

# AI/ML 101

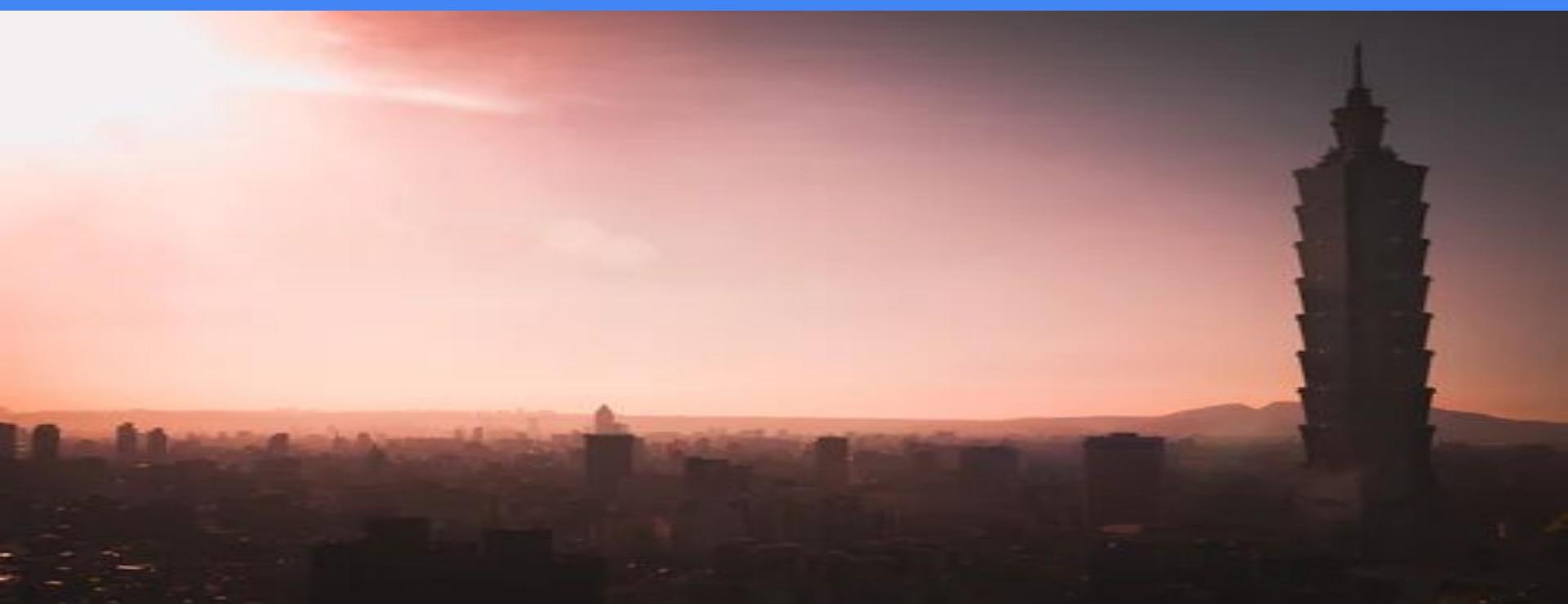
**Aashi Dutt (@AashiDutt)**

# \$whoami

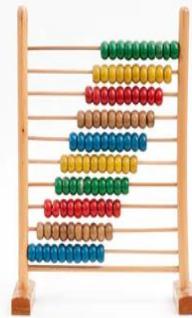


- @AashiDutt
- MS candidate at Georgia Tech, Atlanta
- I contribute to Opensource community
- Lead organizer TensorFlow User Group Chandigarh

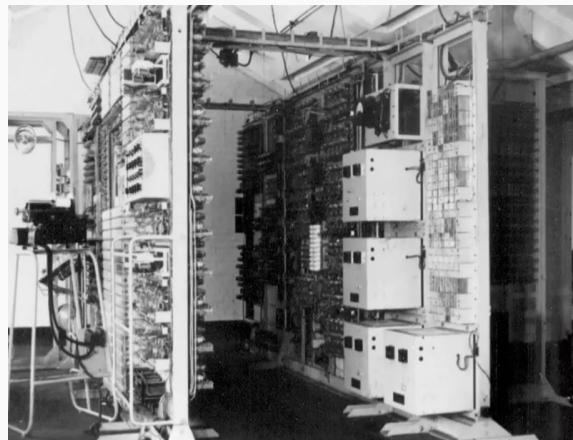
Our world will change more in the next 20 years than in the previous 300 years



# Machines that can hear us, see us, understand us; and that are no longer programmed but taught !



Tabulating Systems Era  
(The Abacus)



The Programmable Systems Era



The Cognitive Systems Era

Data is the new oil, and Artificial Intelligence  
is the new electricity



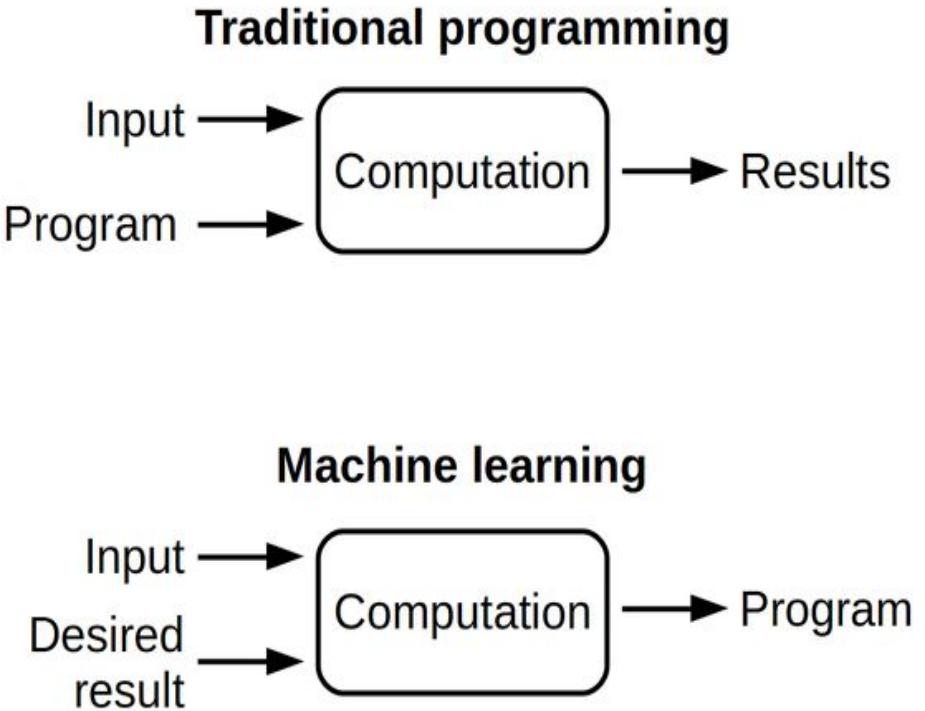
# So what is Artificial Intelligence ?

The science of giving computers  
the ability to learn and find insights  
without explicitly programming the  
machines to do so.

