

Overview of Artificial Intelligence and Machine Learning

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What is Artificial Intelligence (AI)?

- AI is concerned with developing machines with the ability that are usually done by us humans with our natural intelligence

Birth of AI (1950s)

- In 1950, British mathematician and computer scientist Alan Turing posed the Turing test
 - A human evaluator (C) judging natural language conversations between a human (B) and a machine (A) designed to generate human-like responses.
 - The conversation would be limited to a text-only channel, such as a computer keyboard and screen
 - If the evaluator cannot reliably tell the machine from the human, the machine would be said to have passed the test.



VOL. LIX. No. 236.] [October, 1950

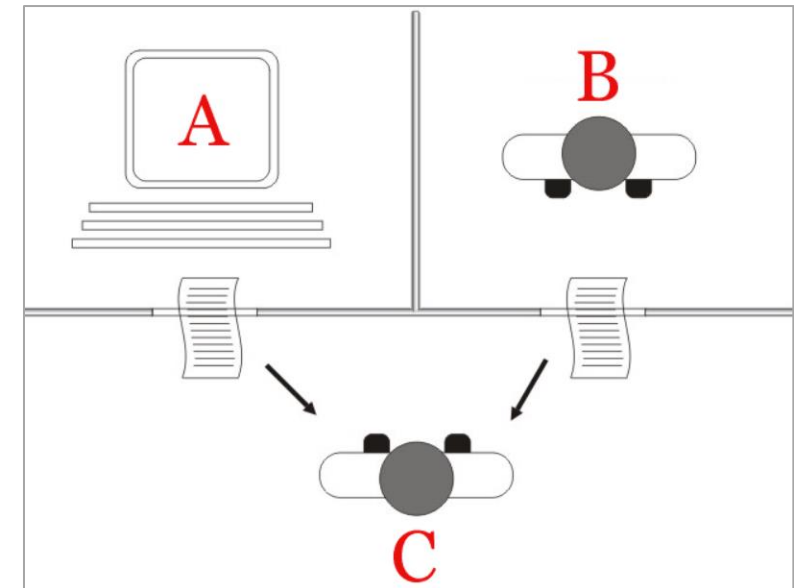
MIND
A QUARTERLY REVIEW
OF
PSYCHOLOGY AND PHILOSOPHY

I.—COMPUTING MACHINERY AND
INTELLIGENCE

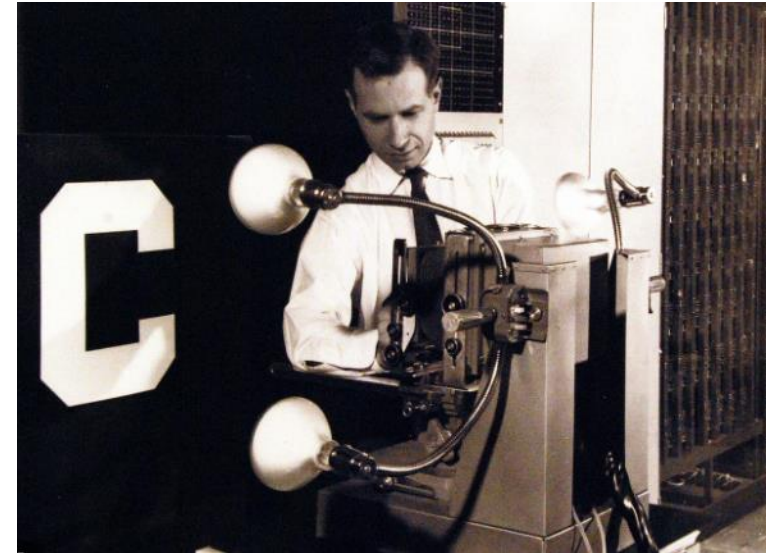
BY A. M. TURING

1. *The Imitation Game.*

I PROPOSE to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words 'machine' and 'think' are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning



