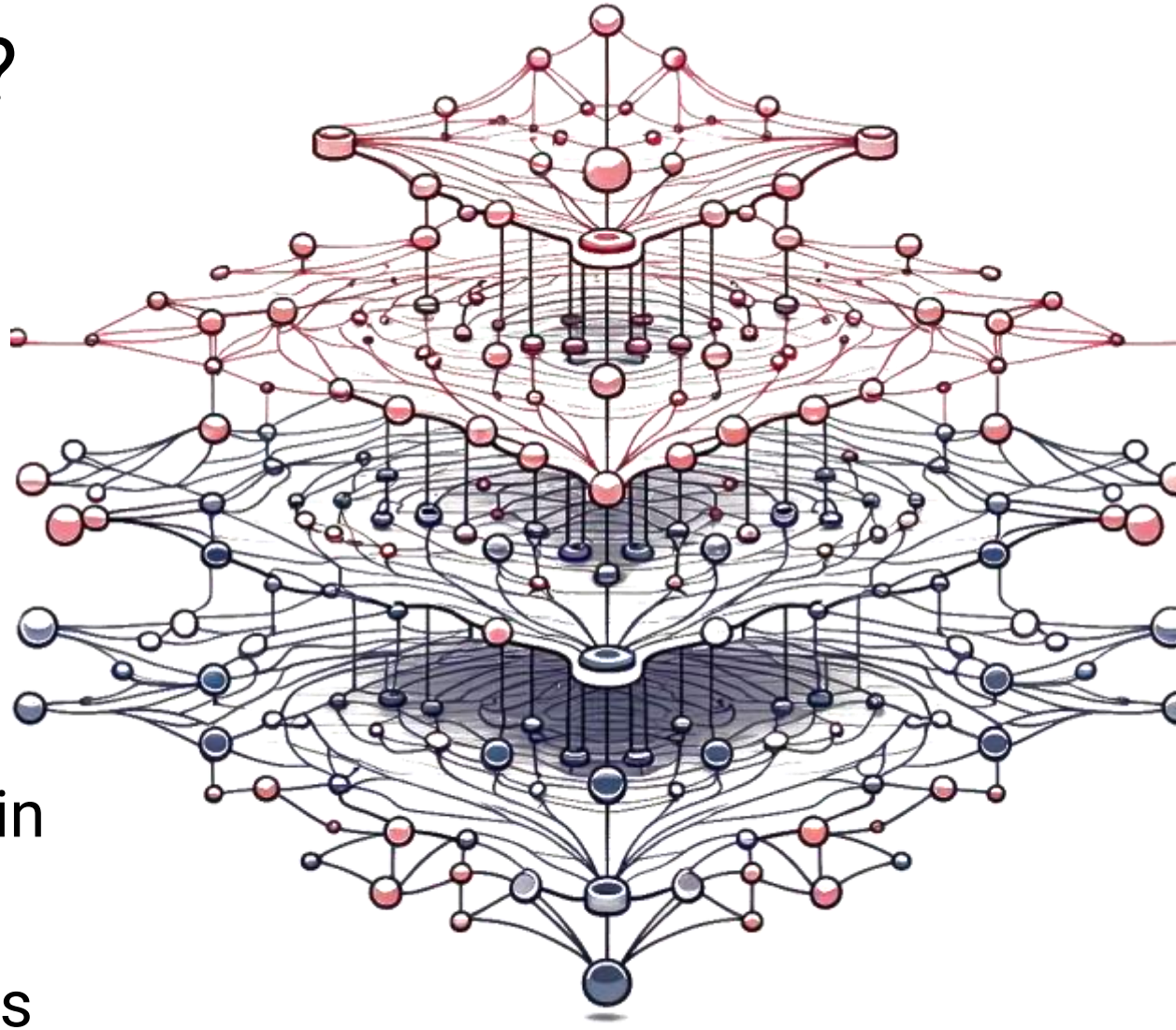
 Source: ChatGPT, OpenAI



Source: ChatGPT, OpenAI

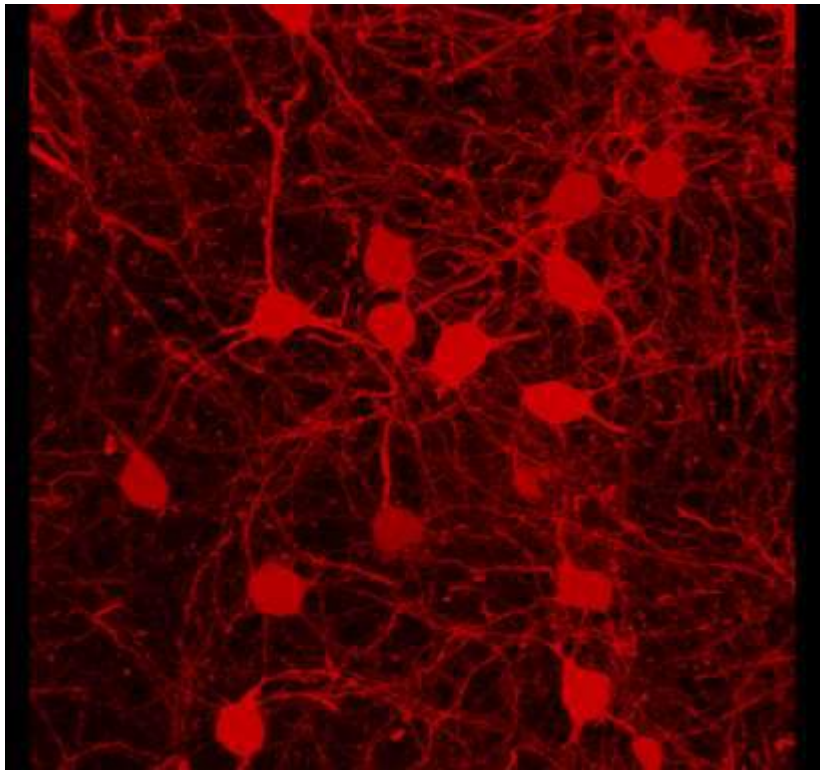
What is a Neural Network?

- An artificial neural network is a mathematical model used to approximate nonlinear functions
- Made of connected units or nodes called artificial neurons, which loosely model the neurons in a brain
- LLMs are based on neural networks