# Traditional Programming

vs

# Machine Learning



# ARTIFICIAL INTELLIGENCE

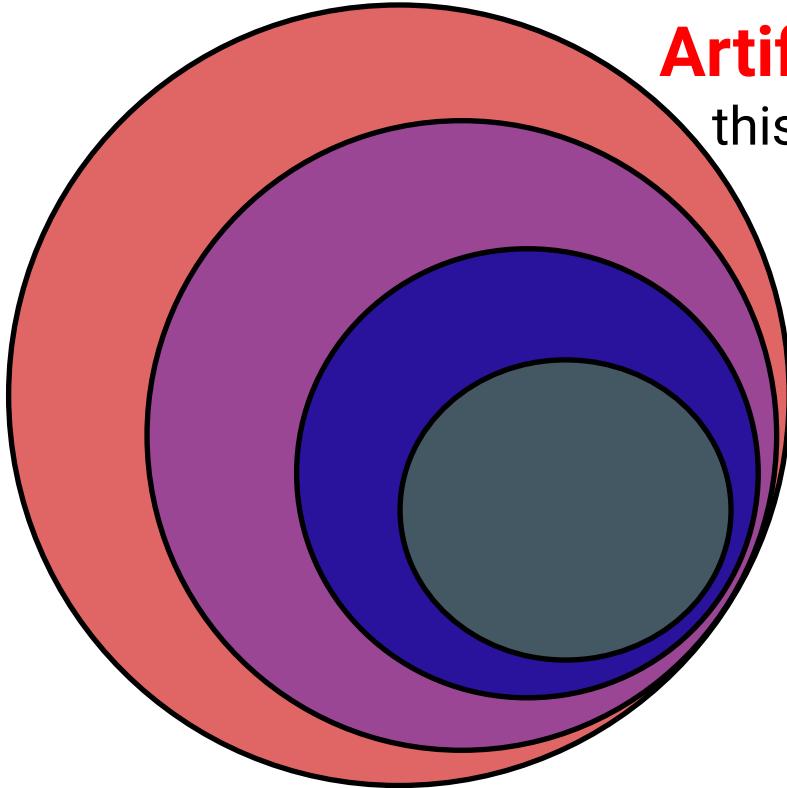
A program that can sense, reason,  
act, and adapt

# MACHINE LEARNING

Algorithms whose performance improve  
as they are exposed to more data over time

# DEEP LEARNING

Subset of machine learning in  
which multilayered neural  
networks learn from  
vast amounts of data



# **Artificial Intelligence**

this whole grand 100-year project

## **Machine Learning**

machines that learn to be smarter

## **Deep Learning**

one of many ways of doing ML

## **Generative AI**

the most popular area of deep learning  
Stable Diffusion(Imagen),  
ChatGPT(Bard), GPT-4(Gemini)...

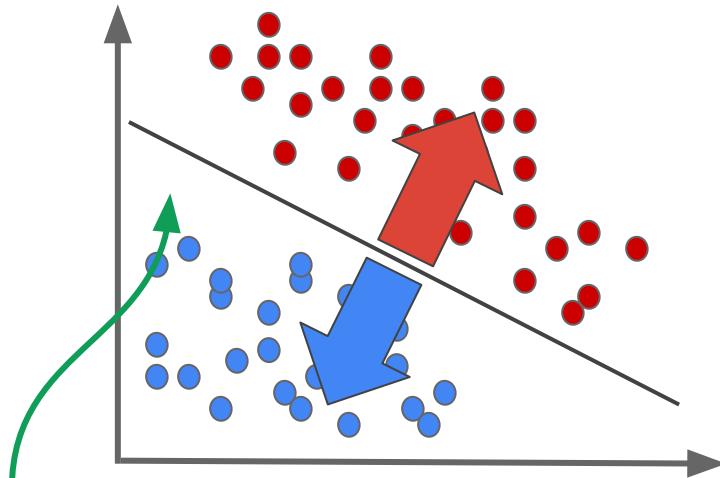
Machine learning is the science of getting computers to act without being explicitly programmed.

vs. Explicit programming

- Spam filter: many rules
- Automatic driving: way too many rules

# What is Machine Learning

identifies trends using patterns in data.



ML Algorithm (rules)



# How Machine Learning works?

# Supervised

Machine needs to be told what the correct label is for a particular input.

Here is a spammy email, correct label is “spam”

# Unsupervised

Machine identifies similar examples in the dataset without knowing the labels.

Customers segmentation for customized marketing strategies

# Semi-supervised

Only some examples have labels

Terrorist detection

# Reinforcement

Guide machine which decision to take in order to maximize rewards.

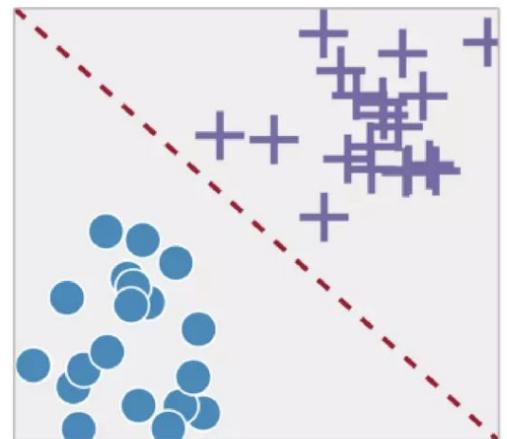
AlphaGo

# And more

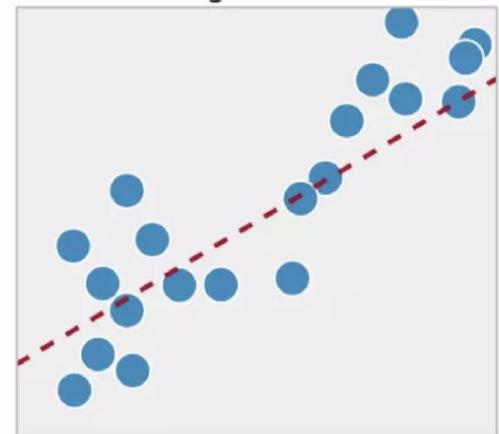
- batch vs online
- instance-based vs model based
- ... etc etc

- **SUPERVISED LEARNING**
- Uses ground truth and labeled data
- Requires prior knowledge
- Approximates the relationship between input and output
- Mainly divided into CLASSIFICATION and REGRESSION
- Naïve Bayes, Random Forest, Support Vector Machine, Neural Networks

- **CLASSIFICATION**
- approximating a mapping function ( $f$ ) from input variables ( $X$ ) to discrete output variables ( $y$ )
- Predicting a label
- Spam/ non spam
- Positive/ negative



- **REGRESSION**
- Approximating a mapping function ( $f$ ) from input variables ( $X$ ) to a continuous output variable ( $y$ )
- Predicting a quantity
- Predict salary from age/experience data
- Sales forecast



- **UNSUPERVISED LEARNING**
- No historical labels
- Learn the inherent structure of data
- Discover the trends in data
- Mainly divided into CLUSTERING and ASSOCIATION

- **CLUSTERING**

- Dividing the population into groups
- Same group members resemble each other compared to other groups
- Connectivity/ centroid/ distribution/density models
- K Means, Hierarchical, KNN, PCA



sample



Cluster/group

# Supervised vs. Unsupervised Learning

Labeled Data



<http://cs231n.github.io/classification/>

Unlabeled Data

The image shows a screenshot of a Google News search results page. At the top, there is a search bar with a magnifying glass icon and a 'Google' logo. Below the search bar, there are two tabs: 'U.S. edition' and 'Modern'. The main content area is titled 'Top Stories' and lists several news items:

- Washington mall shooting: Manhunt underway after gunman kills 5**  
CNN - 3 hours ago  
(CNN) A man carrying a rifle entered a Macy's store at a mall in Washington state, shot dead four women and a man, and vanished into the night, police said.
- Syrian Troops Advance Near Aleppo**  
Wall Street Journal - 1 hour ago  
BEIRUT—Syrian government forces captured a rebel-held area on the edge of Aleppo on Saturday, tightening their siege on opposition-held neighborhoods in the northern city as an ongoing wave of airstrikes destroyed more buildings.
- Video shows moments before Keith Lamont Scott's shooting**  
CNN - 3 hours ago  
(CNN) The family of Keith Lamont Scott has released cell phone video, recorded by his wife, that shows the moments leading to his fatal shooting by police in Charlotte, North Carolina.
- African American Museum opening: 'This place is more than a building. It is a dream come true.'**  
Washington Post - 10 minutes ago  
More than 100 years after it was first proposed and 13 years after it was authorized by Congress, the National Museum of African American History and Culture opens today in Washington.
- Snapchat Releases First Hardware Product, Spectacles**  
Wall Street Journal - 13 hours ago  
IN AN UNMARKED BUILDING on a quiet side street just off the beach in Venice, California, 26-year-old Snapchat CEO Evan Spiegel stands in a small conference room.
- A new study says Trump would raise taxes for millions. Trump's campaign insists he won't.**  
Washington Post - 1 hour ago  
More than half of America's single parents and one-fifth of its families with children could see their federal income taxes go up under Republican Donald Trump's revamped tax plan, according to a new analysis of the plan by a New York University ...