- In 1958, a psychologist Frank Rosenblatt designed the Perceptron, an Artificial neural network
 - Demonstrate the potential of machine learning algorithms to mimic human intelligence.
 - Foundation of deep learning



AI Booms (1960s –1970s)

- Significant progress in AI development
- Development of “Expert Systems”
 - Computer systems that emulates decision making of a human expert.
- Development of Neural Networks and Machine Learning

Expert Systems

- Computer programs intended to encapsulate the thought processes of human experts such as doctors, engineers, and even musicians.
 - Study a human expert at work, watch what they do and how they do it, and perhaps ask them to describe their process
 - Capture that thinking and behavior with a set of rules.
- MYCIN Expert System
 - The First AI Medical Diagnosis developed in 1972
 - Help identify bacteria that cause blood infections and other severe infections
 - Perform diagnoses by asking questions about a patient's symptoms, and then comparing the answers to a database of known infections.
 - Used a rule-based system to make decisions.

Eliza

- A chatbot created in 1964 at the MIT Artificial Intelligence Laboratory
- Simulates a conversation with psychotherapist
- Use rules to mechanically transform inputs into outputs

Video: [Before Siri and Alexa, there was ELIZA](#)
Try: <https://web.njit.edu/~ronkowitz/eliza.html>

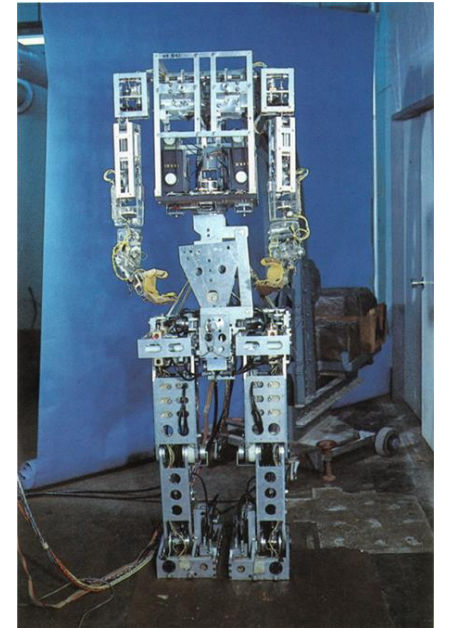
```
Welcome to
      EEEEE LL      IIII ZZZZZZ AAAAA
      EE     LL      II     ZZ  AA  AA
      EEEEE LL      II     ZZ  AAAAAA
      EE     LL      II     ZZ  AA  AA
      EEEEE LLLLLL IIII ZZZZZZ AA  AA

Eliza is a mock Rogerian psychotherapist.
The original program was described by Joseph Weizenbaum in 1966.
This implementation by Norbert Landsteiner 2005.

ELIZA: Is something troubling you ?
YOU:   Men are all alike.
ELIZA: What is the connection, do you suppose ?
YOU:   They're always bugging us about something or other.
ELIZA: Can you think of a specific example ?
YOU:   Well, my boyfriend made me come here.
ELIZA: Is it important to you that your boyfriend made you come here ?
YOU:   He says I'm depressed much of the time.
ELIZA: I am sorry to hear that you are depressed.
YOU:   It's true. I am unhappy.
ELIZA: Can you explain what made you unhappy ?
YOU:
```