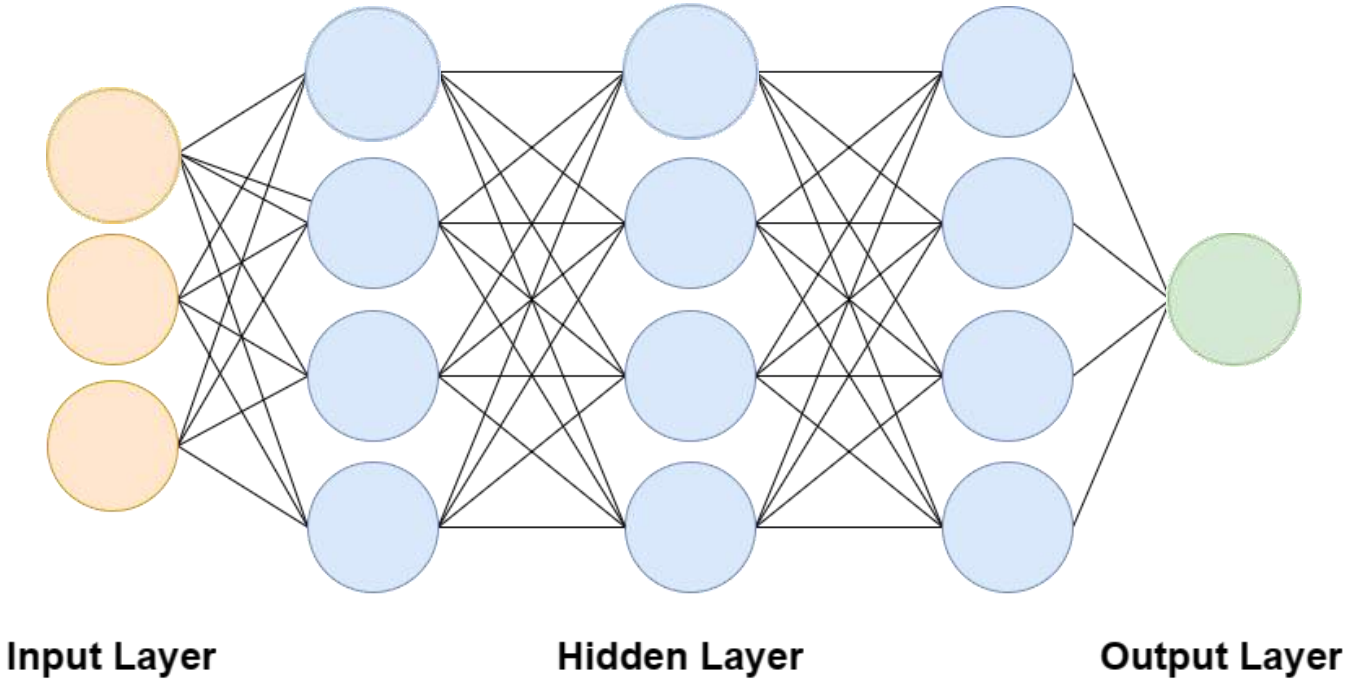


Source: Image AI-Generated with DALLE-3

What is a Neural Network?



A biological neural network (BNN) in a mouse's brain



An artificial neutral network (ANN) diagram

BNN: Wikipedia, ANN: UN-Habitat

How does a Neural Network work?

1. **Input:** The network receives data (like a sentence) at the input layer.

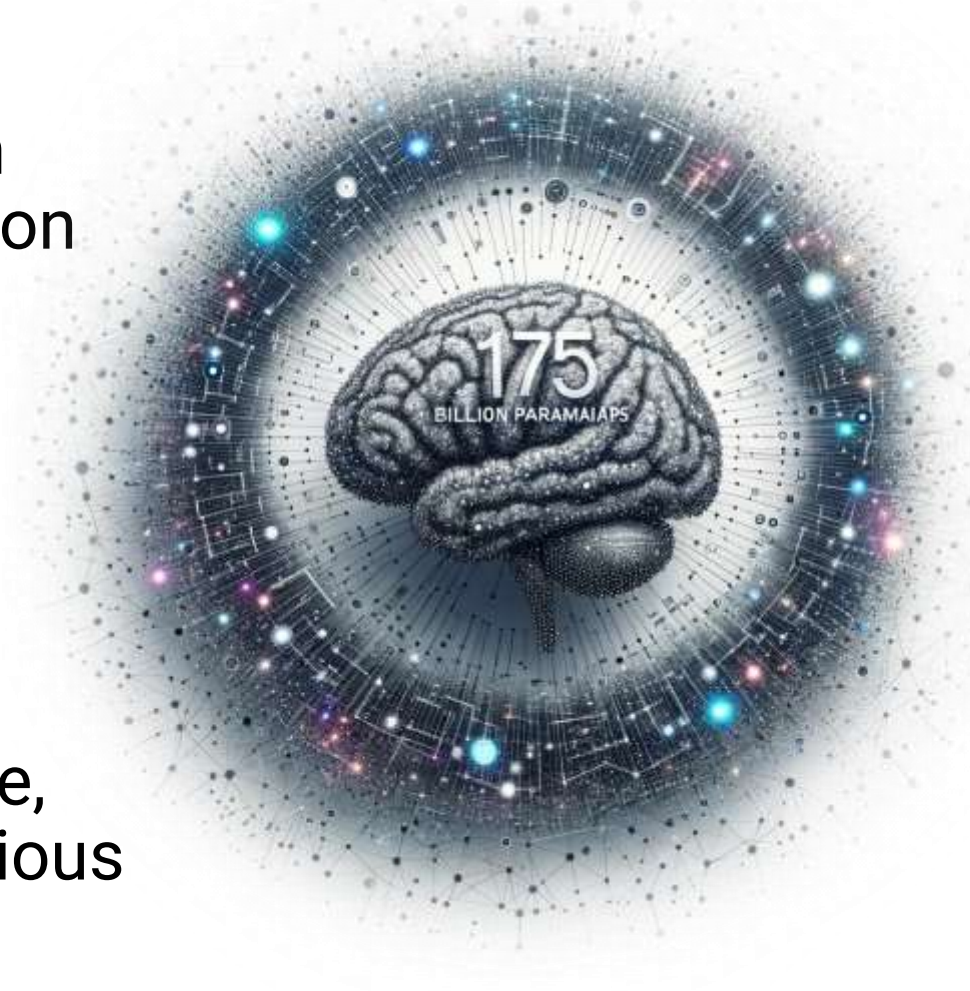
2. **Processing:** The data then moves through the hidden layers. In each layer, simple operations are performed on the data (like adding or multiplying). Each point in the layer combines the inputs it receives from the previous layer in different ways, determined by a set of internal parameters (or "weights") that the network adjusts through learning.

3. **Learning:** Initially, the network makes a lot of mistakes. It learns by adjusting the weights based on the errors it makes, trying to reduce these mistakes over time. This process is like practicing a skill – the more it practices, the better it gets.

4. **Output:** Finally, the processed data reaches the output layer, where the network provides the result

What does this mean for ChatGPT?

- ChatGPT-3 model is trained on ~175 billion parameters while the ChatGPT-4 is trained on more than 1 trillion parameters.
- From this vast training, ChatGPT is able to predict what to output based on your input.
- It generates its response one word at a time, with each new word depending on the previous ones.



