



성균관대학교
SUNG KYUNKWAN UNIVERSITY

Foundations of Machine Learning (ECE 5984)

- Introduction -

Eunbyung Park

Assistant Professor

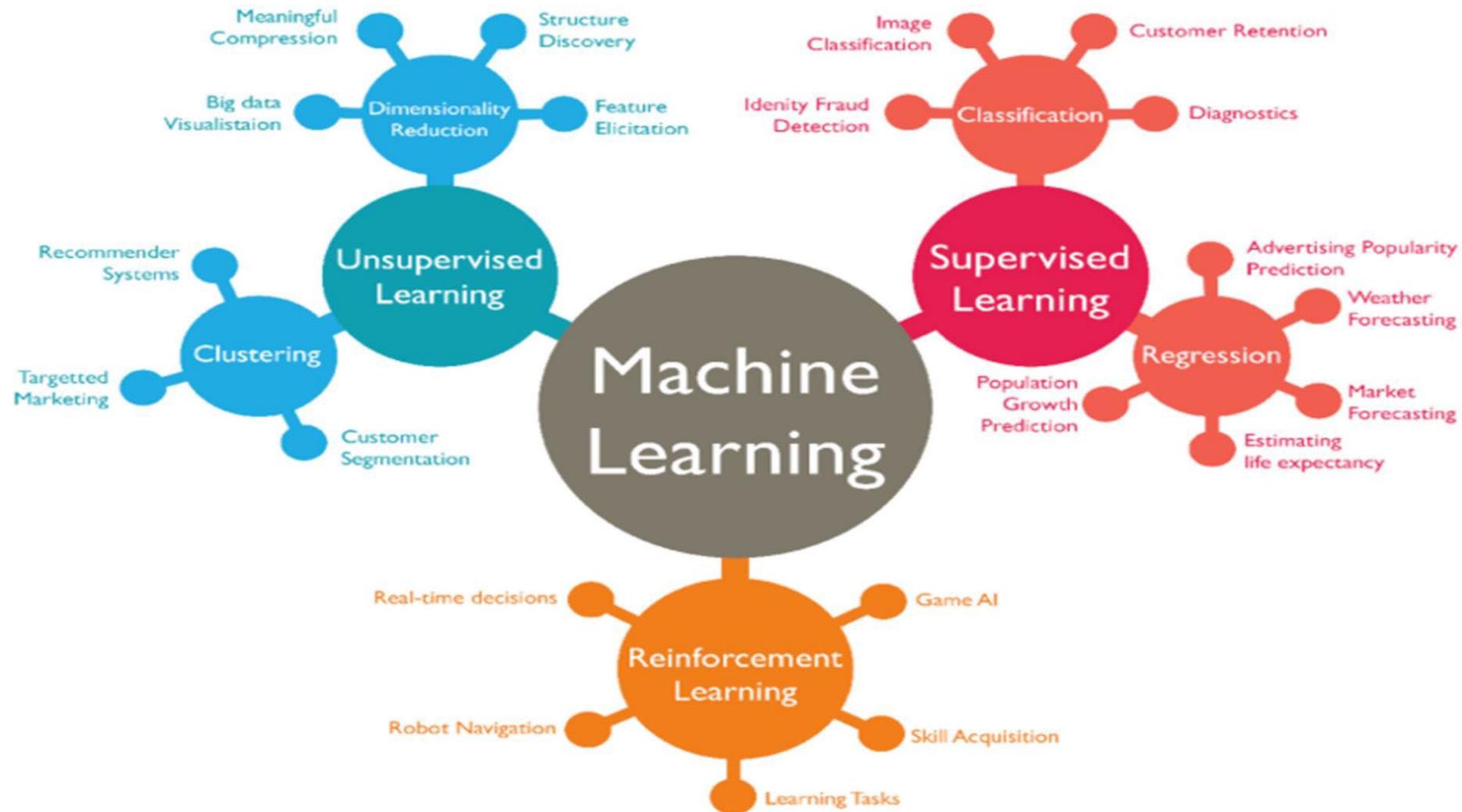
School of Electronic and Electrical Engineering

[Eunbyung Park \(silverbottlep.github.io\)](https://silverbottlep.github.io)

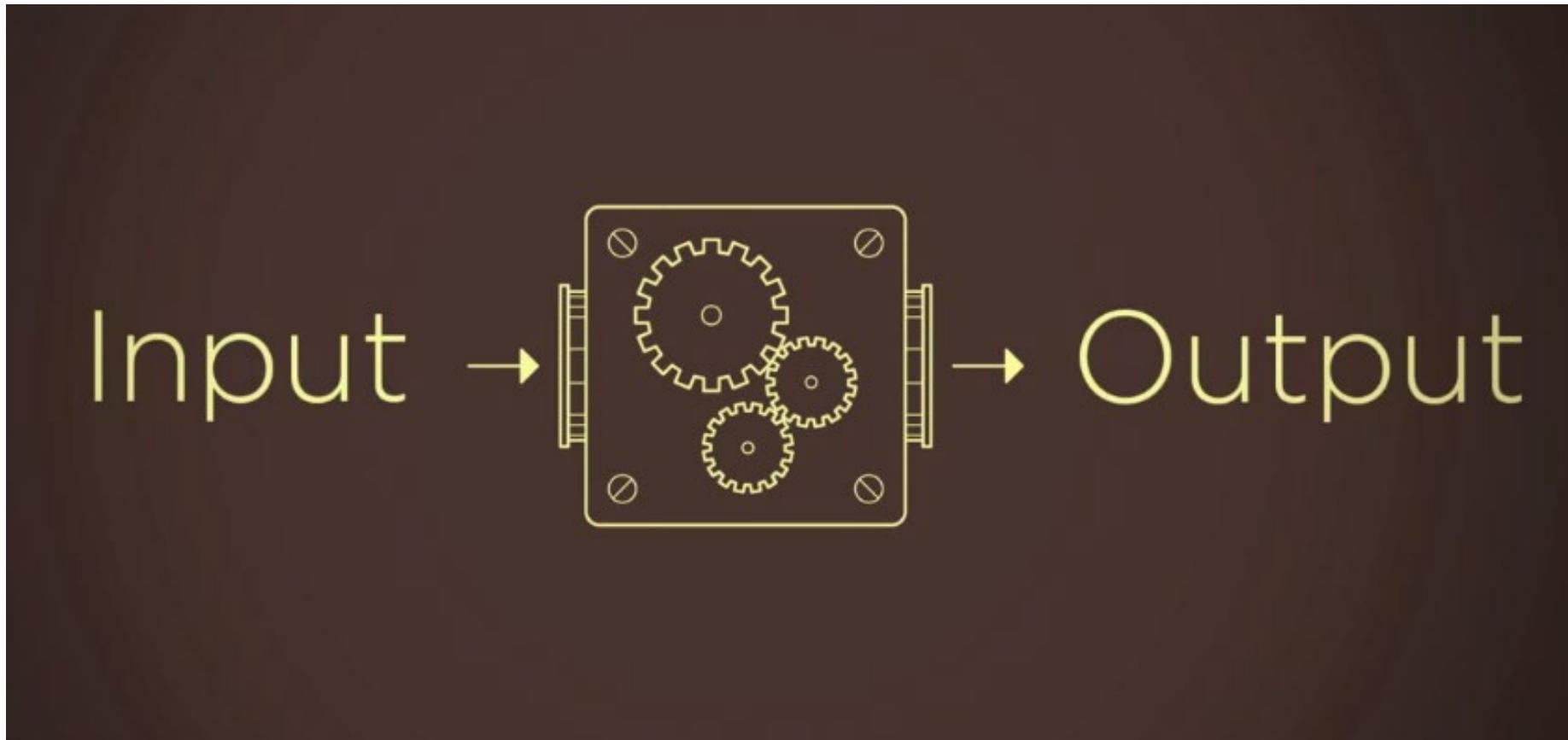
Machine Learning

- Machine learning (ML) is the study of computer algorithms that can improve automatically through data and experience
- It's a core field in modern artificial intelligence
- Especially, deep neural networks are taking over many engineering and science fields!