<https://news.google.com/>

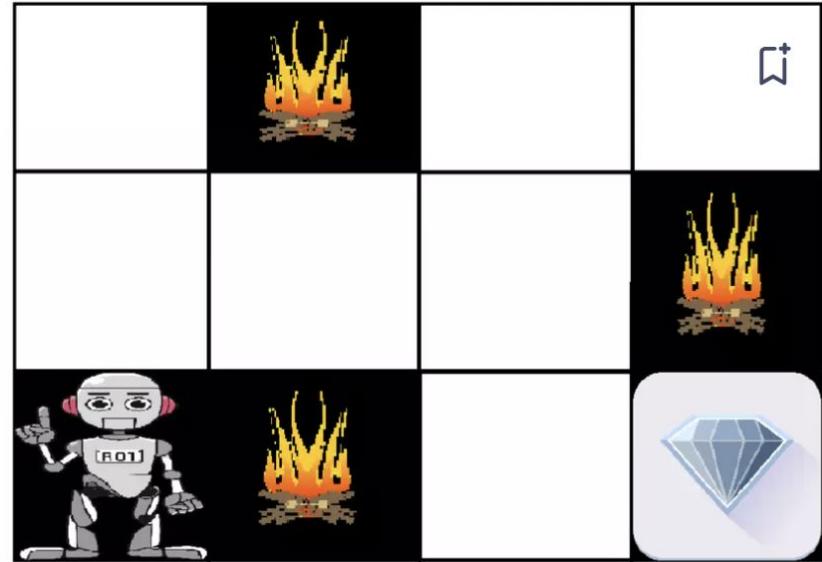
# Supervised Learning

- Linear Regression
- Logistic Regression
- Softmax Regression
- Support Vector Machines... and more

# Unsupervised Learning

- Naive Bayes Classifier, K-means Clustering... and more

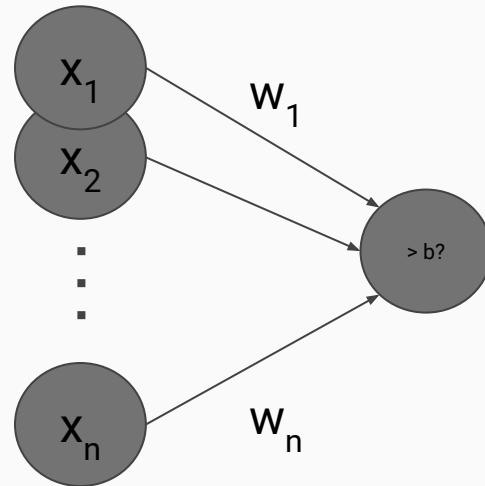
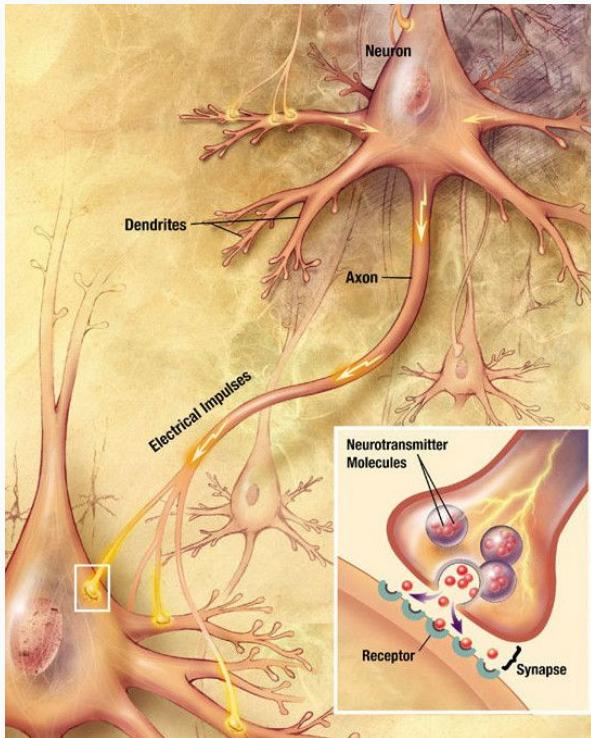
- **REINFORCEMENT**
- Maximize reward in a given situation
- Find the best possible behavior/ path
- Input: initial state of the model
- Output: many possible solutions to a given problem
- Training: reward or punishment
- Iterations: best solution is selected when reward is maximum





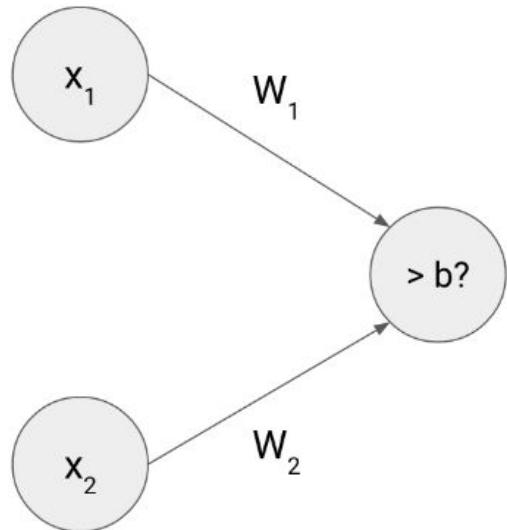
# What is Neural Network and Deep Learning?

# Inspired by the behavior of biological neurons



$$\sum_i^n w_i x_i > b$$

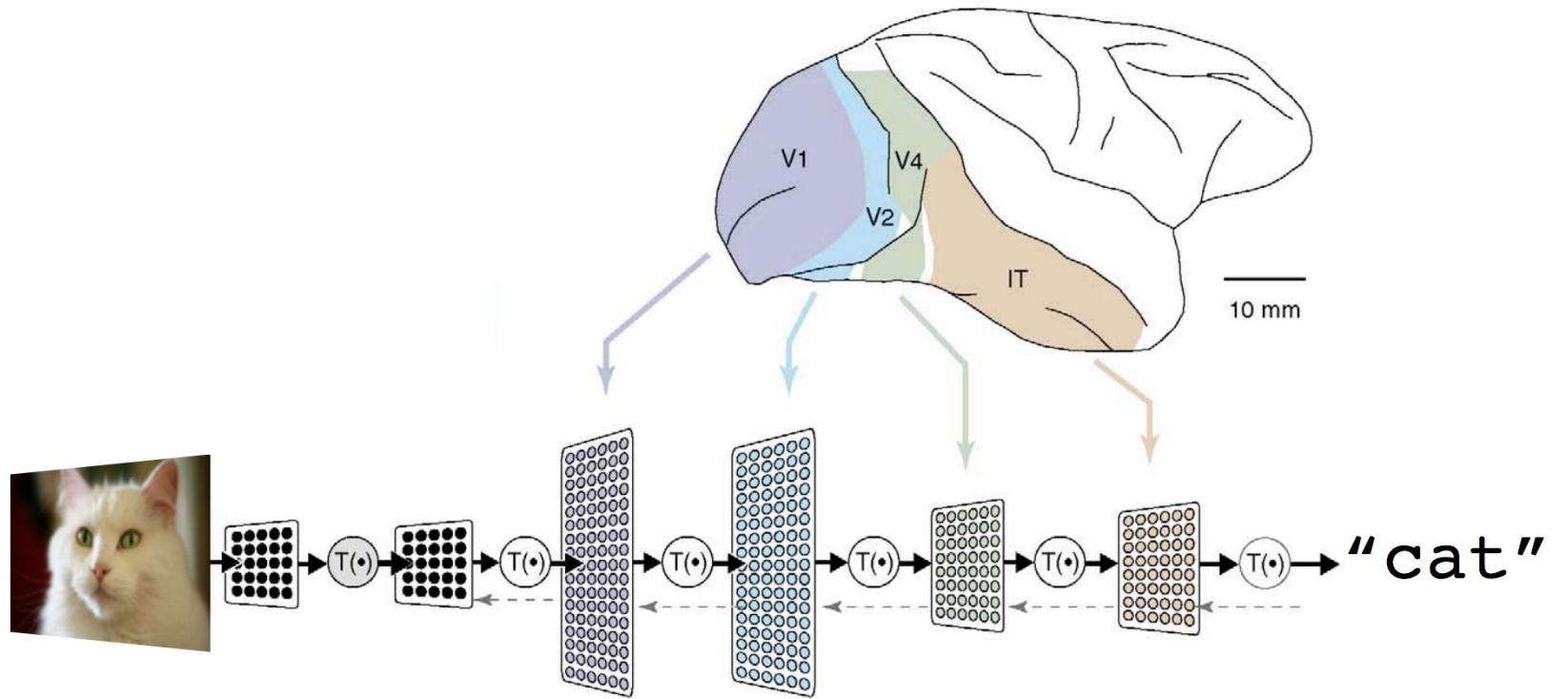
# What is Parameters?