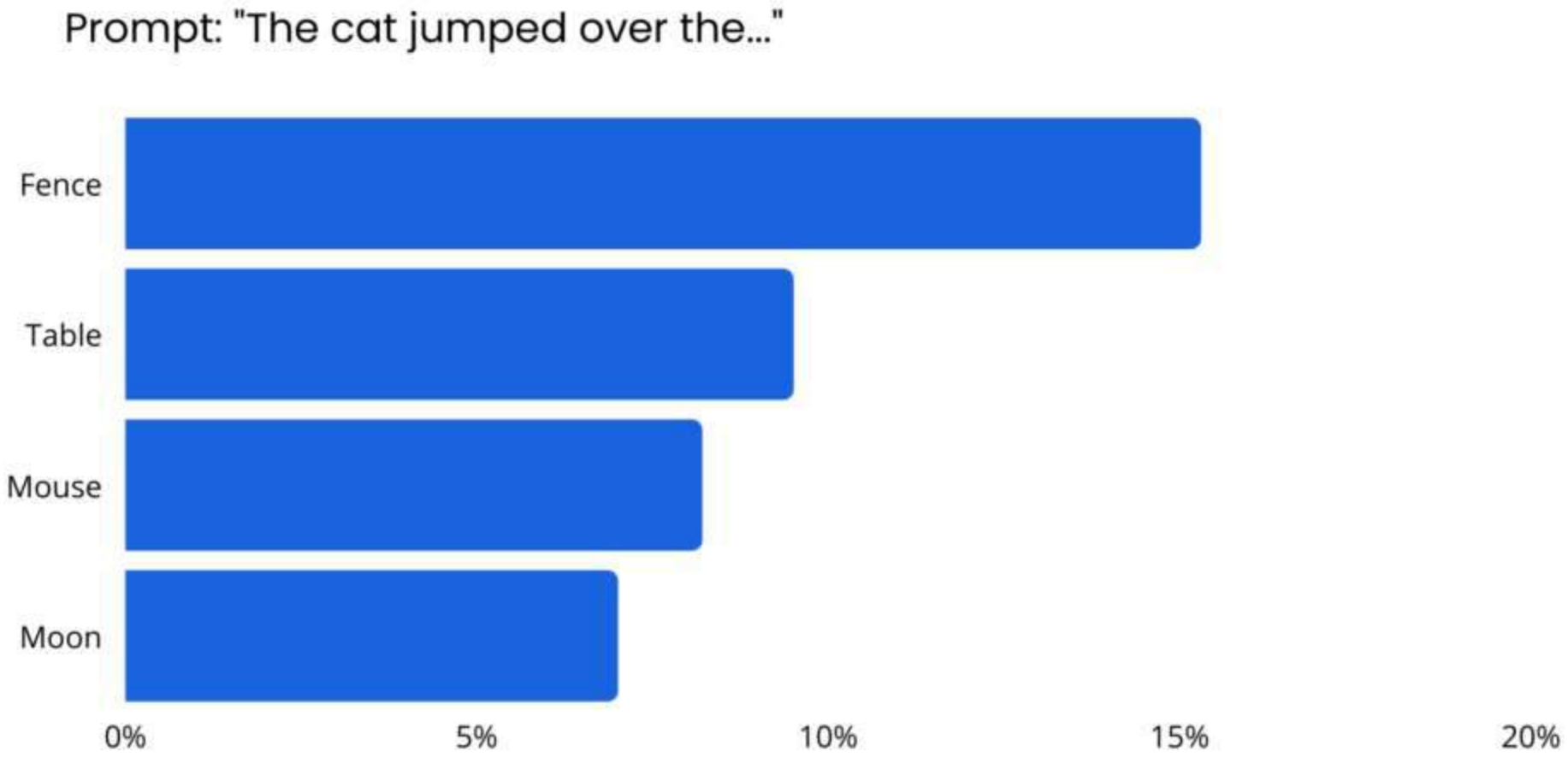
Source: AI-Generated with DALLE-3

Does ChatGPT understand what it is saying?

No! It is “simply” predicting the next word (or pixel if generating images) based on its neural network and vast training data

Source: AI-Generated with DALLE-3

| Probability of ChatGPT Generating a Particular Word



Source: https://www.scalablepath.com/machine-learning/chatgpt-architecture-explained

What does this mean for ChatGPT?

- You should not blatantly trust anything generated by AI because it may not be true!
- You should always proofread and fact check AI-generated content.
- Despite this current limitation, generative AI is still a very useful tool

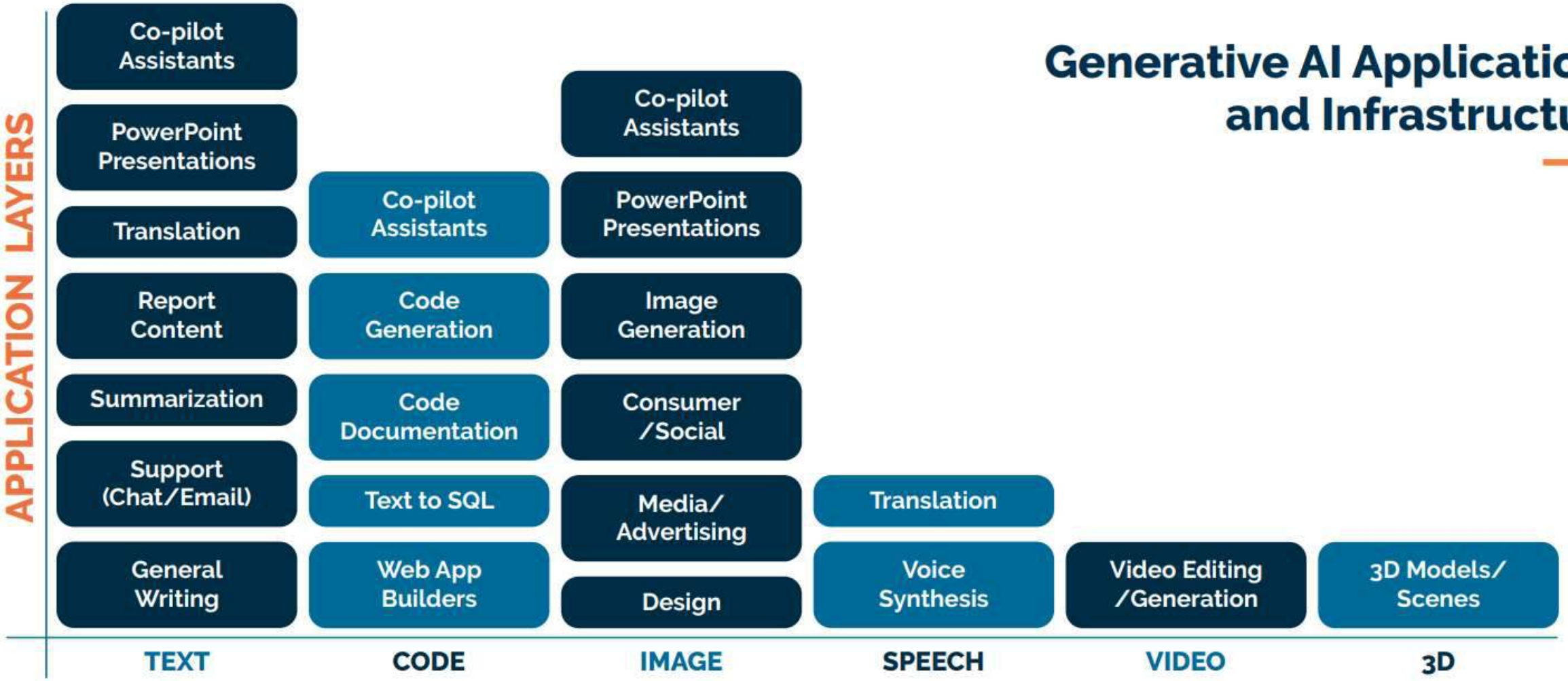
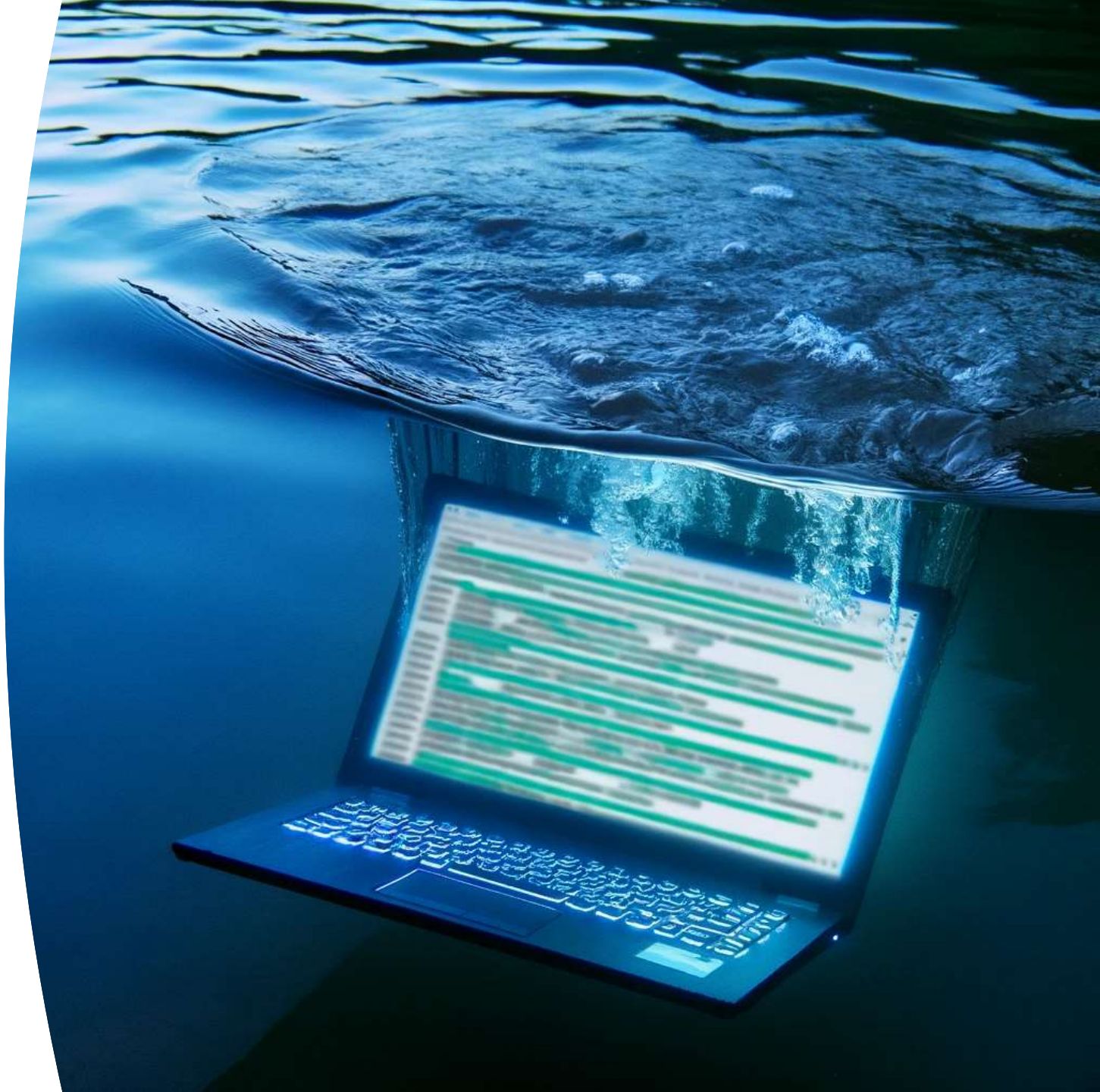