Machine Learning Taxonomy

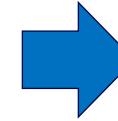
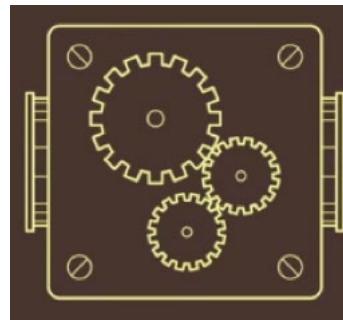
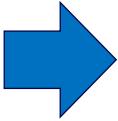


Supervised Learning



Examples

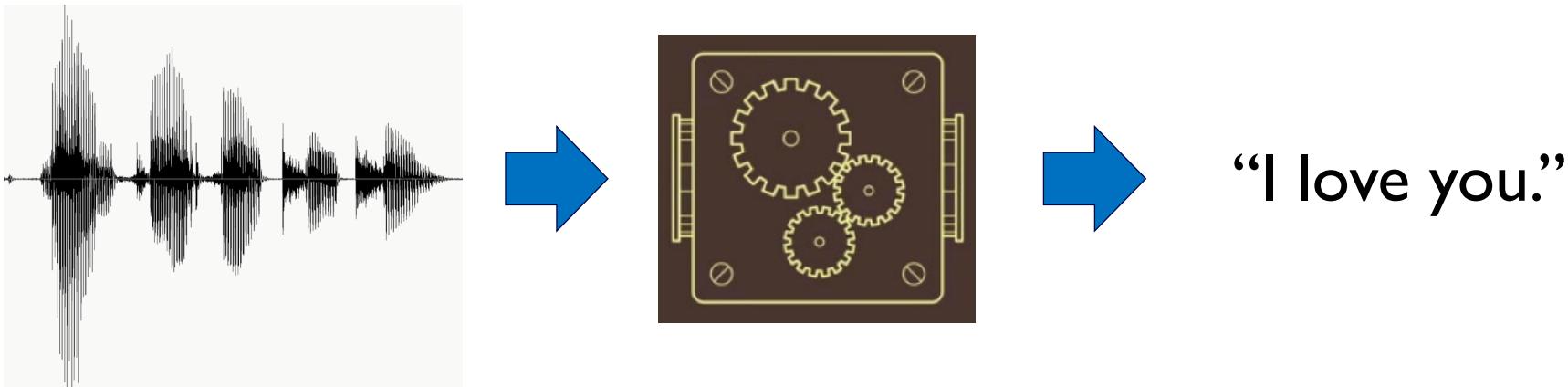
- Image classification



“Cat”

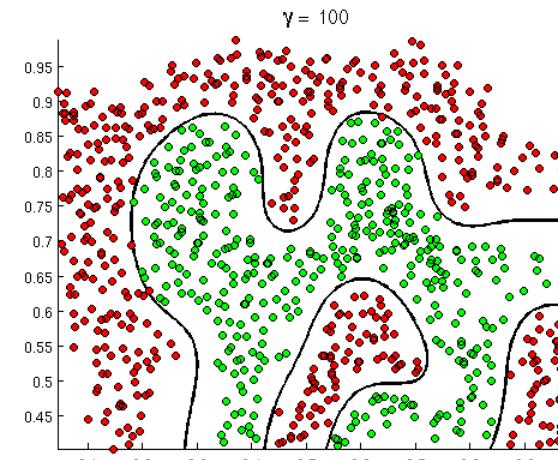
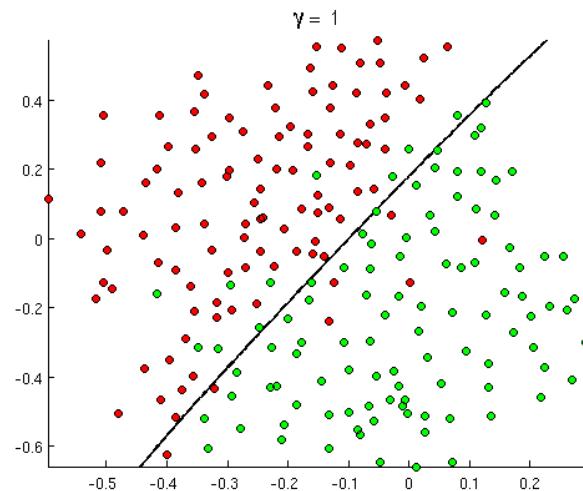
Examples

- Speech recognition



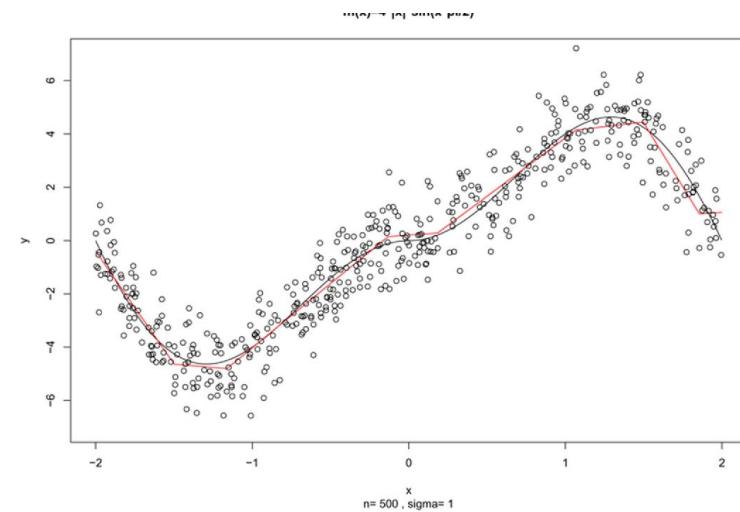
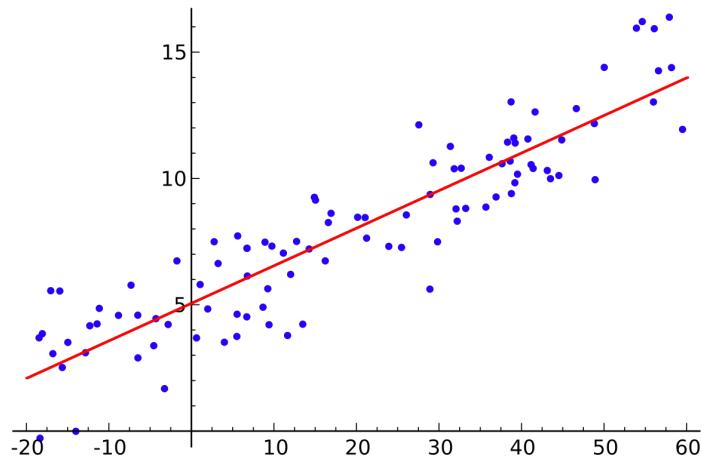
Supervised Learning

- Classification -> Learning boundaries
 - Logistic regression
 - Support Vector Machines (SVM)
 - K-nearest neighbors
 - Decision Trees, Neural networks



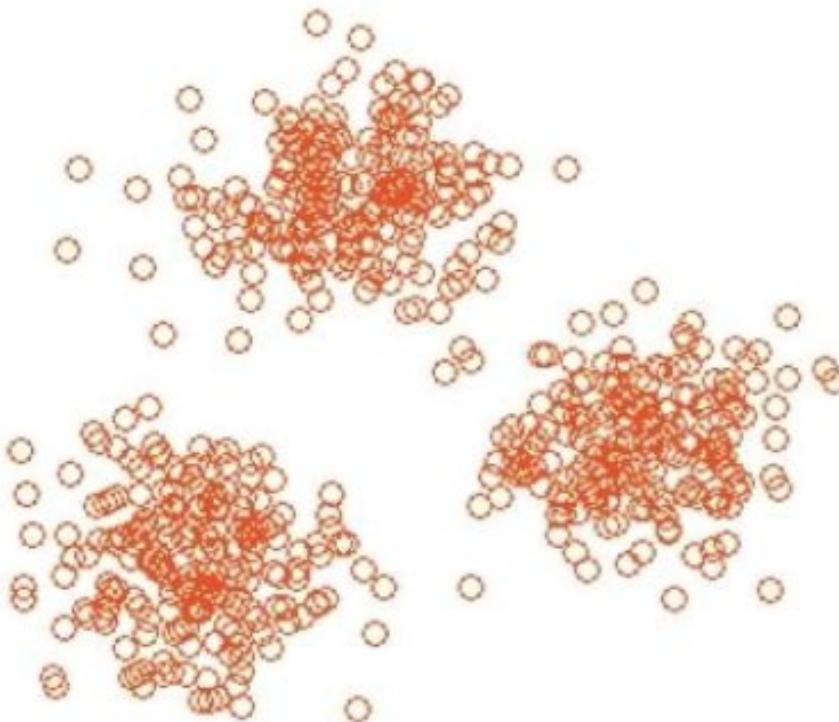
Supervised Learning

- Regression -> predicting real values
 - Linear regression
 - Polynomial regression
 - Neural networks
 - Gaussian process
 - Etc..