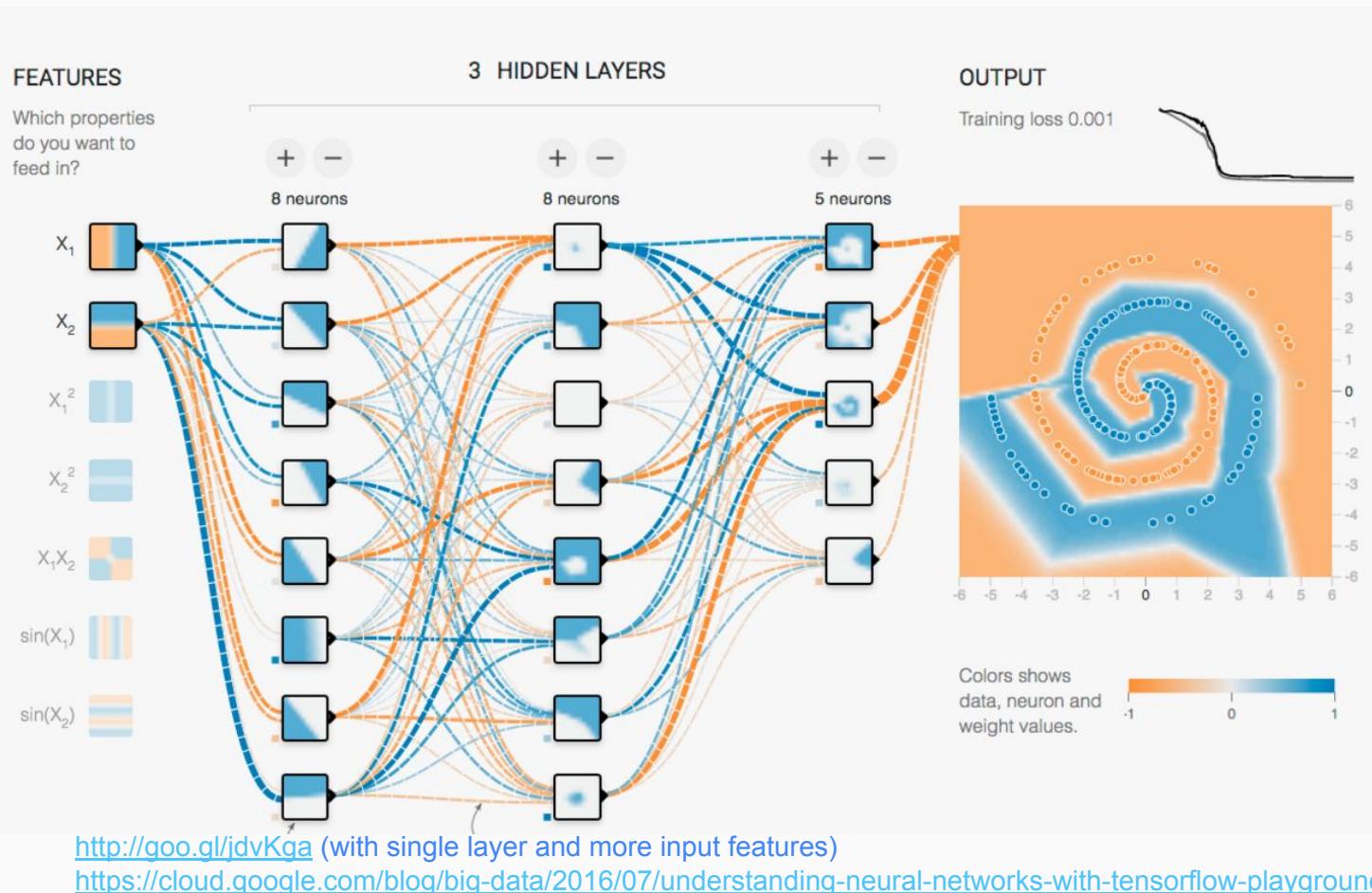
$$w_1x_1 + w_2x_2 > b$$

The computer tries to find  
the best **parameters**

# Neural Network is a function that can learn



# Deep Neural Network & Backpropagation



# So, what is Deep Learning?

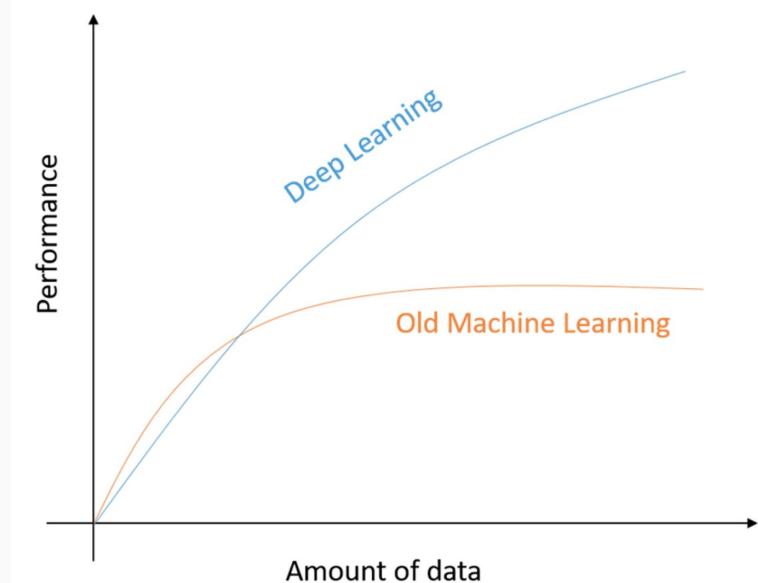
- Neural Networks with many layers really could be trained well, if the weights are initialized in a clever way rather than randomly
- Deep machine methods are more efficient for difficult problems than shallow methods
- Rebranding to Deep Nets, Deep Learning