Figure 2: *Generative AI applications (Source: Adapted to Huang S. and Grady P., 2022)*

Is ChatGPT safe?

Yes, BUT…



Source: AI-Generated with DALLE-3

Considerations for Generative AI Use

- **Privacy:**
  - All data inputted into generative AI models is used to further train the model (that is why it is free)
  - Therefore, NO sensitive documents or information should be inputted into any GPT
- **Bias:**
  - The output of generative AI models is highly dependent on the data they are trained on. If the training data contains biases, the generated content will likely perpetuate or even amplify these biases
- **Intellectual Property (IP) Rights:**
  - Generative AI can produce content that closely mimics the work of human creators, which could lead to disputes over copyright and IP rights

Limitations of Generative AI

- **Misinformation:**
  - AI does not understand what it is saying and may produce misinformation
- **Language:**
  - Current generative AI models work best with English and may not work as well with other languages, especially lesser spoken languages like Lao
- **Generalization vs. Specialization:**
  - While generative AI models are capable of generating content across a wide range of topics and formats, their ability to generate highly specialized or domain-specific content accurately is often limited

Generative AI Recap

- **Supervised and semi-supervised learning** - A machine learning technique that helps algorithms learn to recognize patterns and make predictions based on categorized or labeled data. In the case of semisupervised learning, algorithms are trained on both labeled and unlabeled data to detect patterns and make predictions.
- **Deep learning** - A machine learning technique that uses layers of neural networks to process data and make decisions.
- **Neural networks** - An AI method that simulates the structure and function of the human brain. Neural networks process information through interconnected nodes that are organized in a layered structure. This computational model serves as the basis of deep learning and is used in various types of generative models.
- **Generative Adversarial Network (GAN)** - A machine learning model that uses two neural networks—a generator and a discriminator—to produce new data that is similar to a given data set. GANs have become a popular approach for generative AI in various domains, such as image and video generation.
- **Transformer** - A type of neural network that uses encoders and decoders to generate the best probability for the following word in a sentence. Transformers enable the development of powerful generative models.
- **Large Language Model (LLM)** - A statistical AI model that is trained on massive amounts of text data and predicts the probability of sequences of words to produce human-like text responses.
- **Natural Language Processing (NLP)** - A subfield of AI that is at the intersection of linguistics, computer science and machine learning. NLP enables computer programs to process and analyze large amounts of natural language data. It uses a range of computational methods and algorithms to allow machines, such as chatbots and voice assistants, to understand and mimic written or spoken human language.
- **Generative Pre-trained Transformer (GPT)** - A type of LLM developed by the research lab OpenAI that uses deep learning and NLP techniques. GPT underlies the user-facing, general-purpose chatbot, ChatGPT, which produces human-like conversational responses in reaction to short user prompts.

Source: UNOICT Generative AI Primer

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Coffee Break

Next: Generative AI
for Urban Development

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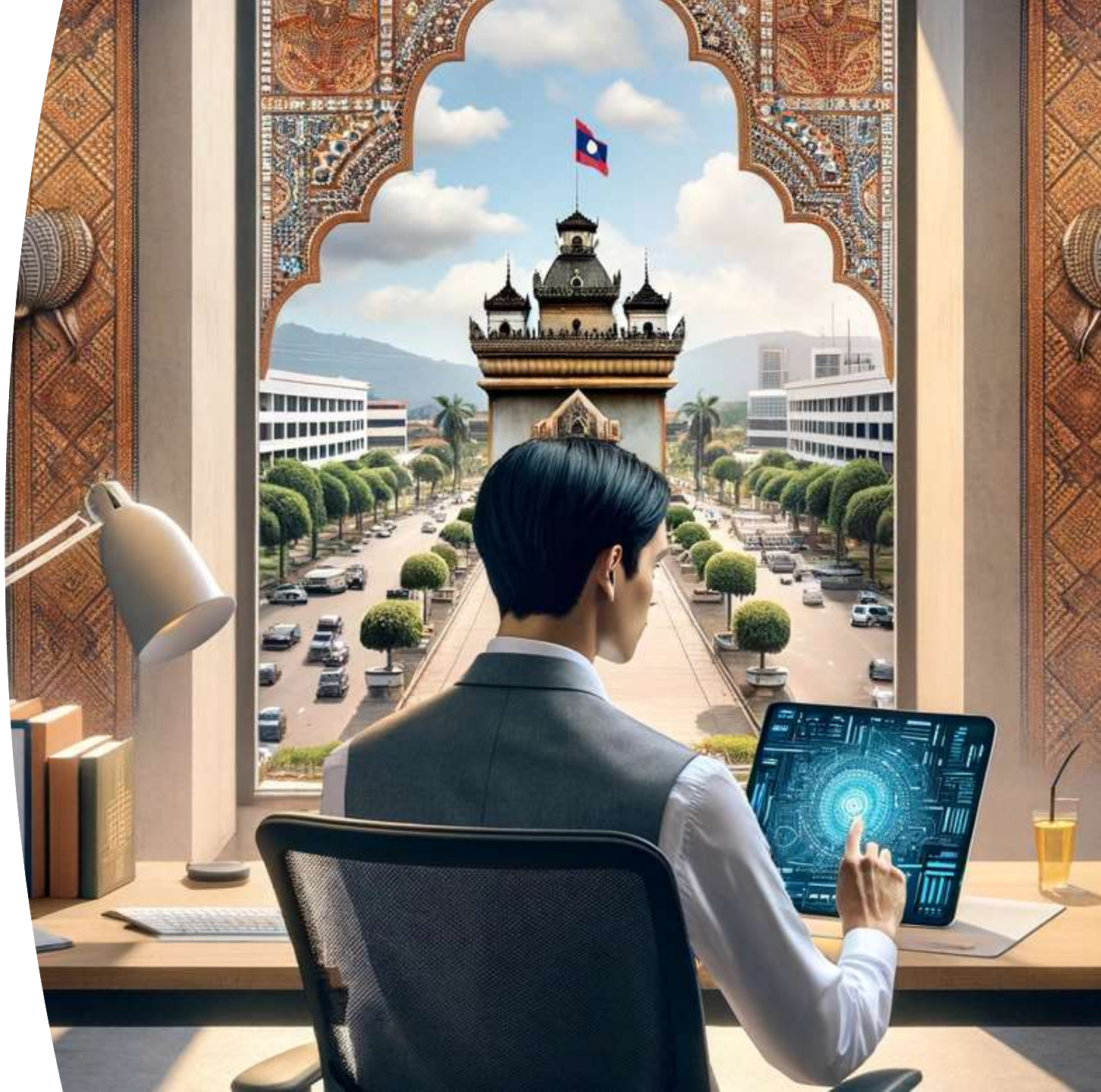
Generative AI for Urban Development