Unsupervised Learning

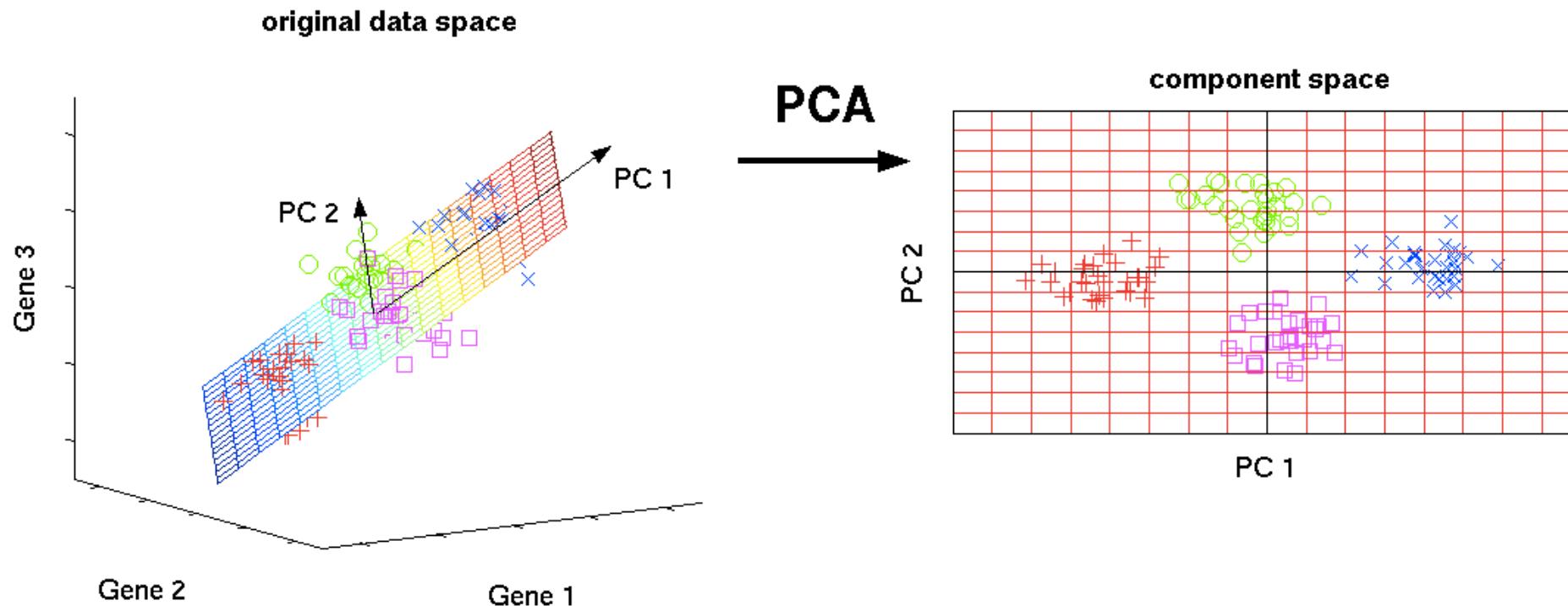
- Clustering



- Documents
- Users
- Webpages
- Diseases
- Pictures
- Vehicles
- ...

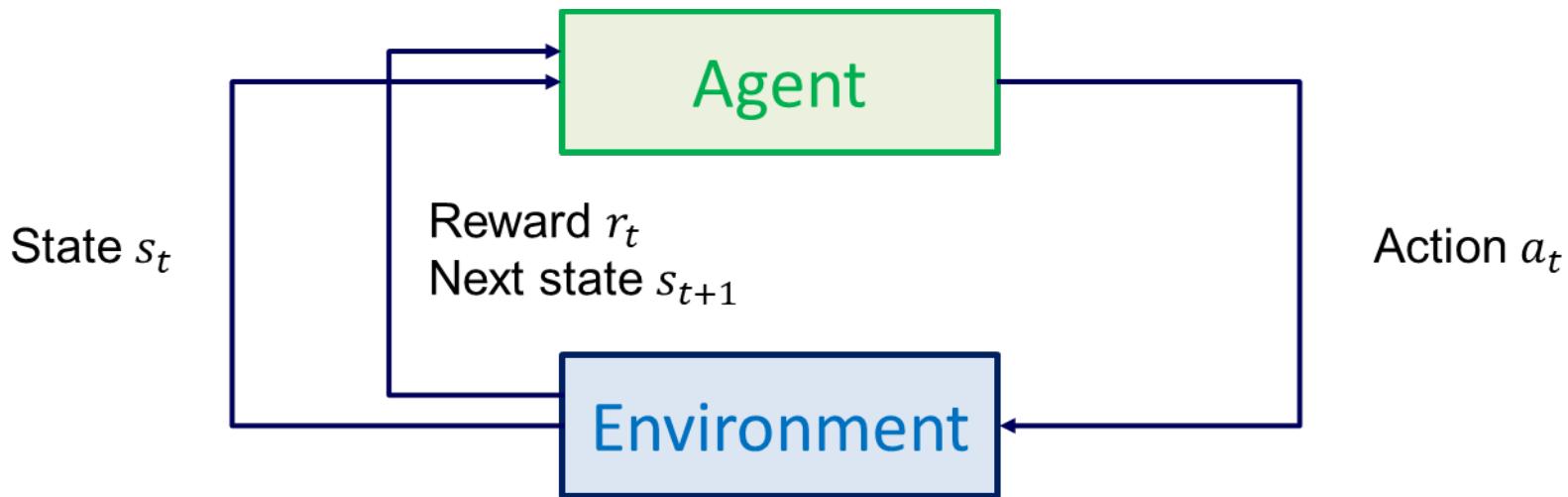
Unsupervised Learning

- Principal Component Analyses (Dimensionality reduction)



Reinforcement Learning

- Sequential interactions between the agent and the environment
 - Alphago, robot, ...