# Machine Learning vs Deep Learning

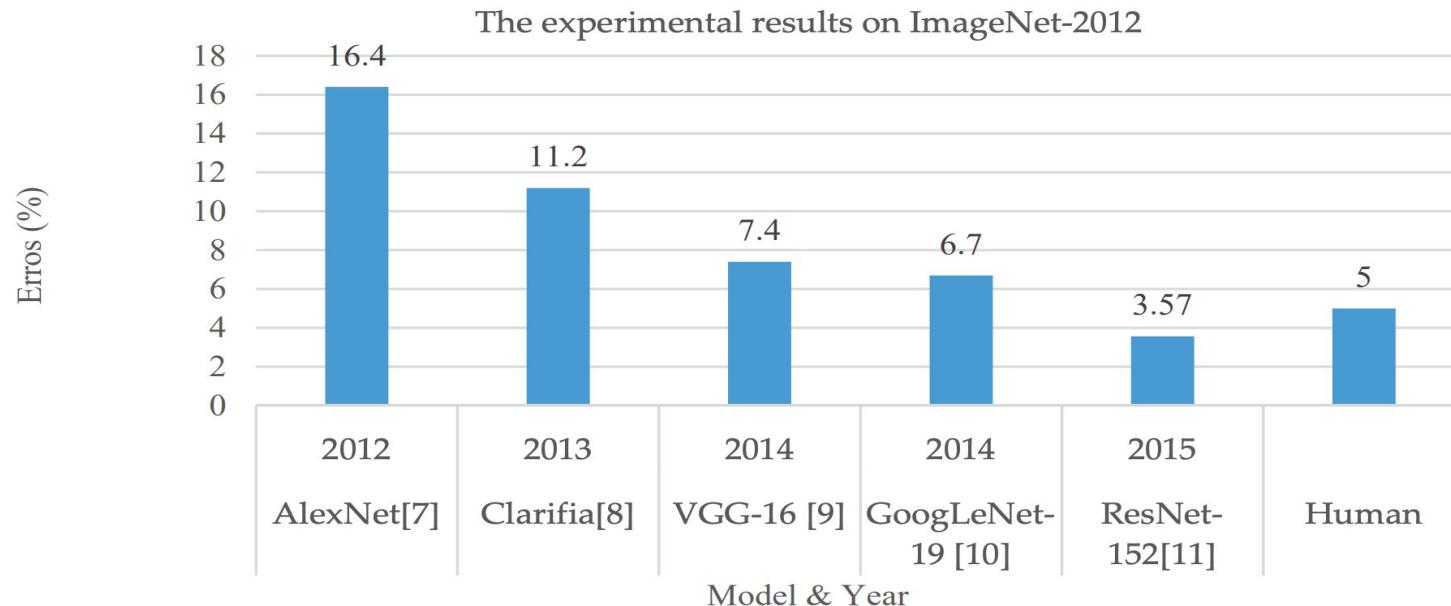
In ML, a lot of feature extraction is required whereas DL learns that as part of the training process.

With more data, DL models can outperform the ML models.

Hence, DL is most widely used when a lot of data is present.



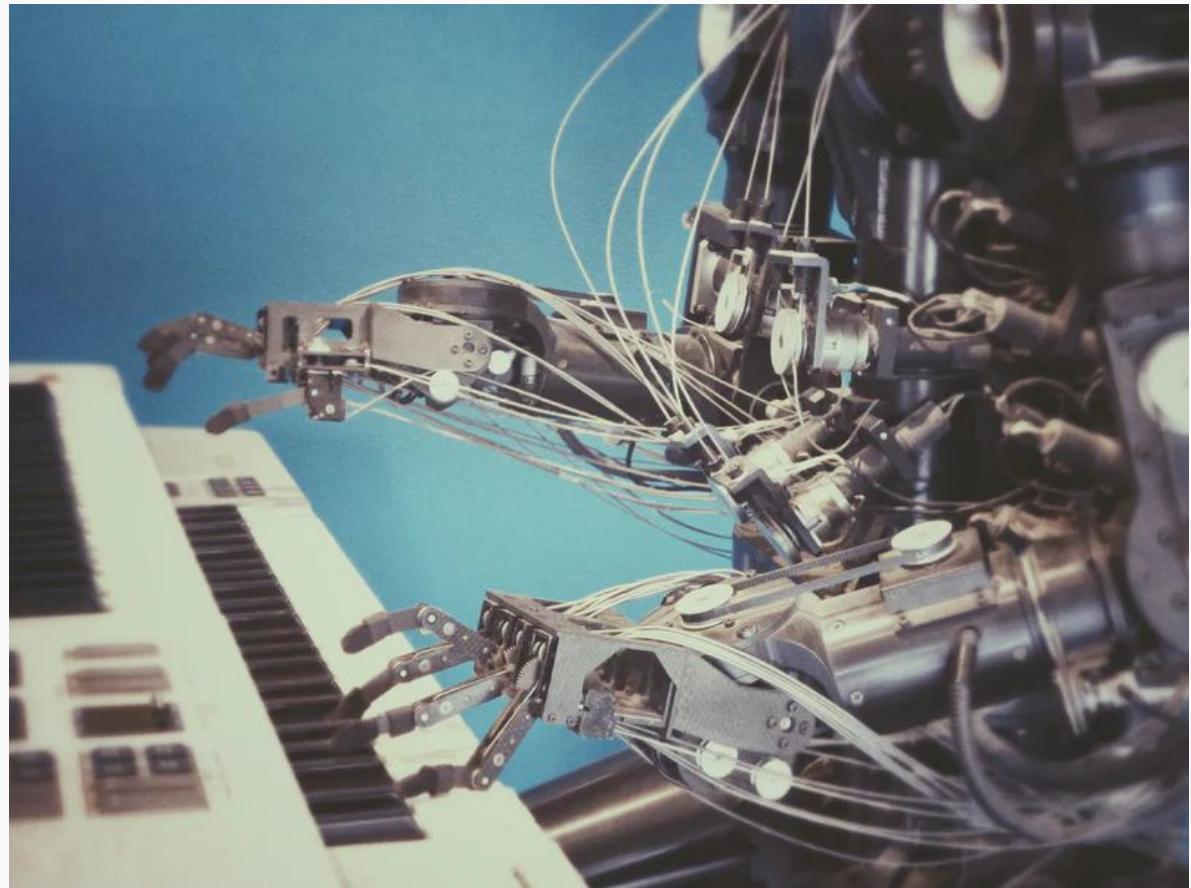
In 2015, for the first time, a Deep Learning model beats human accuracy at Image Classification.



Source: [A State-of-the-Art Survey on Deep Learning Theory and Architectures](#)

*“If you can describe  
your job, it will probably  
be automated.”*

*“If you cannot fight it,  
join it.”*





# Google's AI/ML products

# What is TensorFlow?



TensorFlow

Google's **open source** library for  
machine intelligence

**[tensorflow.org](https://tensorflow.org)** launched in Nov 2015

Used by many production ML projects

# What is Keras?



Google's Deep Learning framework  
supporting multiple  
backends(TensorFlow, PyTorch,  
JAX)

# What is JAX?

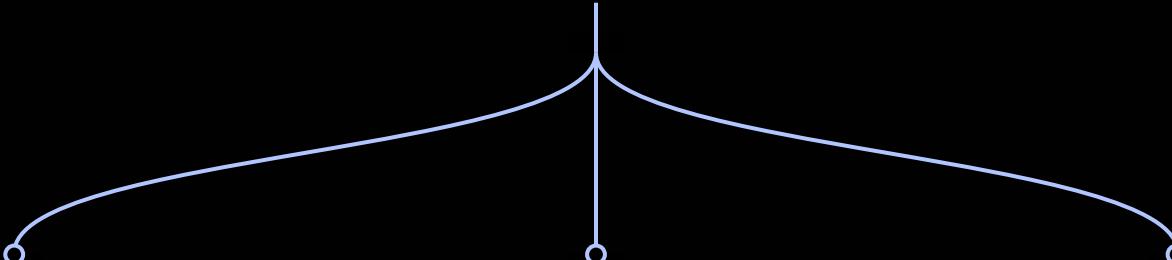


Google's Deep Learning  
framework for cutting-edge  
research  
(NumPy running on TPU)