Presented by Rhys Evans

Everyday Use of AI

Generative AI can:

- Enhance productivity and efficiency
- Provide creative assistance and innovation



Source: AI-Generated with DALLE-3

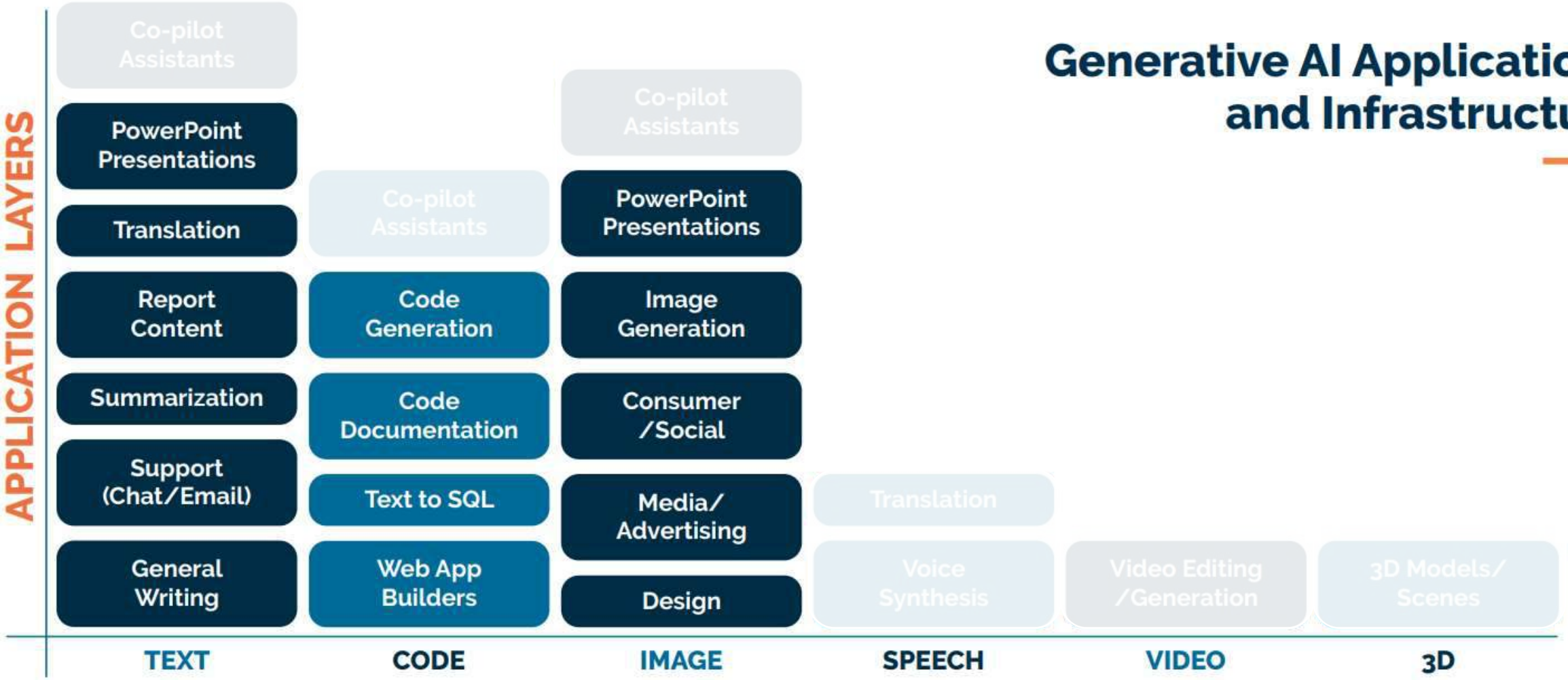
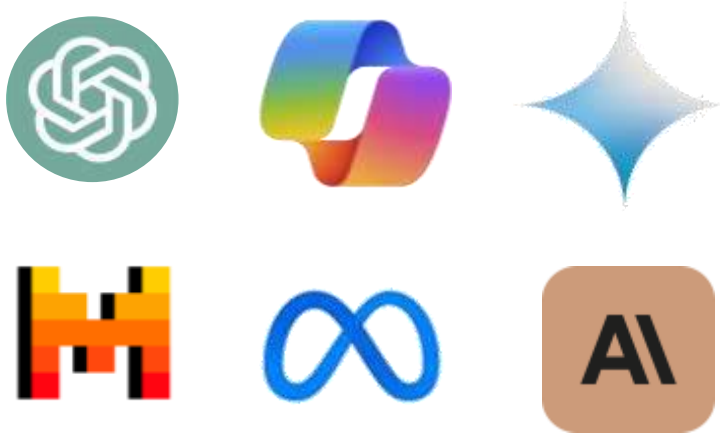


Figure 2: *Generative AI applications (Source: Adapted to Huang S. and Grady P., 2022)*