Motivating Examples

Object Detection

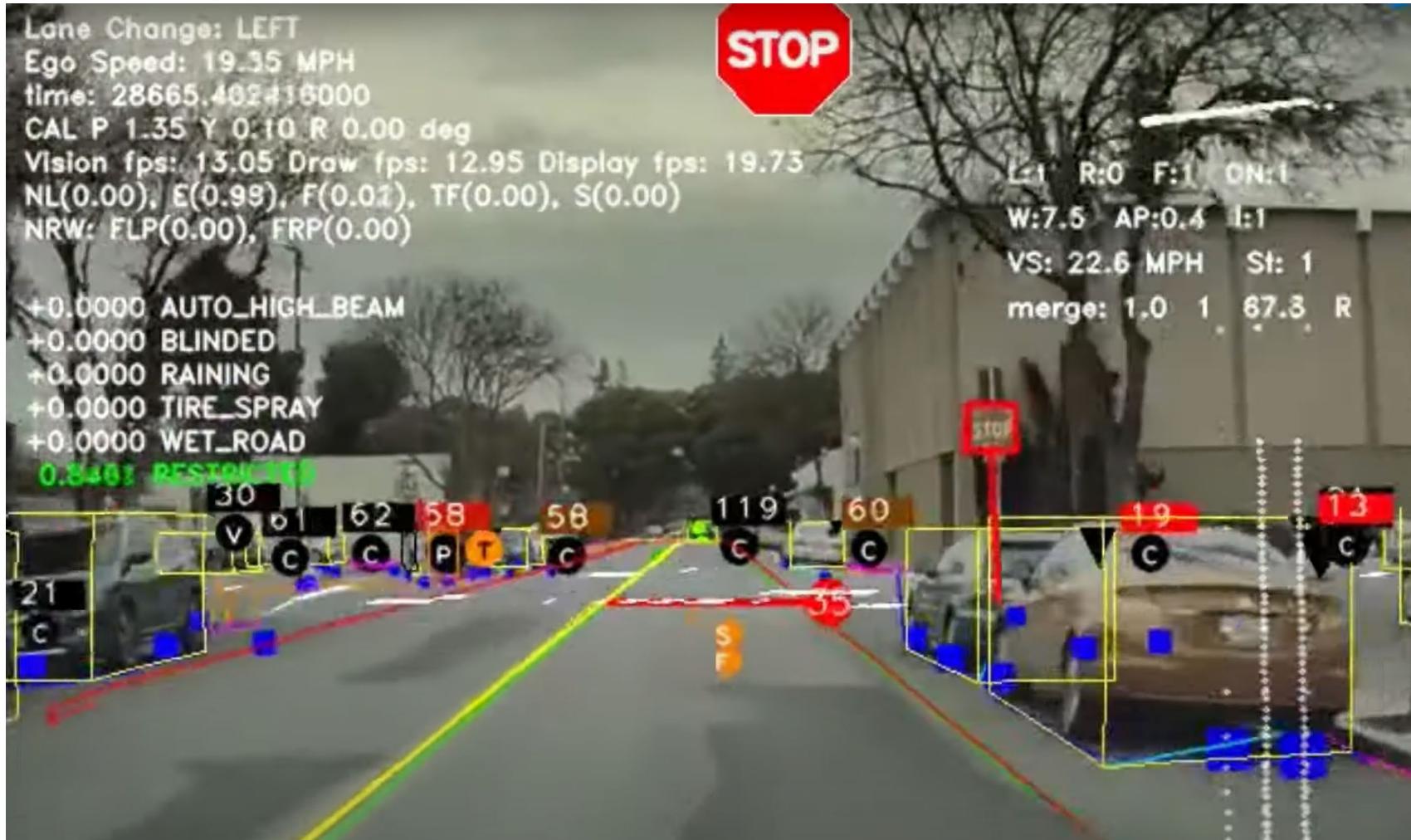


Image Segmentation



Human Pose Estimation



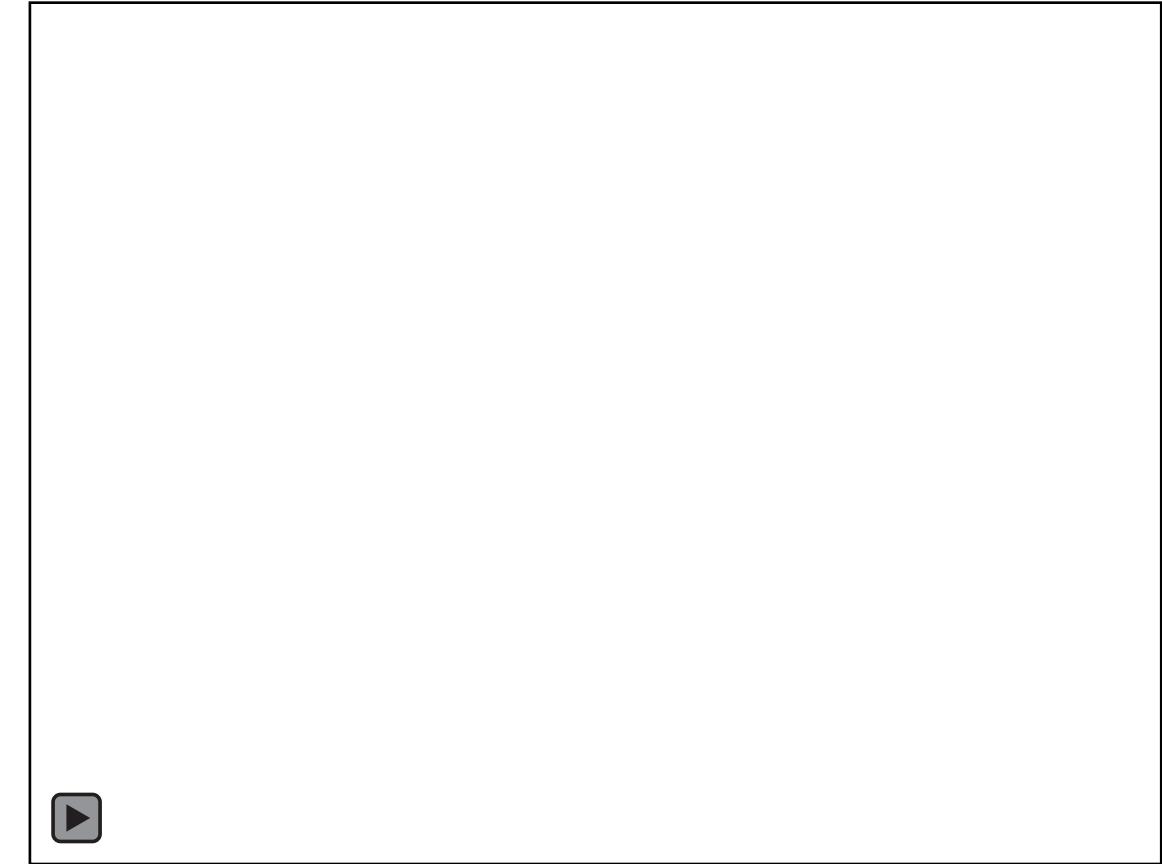