# Generative AI

# Gemini



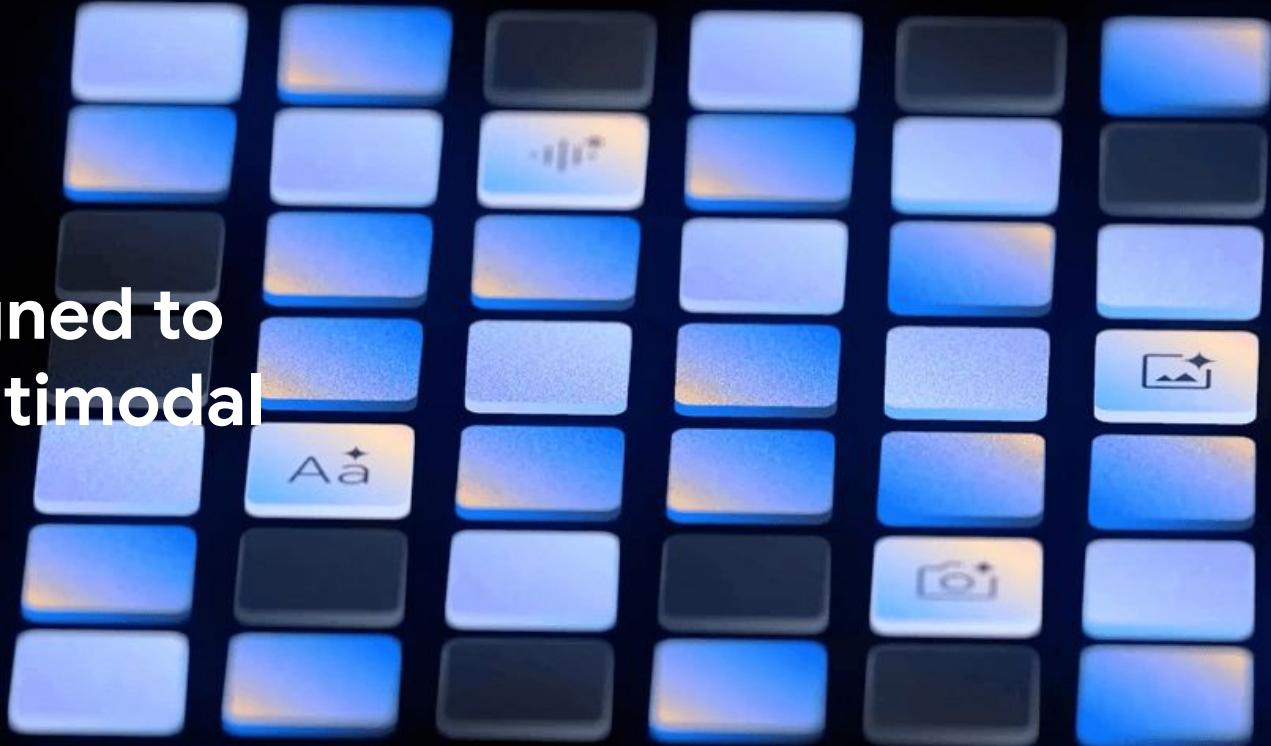
The diagram features the word "Gemini" in a large, blue, serif font. A small, multi-pointed star is positioned above the letter "i". Below the word, a vertical line descends to a horizontal line that curves outwards to the left and right, ending in three small circles. These circles are connected by curved lines to three descriptive labels: "Natively multimodal" on the left, "Sophisticated reasoning" in the center, and "Advanced Coding" on the right.

Natively  
multimodal

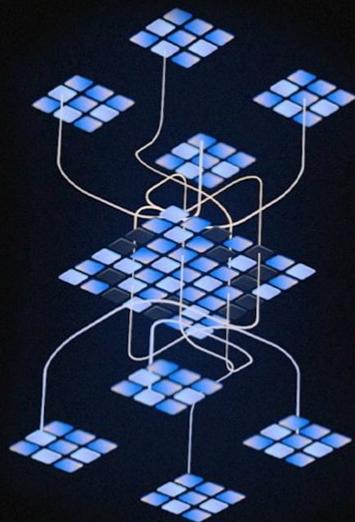
Sophisticated  
reasoning

Advanced  
Coding

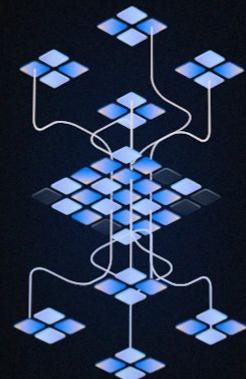
**Gemini is designed to  
be natively multimodal**



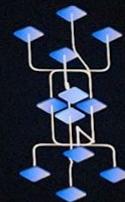
# Gemini is also the most flexible model Google ever built



Ultra



Pro



Nano



Ultra

Our most capable and largest model for highly-complex tasks.



Pro

Our best model for scaling across a wide range of tasks.



Nano

Our most efficient model for on-device tasks.

**Try Gemini for yourself**

# Google AI Studio (fka MakerSuite)

Google AI Studio

- Get API key
- Create new
- My library
- No prompts yet
- Getting started
- Documentation
- Prompt gallery
- Discord community
- AI Studio in Vertex
- Settings

<

Untitled prompt ↵

Save Get code :

Insert: Image {{ }} Test input

Run settings Reset

Identify the city where this photo was taken and give a brief description of the city

Model [redacted]

Temperature 0.25

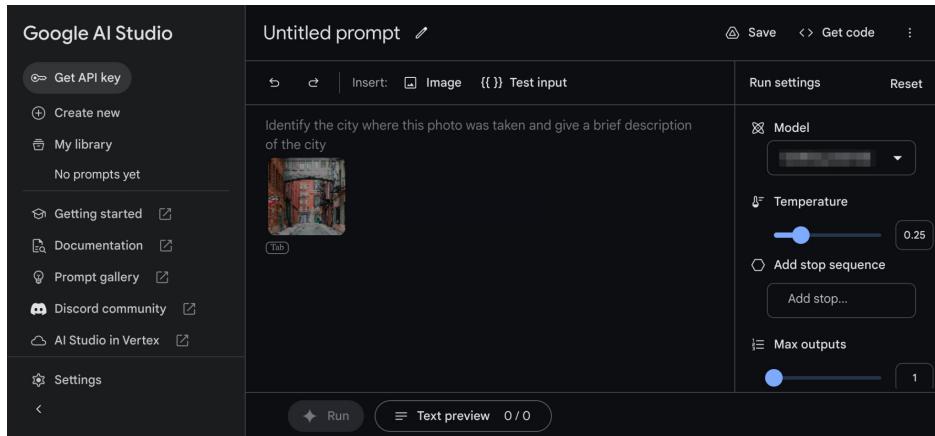
Add stop sequence Add stop...