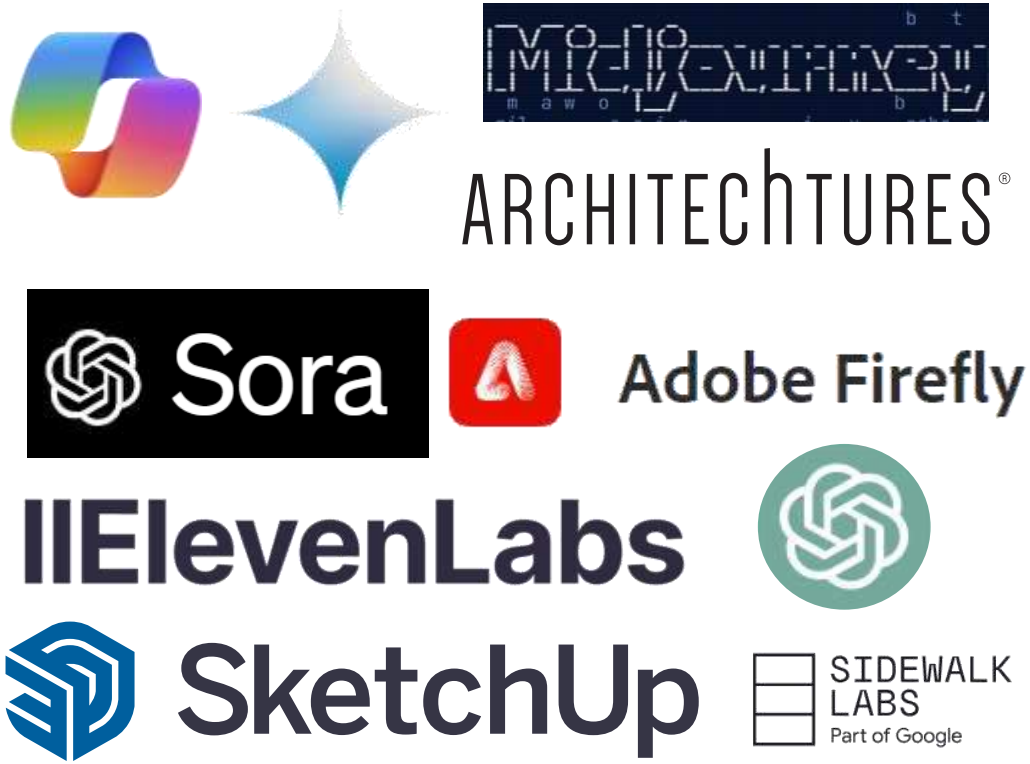
How do I know which AI tool to use?

Generalist



and others

Specialist

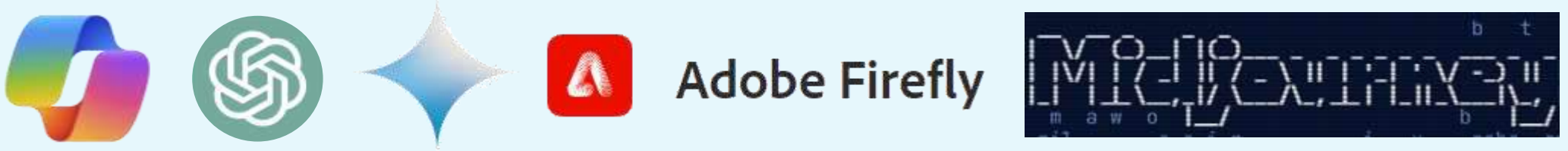


Source: Logos from their respective companies

How do I know which AI tool to use?

Specialist

IMAGE



VIDEO

SPEECH

3D

Source: Logos from their respective companies

AI Video and Speech

IIElevenLabs

AI video and speech is one of the newest developments in Generative AI.

The most advanced video generation tools like Sora are not available to the public yet

Source: Logos from their respective companies

Sora

Source: Sora, OpenAI

Sora

Source: Sora, OpenAI

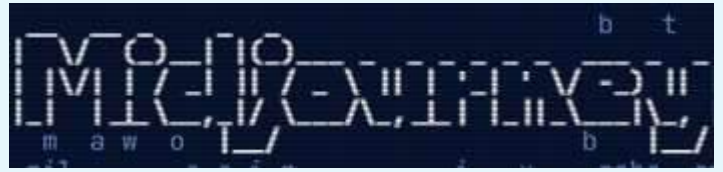
How do I know which AI tool to use?

Specialist

IMAGE




Adobe Firefly



VIDEO

SPEECH

Sora

IIElevenLabs

3D

SketchUp

SIDEWALK LABS Part of Google

ARCHITECHTURES®

Source: Logos from their respective companies

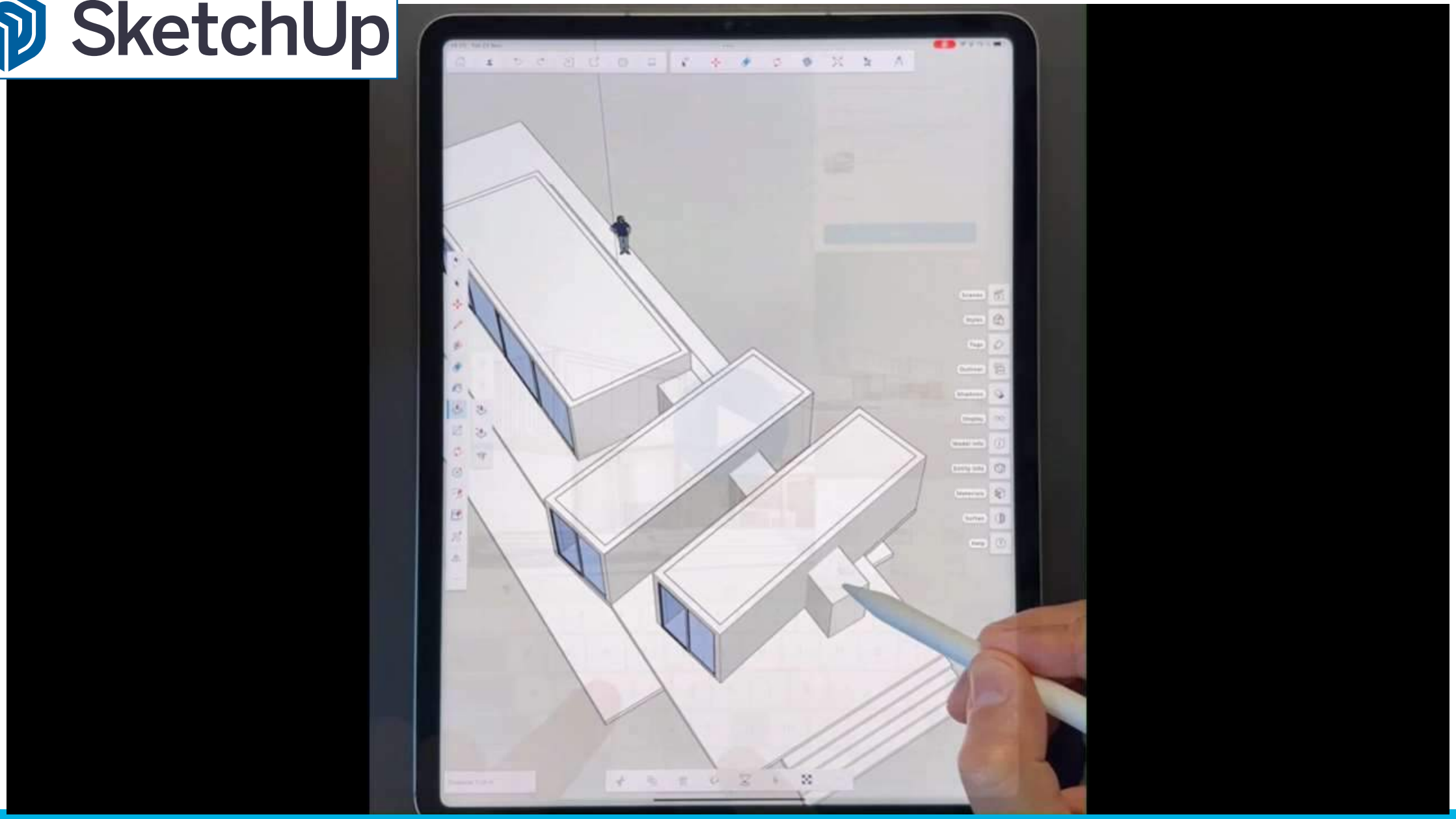
3D AI Tools for Urban Planning

3D generative AI tools offer the most potential for urban planning and development.