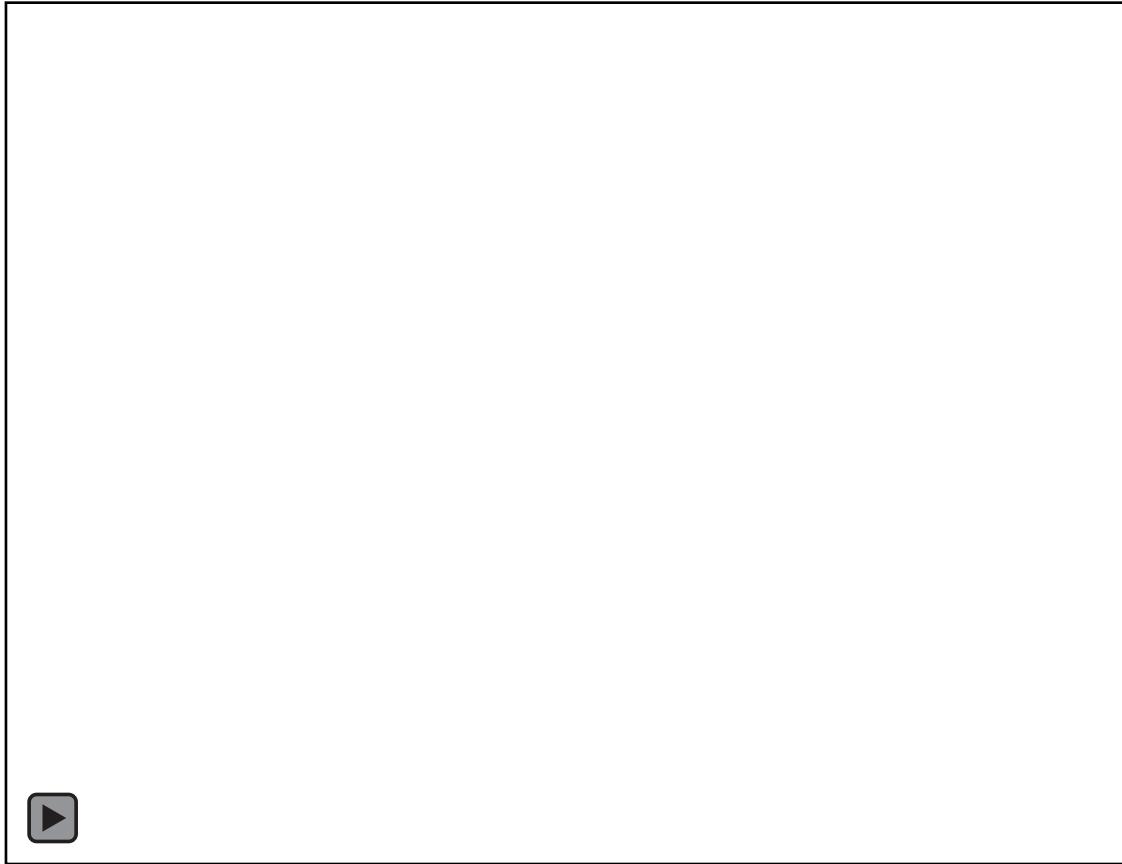
Image Generation



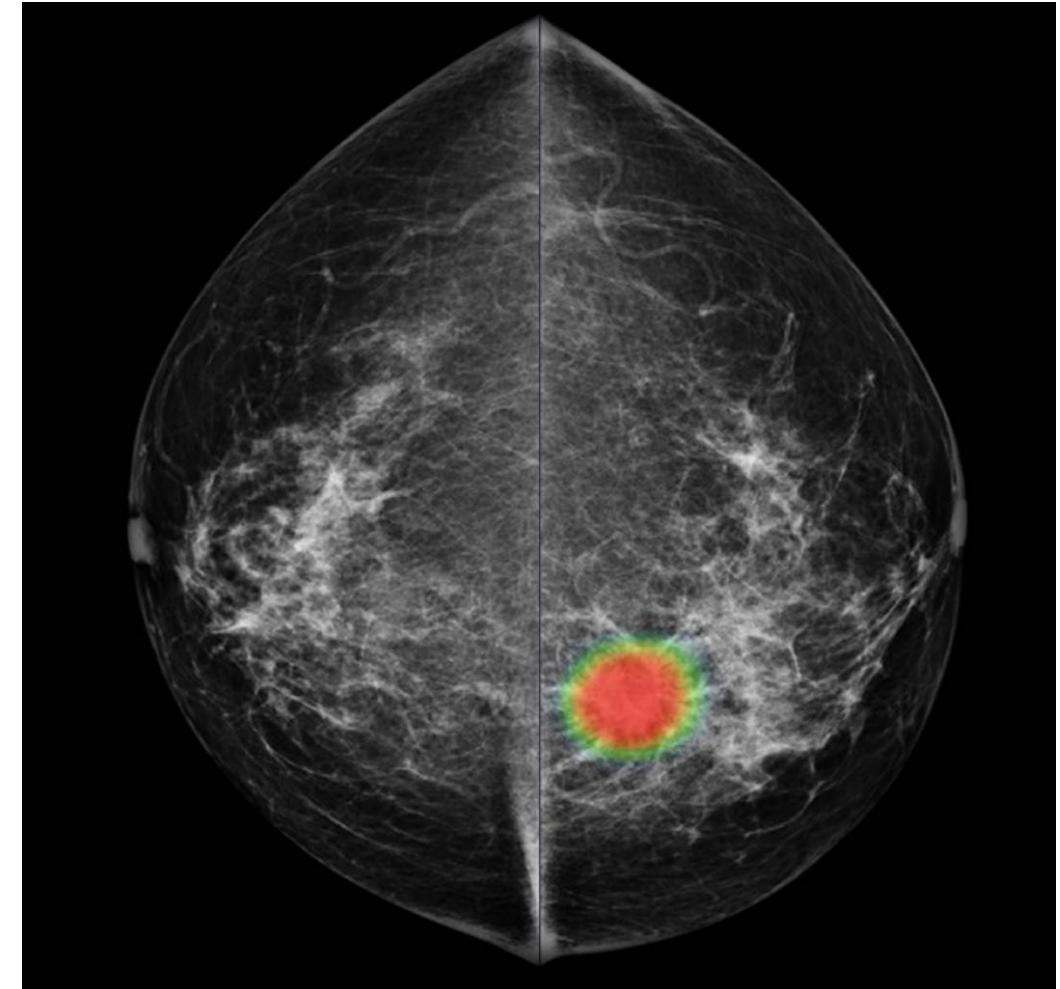
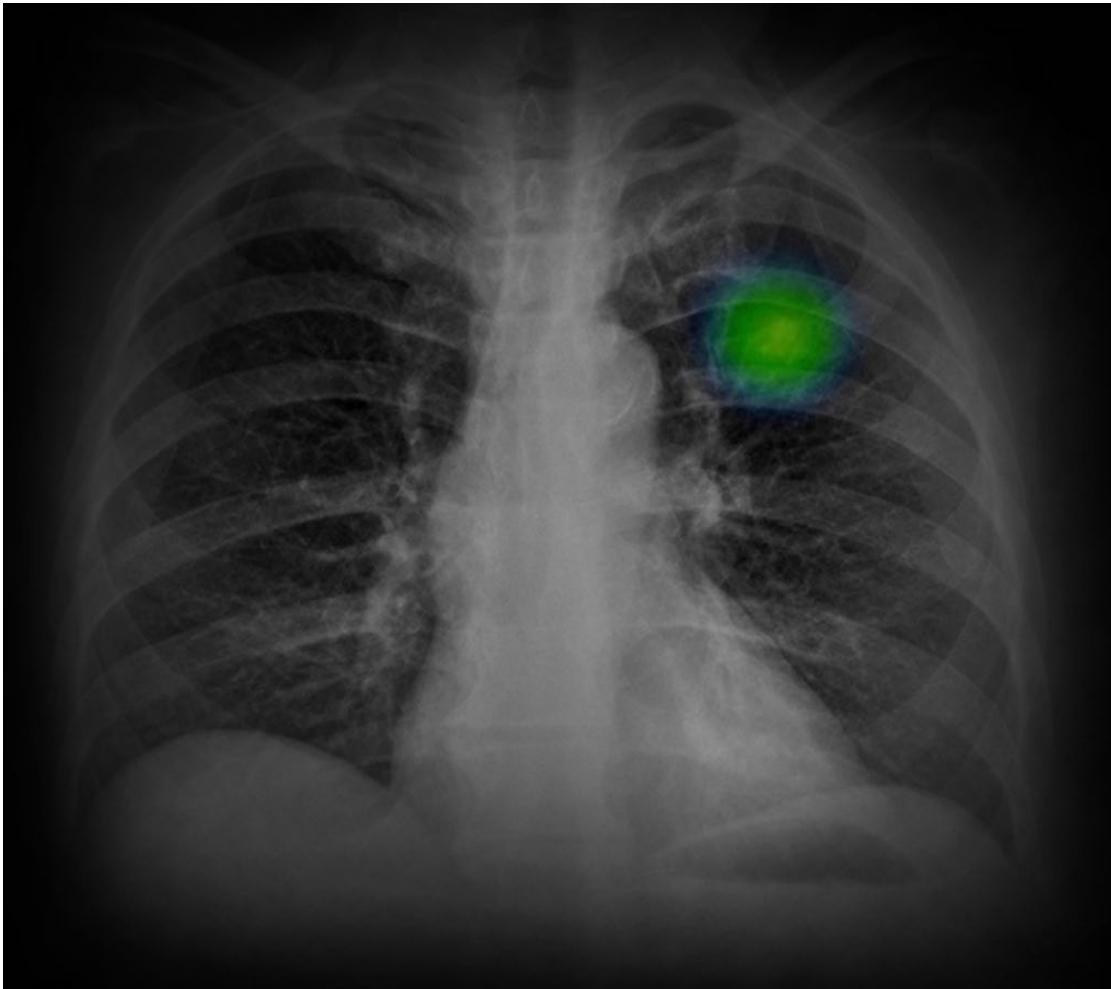
Image Generation