Max outputs 1

Run Text preview 0 / 0

<https://makersuite.google.com/>

# Google AI Studio (fka MakerSuite)

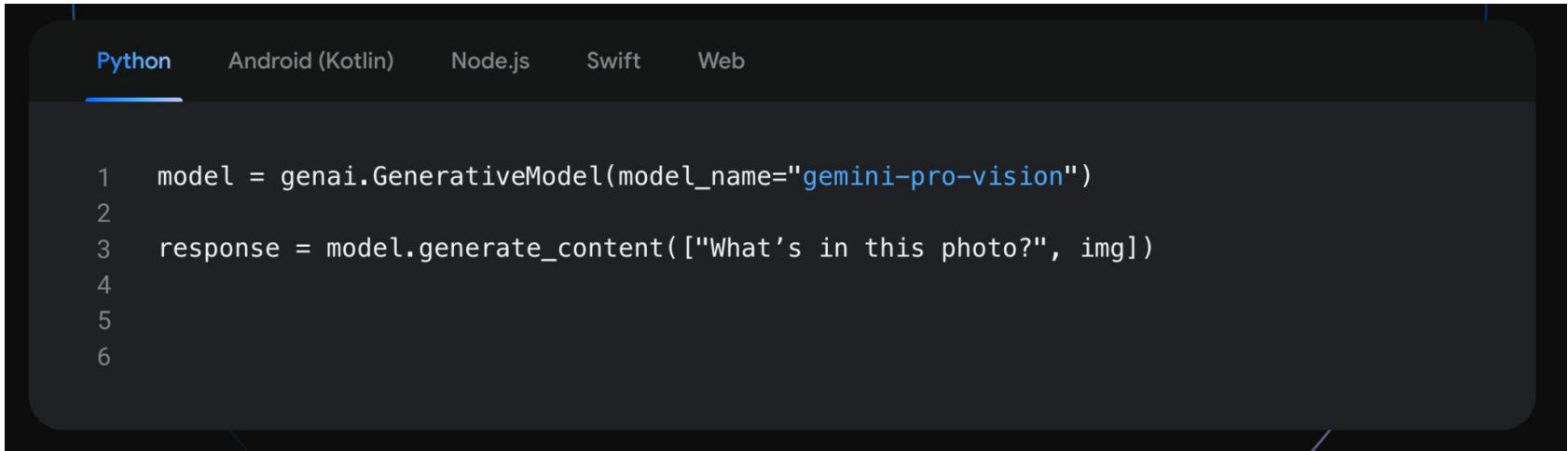


- Try out models
- Experiment with prompts
- Export to code

# 3 Steps to Getting Started with Gemini via AI Studio

- Visit <https://ai.google.dev/> and [get an API Key](#).
- Get inspired by visiting various code samples/applications:  
[Example Prompts, Code and Integrations | Google AI for Developers](#).
- Integrate Gemini Pro into your app with the API. Integrating it is just a few lines of code, as demonstrated below. Tutorials available: [Python](#), [Go](#), [Node.js](#), [Web](#), [Swift](#), [Android](#) and [REST API](#).

# Integrating Gemini Pro model into your application



The image shows a screenshot of a code editor interface. At the top, there is a navigation bar with five tabs: "Python", "Android (Kotlin)", "Node.js", "Swift", and "Web". The "Python" tab is currently selected, indicated by a blue underline. Below the tabs, there is a dark gray code editor area containing the following Python code:

```
1 model = genai.GenerativeModel(model_name="gemini-pro-vision")
2
3 response = model.generate_content(["What's in this photo?", img])
4
5
6
```

# Gemini API

**Gemini Pro:** Optimized for text prompts.

**Gemini Pro Vision:** Optimized for text and image prompts.

```
# Install SDK
pip install -q -U google-generativeai
import google.generativeai as genai

# Configure API Key
genai.configure(api_key=<your-API-key>)

# Configure the model
model = genai.GenerativeModel('gemini-pro-vision')

# Give the input image and prompt, get response.
img = PIL.Image.open('image.jpg')
response = model.generate_content(["Describe the image", img],
stream=True)
```

# Vertex AI



## TOOLS



Dashboard



Model Garden

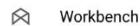


Pipelines

## NOTEBOOKS

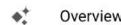


Colab Enterprise



Workbench

## VERTEX AI STUDIO



Overview



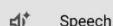
Multimodal NEW



Language



Vision



Speech

## DATA

## MODEL DEVELOPMENT

## DEPLOY AND USE



## Get started with Vertex AI

Vertex AI empowers machine learning developers, data scientists, and data engineers to take their projects from ideation to deployment, quickly and cost-effectively. [Learn more about Vertex AI](#)

[ENABLE ALL RECOMMENDED APIs](#)

## Tutorials

Try an interactive tutorial to learn how to train, evaluate, and deploy a Vertex AI AutoML or custom-trained model.

[VIEW TUTORIALS](#)[SHOW API LIST](#)

## Colab Enterprise

A new notebook experience with enterprise-grade privacy and security. Start coding in a couple clicks.

[Go to Colab Enterprise](#)

## Model Garden

Browse, customize, and deploy machine learning models. Choose from Google or popular open-source models.

[Try now](#)

## Vertex AI Studio

Test and customize large language and generative image models.

[Try now](#)

## Vertex AI

## TOOLS

Dashboard

Model Garden

Pipelines

## NOTEBOOKS

Colab Enterprise

Workbench

## VERTEX AI STUDIO

Overview

 Multimodal NEW

Language

Vision

Speech

## DATA

## MODEL DEVELOPMENT

## DEPLOY AND USE

Marketplace

## Vertex AI Studio

Vertex AI Studio lets you quickly test and customize generative AI models so you can leverage their capabilities in your applications. [Learn more](#)

DOCUMENTATION

API REFERENCE



## Multimodal

Powered by Gemini NEW

Try Gemini, a multimodal model from Google DeepMind capable of processing images, videos and natural language. [Learn more about Gemini](#)

TRY IT NOW

MULTIMODAL HOME

VIEW CODE



### Language

Powered by Gemini NEW

Write natural language and code prompts for tasks like classification, summarization, code generation, chatbots and more, with PaLM 2 or Gemini.

OPEN

VIEW CODE



### Vision

Powered by Imagen NEW

Write text prompts to generate new images or new areas of an existing image.

OPEN

VIEW CODE



### Speech

Convert speech into text or synthesize speech from text using Google's Universal Speech Model (USM).

OPEN

VIEW CODE

**Modalities**

Language	45
Vision	82
Tabular	5
Document	4
Speech	1
Video	4
Multimodal	2

**Tasks**

Generation	51
Classification	48
Detection	31
Extraction	14
Recognition	13
Translation	9
Embedding	3
Segmentation	6
Retrieval	1

 Search modelsSuggestions text embedding essay outline BERT

## Foundation models

Pre-trained multi-task models that can be further tuned or customized for specific tasks. Models marked with ◆ are available in Vertex AI Studio.

◆ Generative AI Language

### Gemini Pro

The best performing Gemini model with features for a wide range of tasks

google/gemini-proVIEW DETAILS◆ Generative AI Multimodal

### Gemini Pro Vision

Created from the ground up to be multimodal (text, images, videos) and to scale across a wide range of tasks

google/gemini-pro-visionVIEW DETAILS◆ Generative AI Language

### PaLM 2 Text Bison

Designed for single-turn instruction tasks like classification, extraction, summarization and generation.

text-bison@002VIEW DETAILS▼ SHOW ALL (65)

## Fine-tunable models

Models that data scientists can further fine-tune through a custom notebook or pipeline.