They are also still a work-in-progress, but some of the tools are now available for the public to use

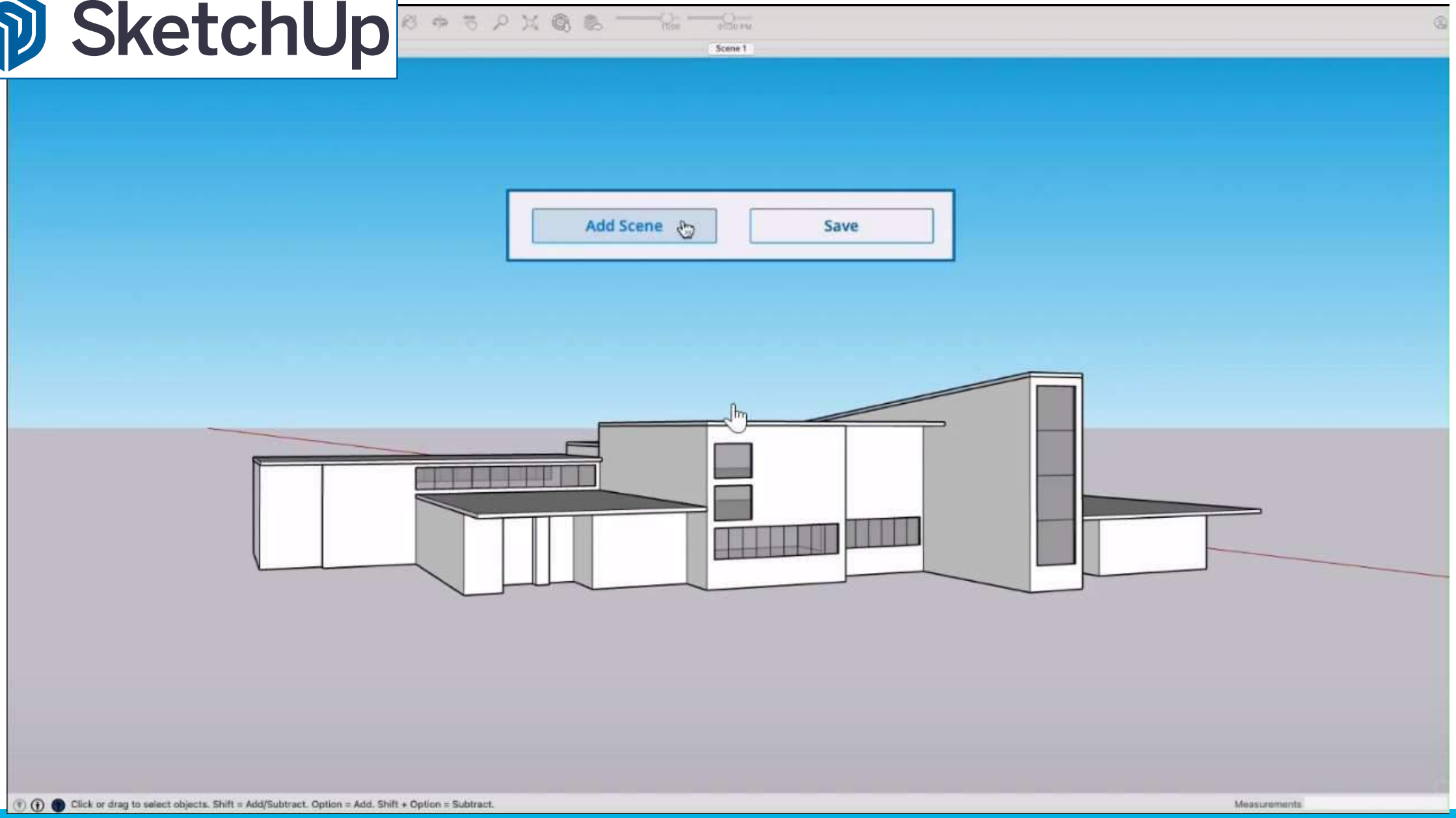
Source: Logos from their respective companies

SketchUp



Source: SketchUp x GenAI: realize your vision faster with Diffusion

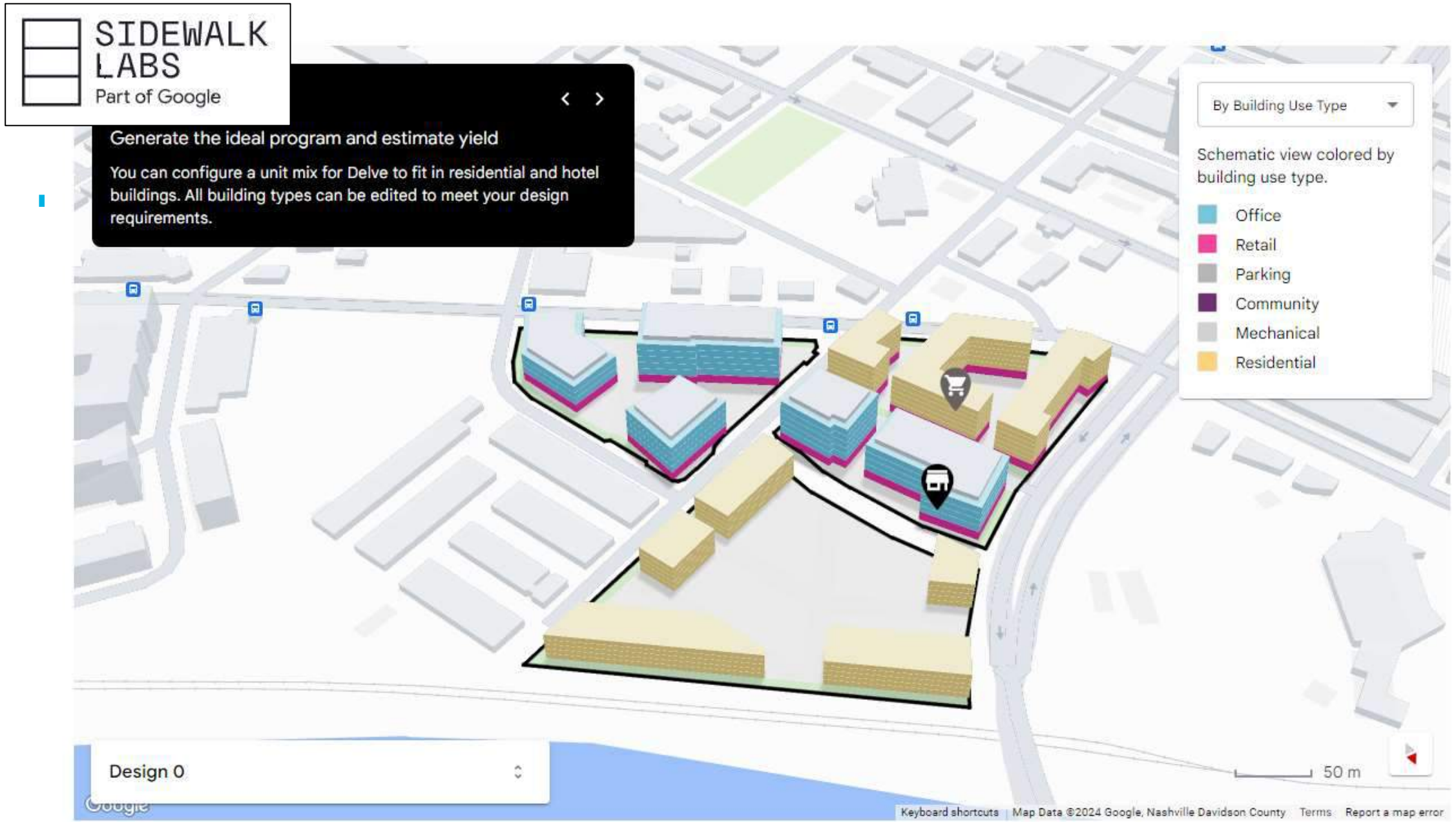
SketchUp



Source: SketchUp x GenAI: realize your vision faster with Diffusion

SketchUp

Source: SketchUp x GenAI: realize your vision faster with Diffusion



Source: Sidewalk Labs, https://youtu.be/h7gq7OrbgxY?si=CoIUZbBKdP0RrQiC

SIDEWALK LABS
Part of Google

Source: Sidewalk Labs, https://youtu.be/h7gq7OrbgxY?si=CoIUZbBKdP0RrQiC

ARCHITECHTURES®

Source: Architechtures, https://vimeo.com/462968148

Future AI for City Planning

- Current research is using AI to recognize terrain and buildings from satellite data.
- The goal is for even more advanced planning like Sidewalk Labs.