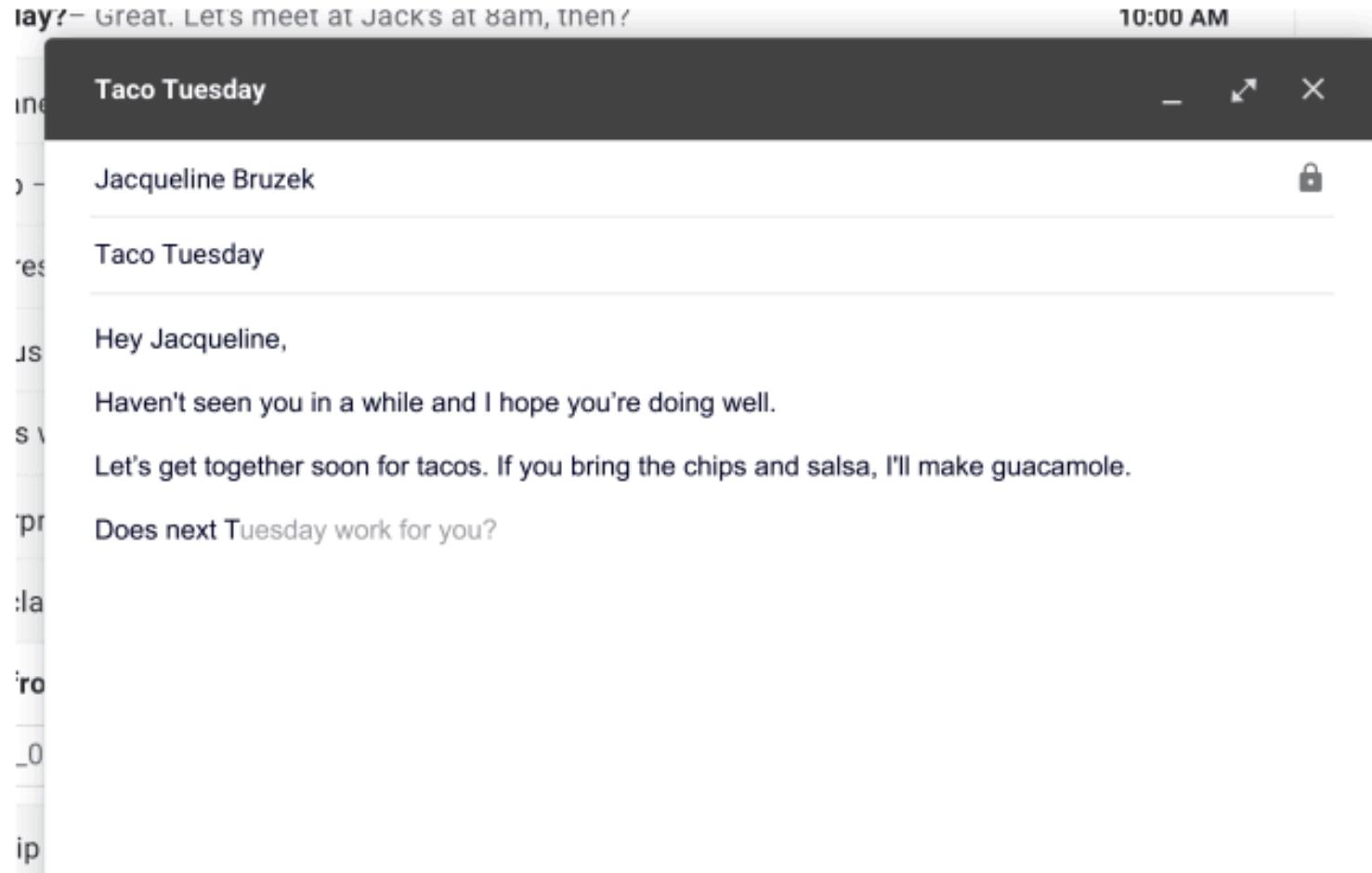
Novel View Synthesis



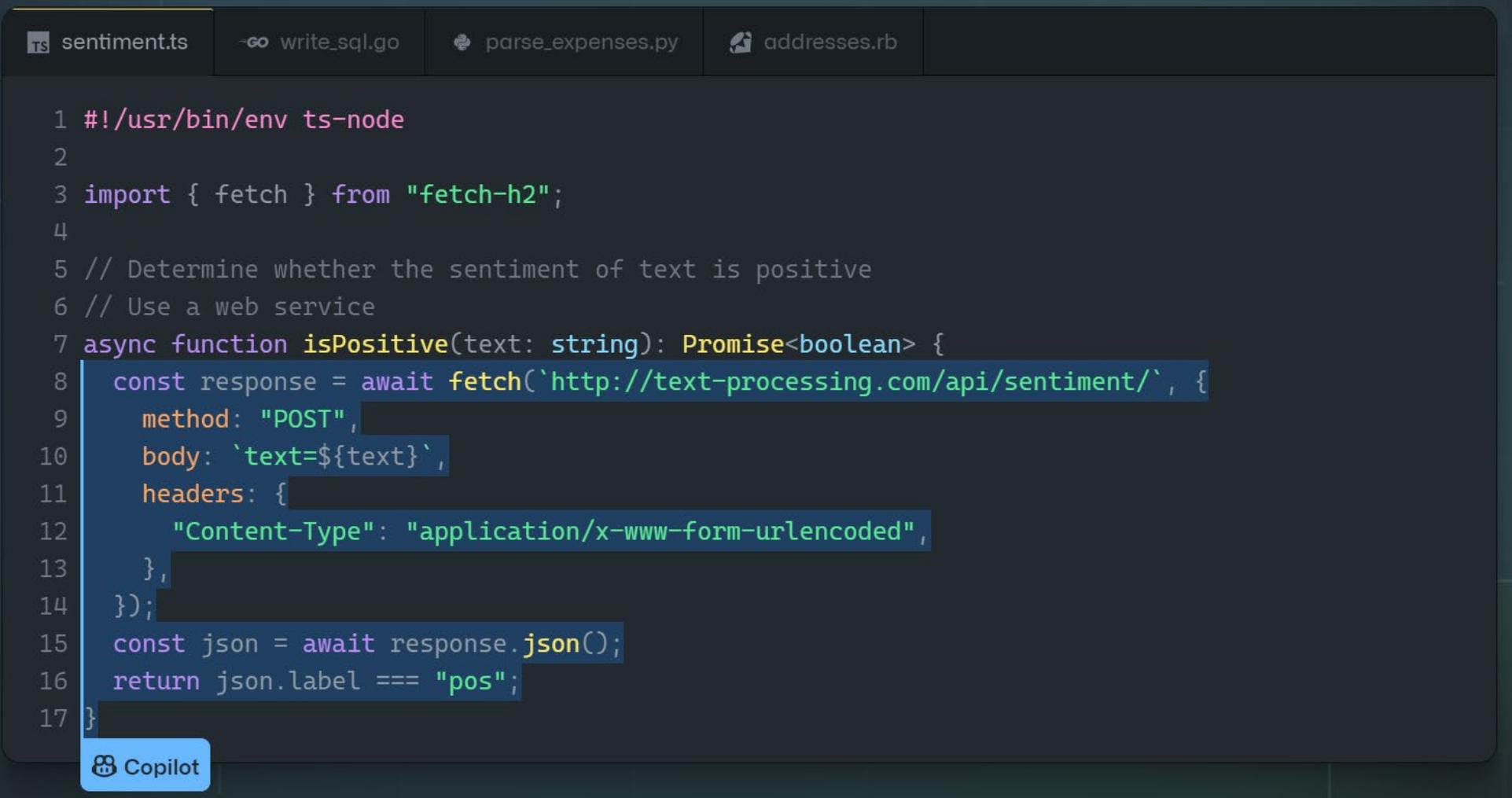
Medical Image Analysis



Smart Compose



AI pair programmer (Copilot)



A screenshot of a code editor interface showing a file named `sentiment.ts`. The code implements a function `isPositive` that sends a POST request to `http://text-processing.com/api/sentiment/` with the provided text as the body. The response is parsed as JSON to determine if the sentiment is positive. The code is written in TypeScript and uses the `fetch` API.

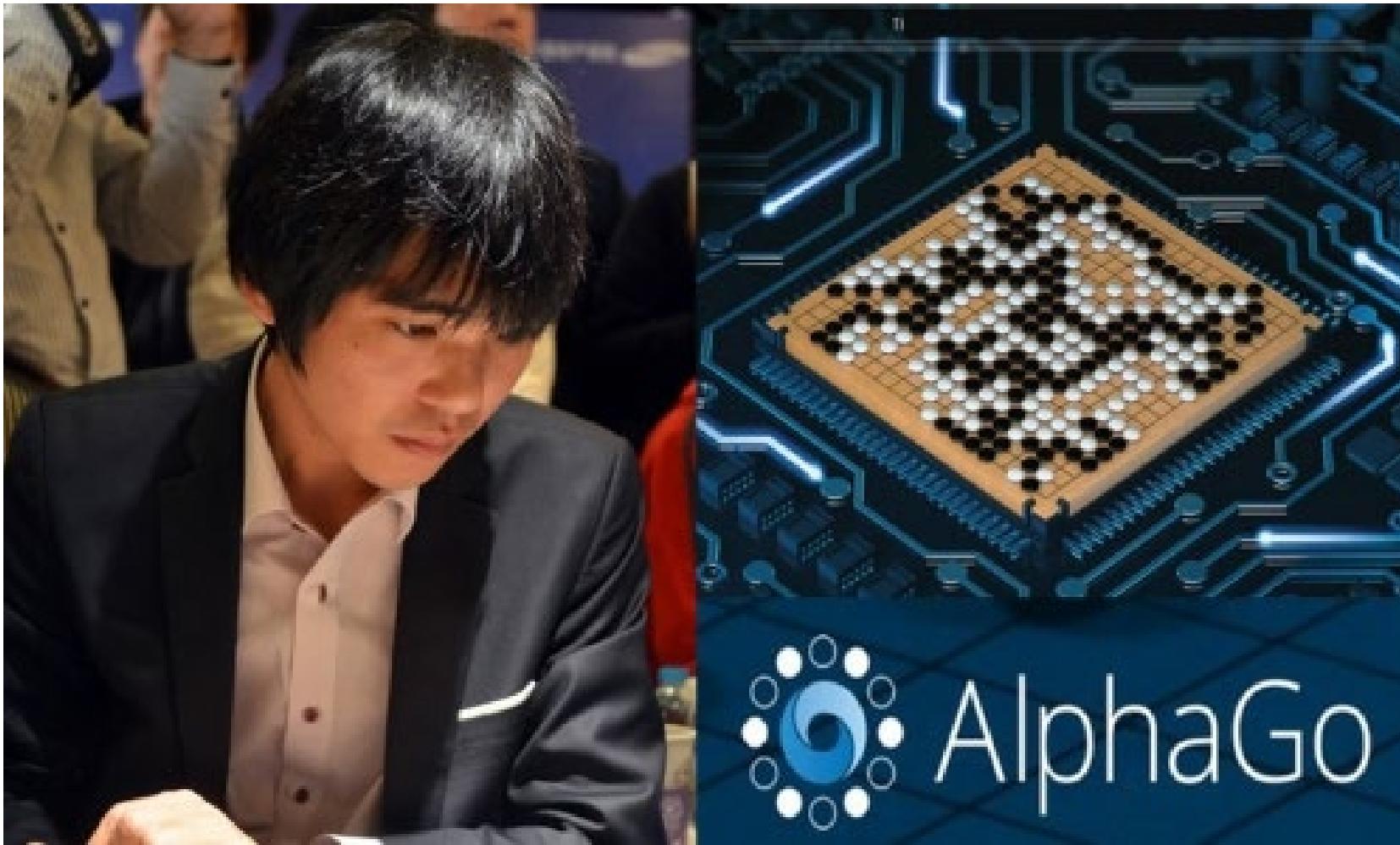
```
1 #!/usr/bin/env ts-node
2
3 import { fetch } from "fetch-h2";
4
5 // Determine whether the sentiment of text is positive
6 // Use a web service
7 async function isPositive(text: string): Promise<boolean> {
8     const response = await fetch(`http://text-processing.com/api/sentiment/`, {
9         method: "POST",
10         body: `text=${text}`,
11         headers: {
12             "Content-Type": "application/x-www-form-urlencoded",
13         },
14     });
15     const json = await response.json();
16     return json.label === "pos";
17 }
```

In the bottom left corner of the code editor, there is a blue button with a white icon and the word "Copilot".