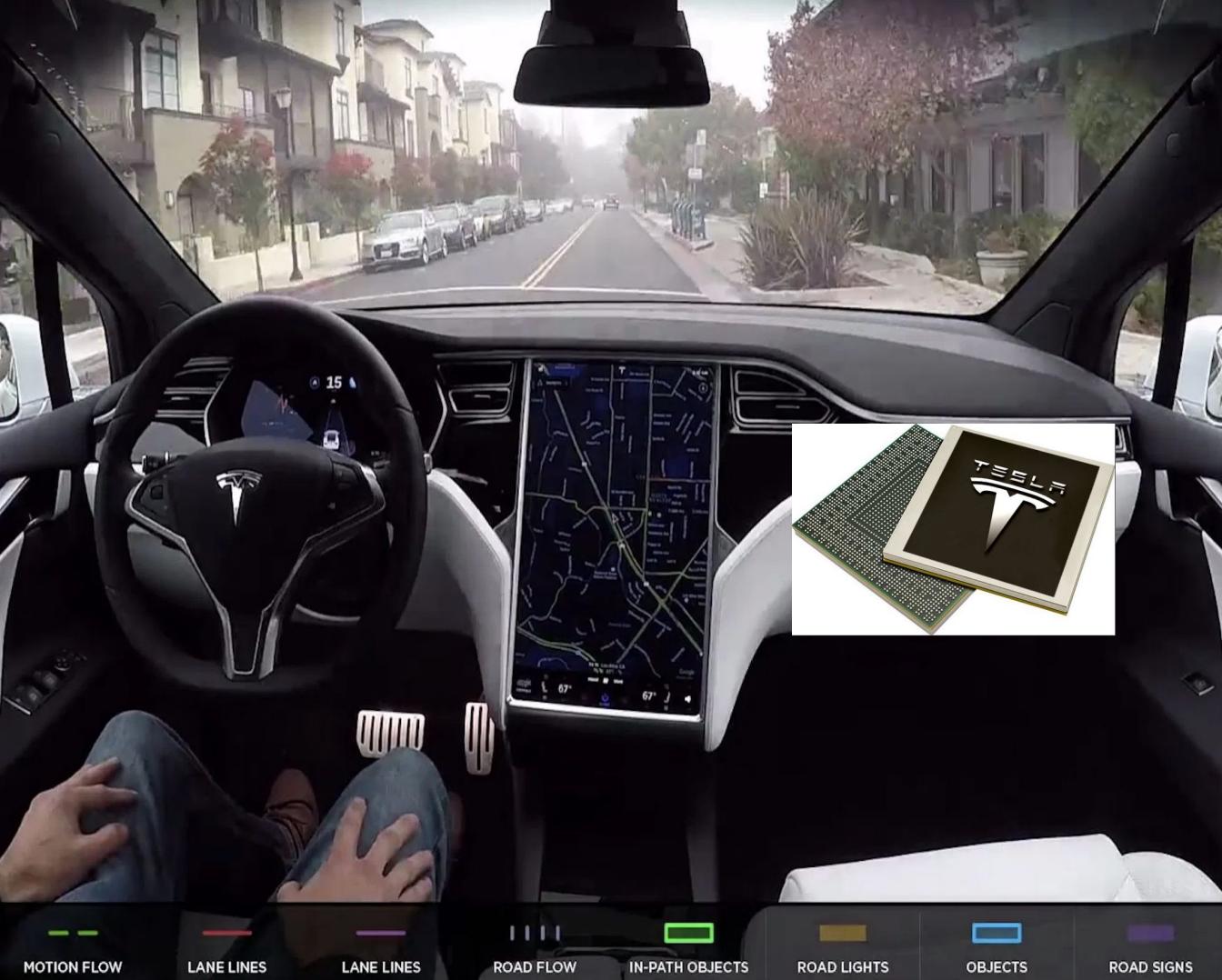
Classification Visiontfhub/EfficientNetV2Classification Visiontfvision/vitDetection Visiontfvision/SpineNet



AI in everyday life

# amazon go grocery





MOTION FLOW

LANE LINES

LANE LINES

ROAD FLOW

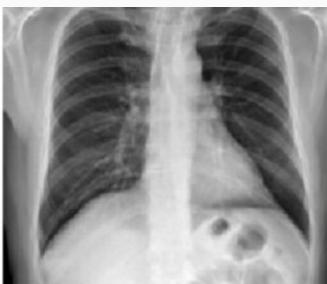
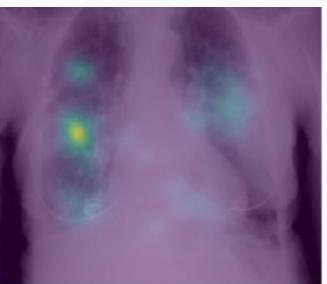
IN-PATH OBJECTS

ROAD LIGHTS

OBJECTS

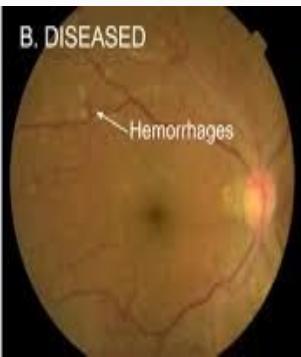
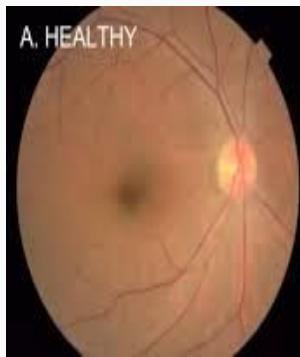
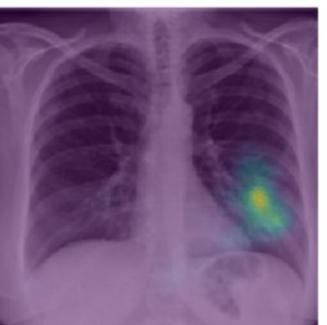
ROAD SIGNS

RIGHT REARWARD VEHICLE CAMERA



(a) Geographic Extent Score: 5, Predicted: 5.3

(b) Geographic Extent Score: 0, Predicted: -0.8



# NeuraLink



# Deep Fakes: *With Great Power comes Great Responsibility*



**Reference**



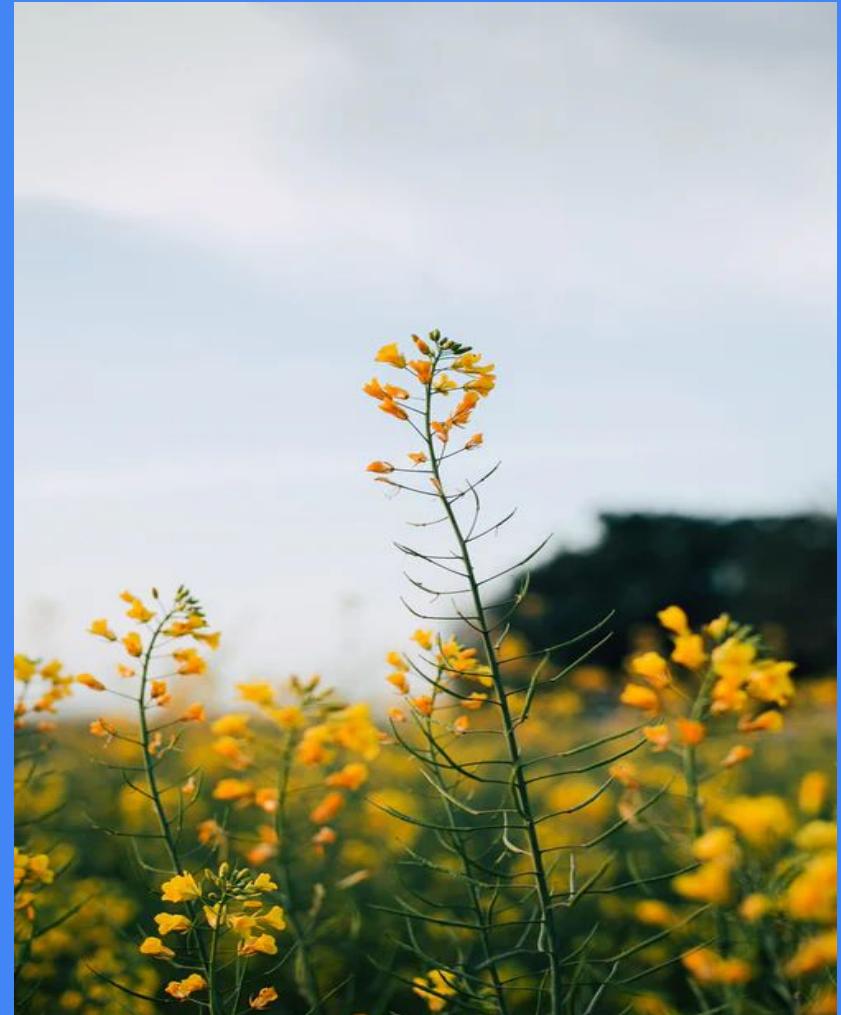
**Our Result**



How to get started?

- TensorFlow Tutorials: <https://www.tensorflow.org/tutorials>
- Deeplearning.ai: <https://www.deeplearning.ai/>
- Fast.ai: <https://course.fast.ai/>
- Arxiv Sanity: <http://www.arxiv-sanity.com/>

The Future is  
Bright and Full  
of Opportunities



*Thank You*