Source: Spatial planning of urban communities via deep reinforcement learning; https://www.nature.com/articles/s43588-023-00503-5

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AI for Smart Cities: Big Picture

Presented by Jun Yang

AI for Smart Cities in Lao PDR

1. Think Big

2. Start Small

AI can be a piece of the smart city puzzle

Source: AI-Generated with DALLE-3

Smart City Management

Data sharing for intelligent decision-making by encompassing:

- city administration,
- public services,
- economic development,
- and other aspects

Smart Traffic Management

- Utilizes modern digital technologies:
  - Internet of Things (IoT)
  - Big data
  - Artificial intelligence
- Aims for precise and efficient urban traffic management
- Includes features such as:
  - Real-time traffic monitoring
  - Intelligent traffic signal control
- Goals:
  - Alleviate congestion
  - Improve traffic flow
  - Provide a safer road environment

Smart Healthcare

- Applies advanced technologies to the medical field
- Enhances efficiency and quality of healthcare services
- Includes:
  - Electronic health record management systems
  - Real-time monitoring and analysis of medical data
  - Intelligent regulation of urban healthcare resources
  - Training big data models for medical image analysis
- Aims to:
  - Facilitate timely medical diagnoses
  - Improve the level of patient care
  - Enhance the rational utilization of healthcare resources

Smart Building Management

- Utilizes advanced technologies:
  - Internet of Things (IoT)
  - Sensors
  - Artificial intelligence
- Involves:
  - Collecting environmental and energy data through sensors
  - Real-time monitoring of building status
  - Controlling automated systems
- Through AI training models, it:
  - Automatically analyzes monitoring data
  - Predicts the expected lifespan of the building
- Aims to:
  - Reduce energy consumption
  - Enhance building security
  - Optimize space utilization

Smart City Services

- Aimed at improving the quality of life for urban residents
- Integrates innovative technologies to enhance:
  - Urban governance
  - Public services
- Includes various aspects such as:
  - Smart waste management
  - Smart fire alarm systems
  - Smart streetlight controls
- Strives to create a more:
  - Efficient
  - Convenient
  - Livable urban environment

Smart streetlights, utilizing LED technology, are more energy-efficient and emit fewer carbon emissions compared to traditional streetlights. Additionally, these smart lights can automatically adjust their brightness based on ambient light levels, further reducing energy consumption.

The deployment of these **smart trash bins** is crucial for improving urban waste management. For instance, at Times Square in New York City, the deployment of these smart bins increased their capacity by nearly **200%**, reduced weekly collection frequency by **50%**, and exceeded the city's ambitious recycling goals.

 Source:https://www.gsma.com/iot/news/smart-trash-cans-telebelly/

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AI for Smart Cities: Intelligent Transportation Systems

Presented by
Jun Yang and Rhys Evans

Two Case Studies

1. Smart Transportation System in Guangzhou

2. Smart Traffic Lights in the Netherlands

Source: AI-Generated with DALLE-3

Intelligent Transportation System in Guangzhou

Mr. Sinlavong Khoutphaythoune, President of the Central Committee of the Lao Front for National Construction, led a delegation on a successful visit to China from January 21st to 28th, 2024.

He visited the smart transportation system in Guangzhou and pointed out that there are many valuable aspects worth learning from.

Intelligent Transportation System

Utilizing various sensors to collect urban data.

Real-time transmission to servers through the network.

Artificial intelligence algorithms solving operations optimization problems.

The system makes decisions within milliseconds to optimize urban traffic.

Intelligent Transportation System

Intelligent traffic signal lights are an integral part of smart transportation, aimed at enhancing the capacity and operational efficiency of intersections. Through the analysis of traffic data, it is possible to optimize traffic light configurations, improve road throughput efficiency, and significantly reduce traffic congestion issues.

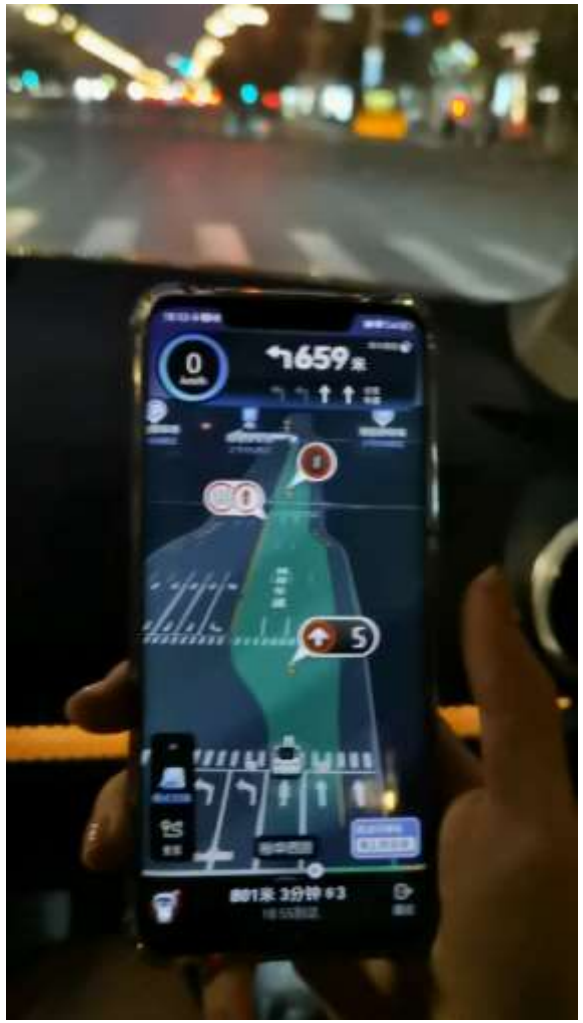
Intelligent Transportation System

At the same time, based on the accumulated big data of traffic flow during various time periods and under different weather conditions, artificial intelligence is employed to predict the traffic flow for a specific time period and weather scenario in the future. This enables advance completion of urban traffic planning.

Intelligent Transportation System

The smart city system can also, in the daily operation of traffic, provide intelligent route planning for city emergency vehicles such as police cars and ambulances. This enables city law enforcement to reach their destinations more quickly and ensures that emergency patients receive professional assistance in the shortest possible time.

Applications——Green waves



Smart Traffic Lights in The Netherlands

- Traffic management systems using AI to adjust signals in real time for optimal flow.
- Uses sensors and cameras to monitor traffic, analyze congestion, and dynamically manage light timings.
- Leads to significant improvements in traffic flow, reductions in waiting times, and enhanced safety for all road users.

Source: flickr.com/claudiaregina_cc

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Q&A

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Thank you