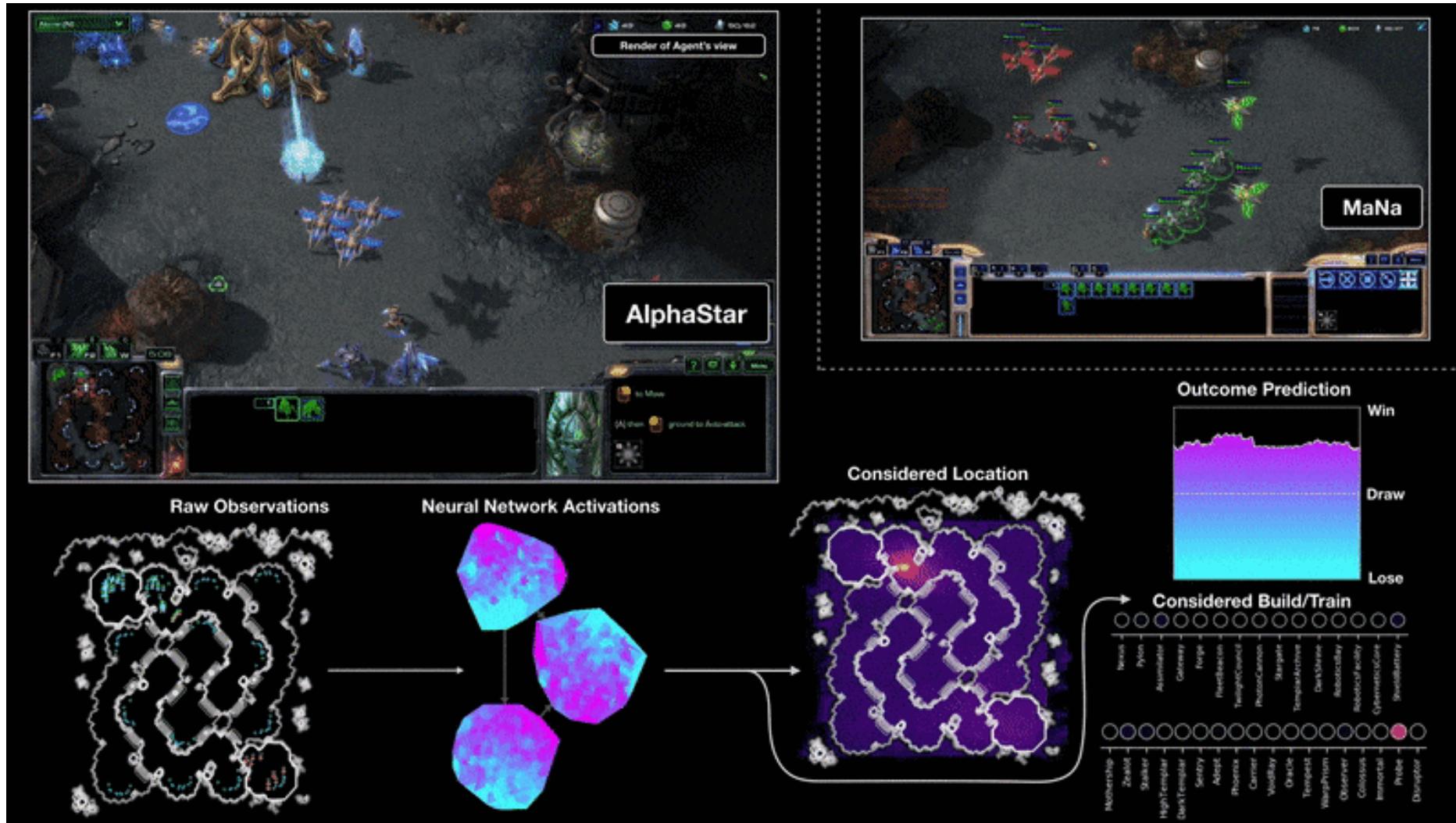
AI Assistants



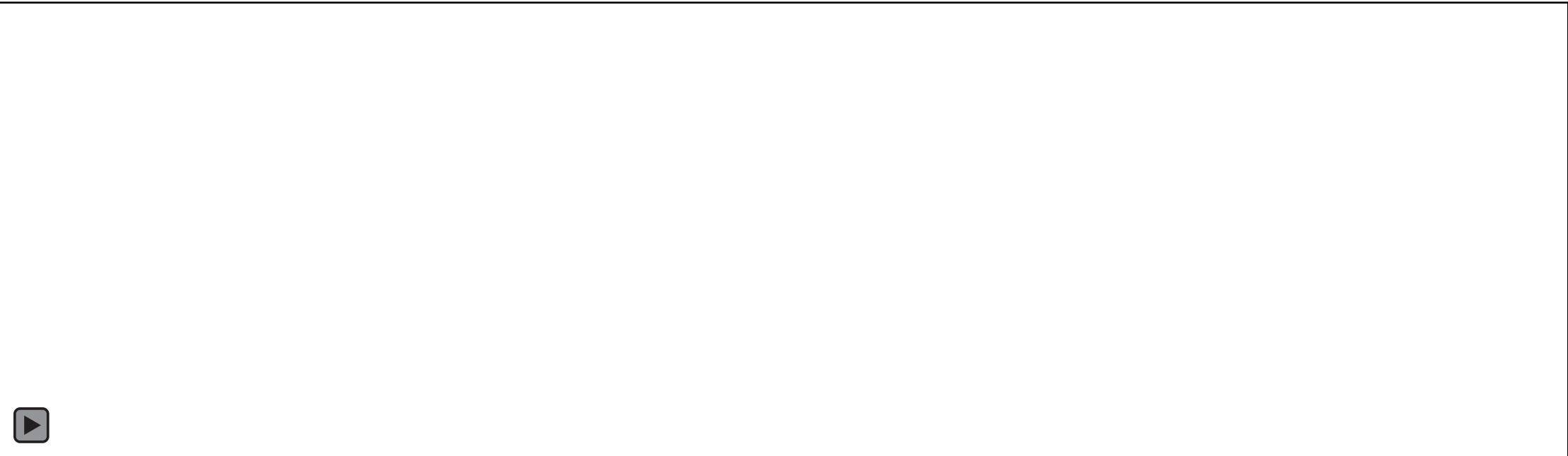
AlphaGo

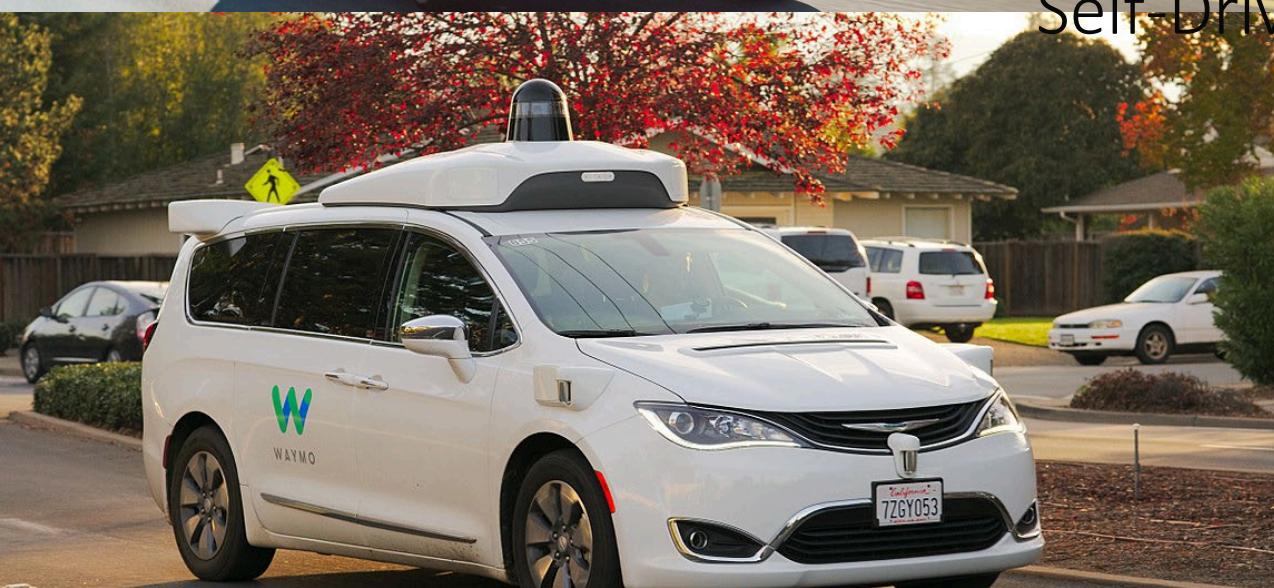


AI Playing Video Games



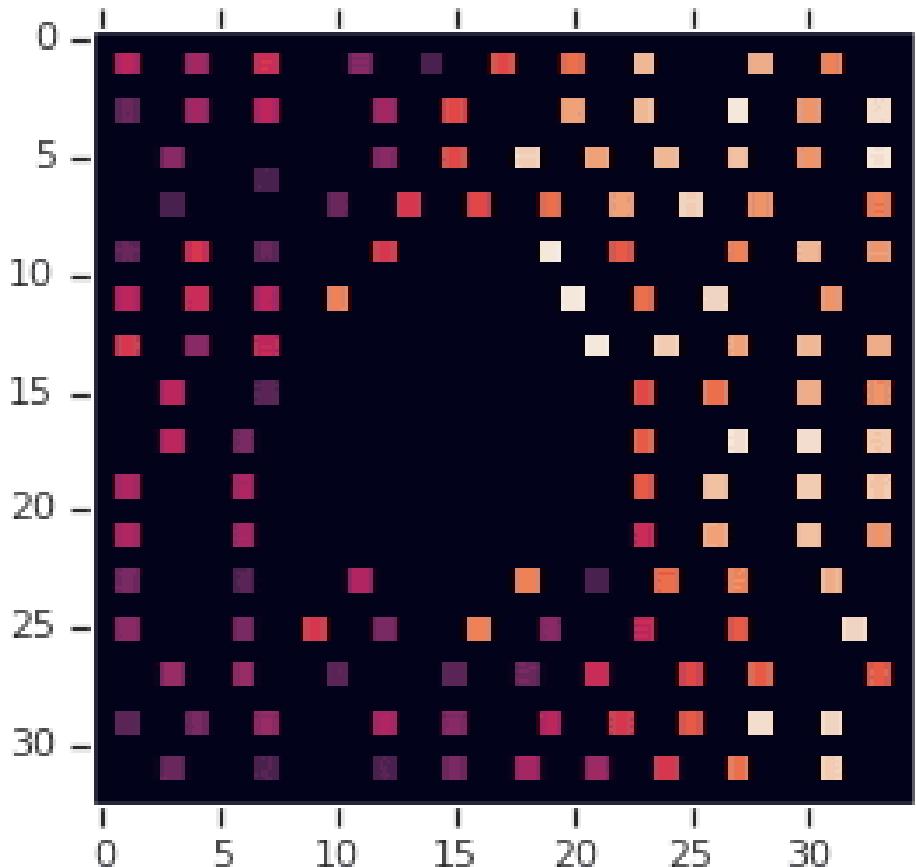
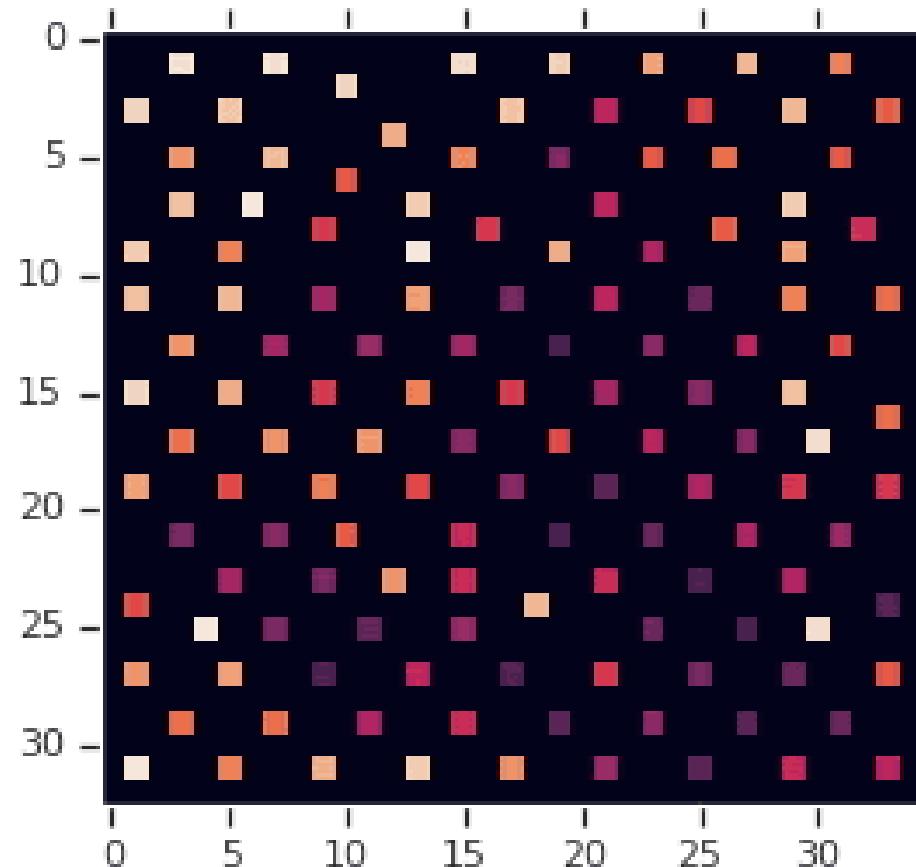
Robot Hands



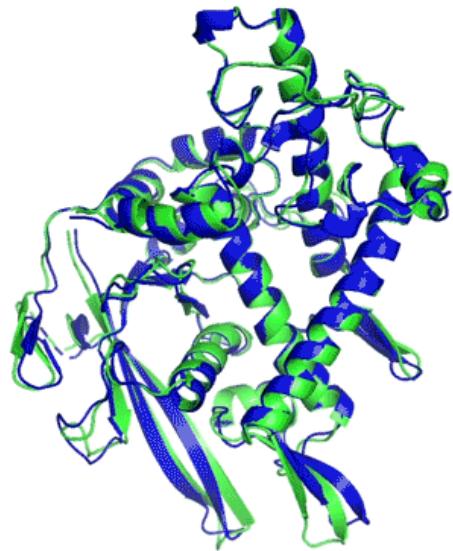


Self-Driving Cars

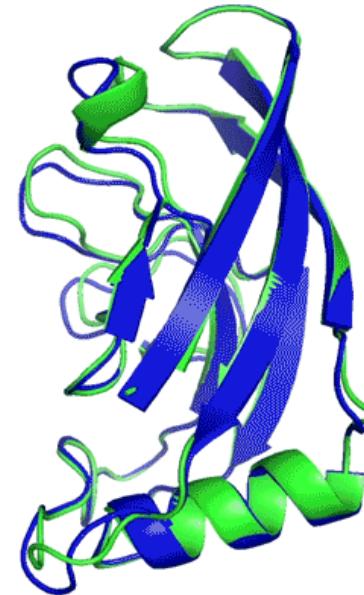
AI Chip Designer



AlphaFold



T1037 / 6vr4
90.7 GDT
(RNA polymerase domain)

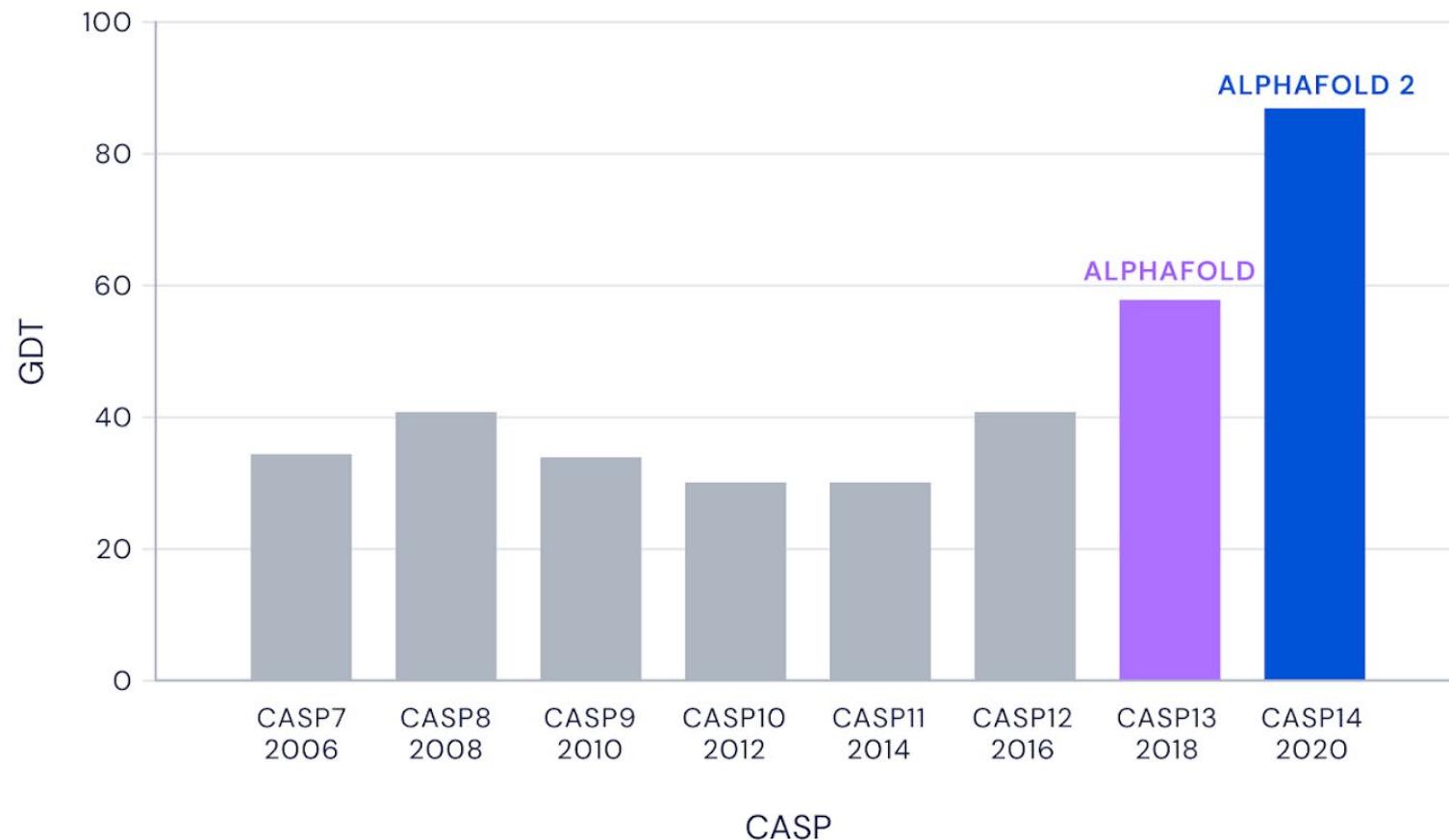


T1049 / 6y4f
93.3 GDT
(adhesin tip)

- Experimental result
- Computational prediction

AlphaFold

Median Free-Modelling Accuracy



AlphaFold

[AlphaFold: The making of a scientific breakthrough - YouTube](#)

OpenAI chatGPT

which topics should I cover in 'deep learning' course?

Designing a comprehensive 'Deep Learning' course requires careful consideration of fundamental concepts and practical applications. Below are some key topics that you should cover in your course:

- 1. Introduction to Deep Learning**
 - What is deep learning?
 - Historical context and evolution of deep learning.
 - Comparison with traditional machine learning approaches.
- 2. Neural Networks**
 - Basics of artificial neural networks.
 - Perceptrons and activation functions.
 - Feedforward and backpropagation algorithms.
 - Gradient descent and optimization techniques.
- 3. Deep Neural Networks**
 - Deep architectures: Deep Feedforward Networks and Convolutional Neural Networks (CNNs).
 - Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks.
 - Autoencoders and Generative Adversarial Networks (GANs).

OpenAI DALL·E 2

TEXT DESCRIPTION

An astronaut Teddy bears A bowl of soup

riding a horse lounging in a tropical resort in space playing basketball with cats in space

in a photorealistic style in the style of Andy Warhol as a pencil drawing

DALL·E 2



OpenAI DALL-E 2

"Picture of the batman in an iron man suit"



OpenAI DALL-E 2

"Cyberpunk illustration of girl
working in cafe in NYC"



OpenAI DALL-E 2

"Photo of a Walmart that looks like a target"



OpenAI DALL·E 2

"A tiger in a lab coat with a 1980s Miami vibe, turning a well oiled science content machine, digital art"



Text-to-3D



Michelangelo style statue of dog reading news on a cellphone.



A pineapple.



A chimpanzee dressed like Henry VIII king of England.



An elephant skull.



A model of a house in Tudor style.



A tarantula, highly detailed.



A snail on a leaf.



An astronaut is riding a horse.

Text-to-3D



Image-to-3D



OpenAI Sora

[OpenAI Sora All Example Videos. - YouTube](#)

Google's PaLM-E



Good Luck!