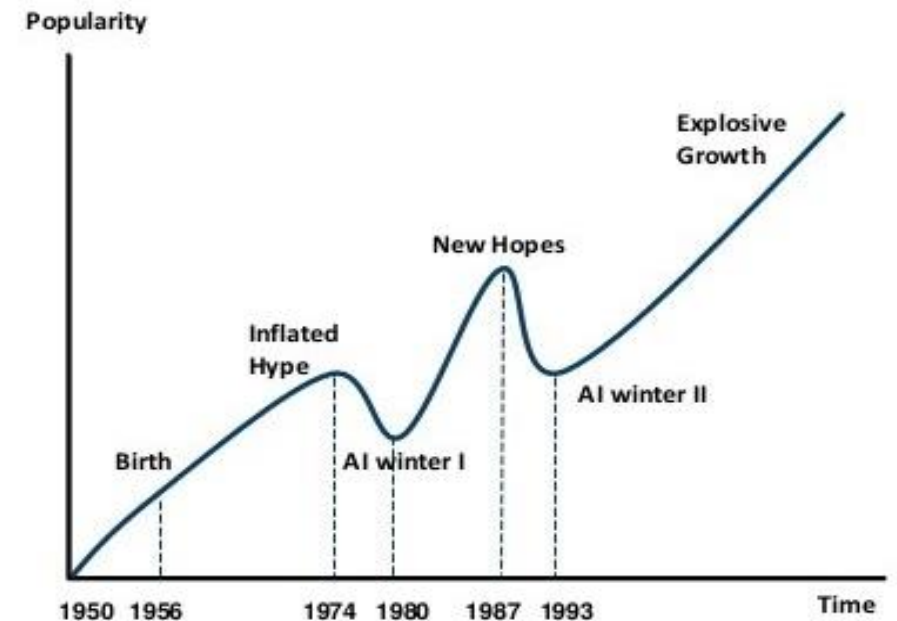
Robots

- WABOT-1 (1970)
 - The first anthropomorphic robot, was built in Japan at Waseda University.
 - Can walk with his lower limbs and was able to grip and transport objects with hands that used tactile-sensors



AI Winters

- A period of reduced interest, funding, and progress in the field of artificial intelligence (AI).
- Overpromising results
- Lack of computational power
- Limitations of early AI models
 - Early AI models and techniques, such as those used in expert systems, proved inflexible and difficult to scale.

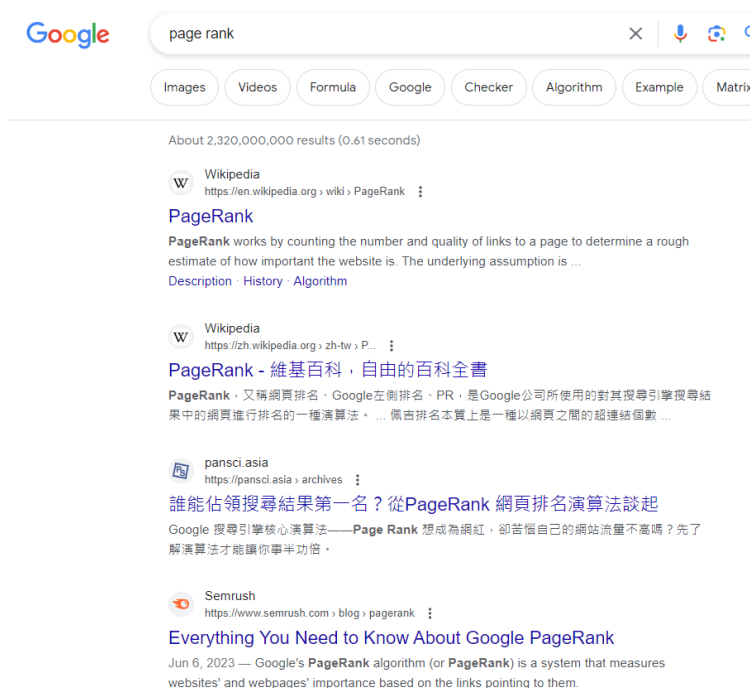


History of AI Winters.

<https://www.actuaries.digital/2018/09/05/history-of-ai-winters>

AI Spring (Late 1990s to 2000s)

- Applications like web search, data mining, and computer vision started to demonstrate the potential of AI technologies.
- Deep Blue - A supercomputer developed by IBM that became famous for defeating world chess champion Garry Kasparov in 1997



Rise of Big Data and Deep Learning (2010s - Now)

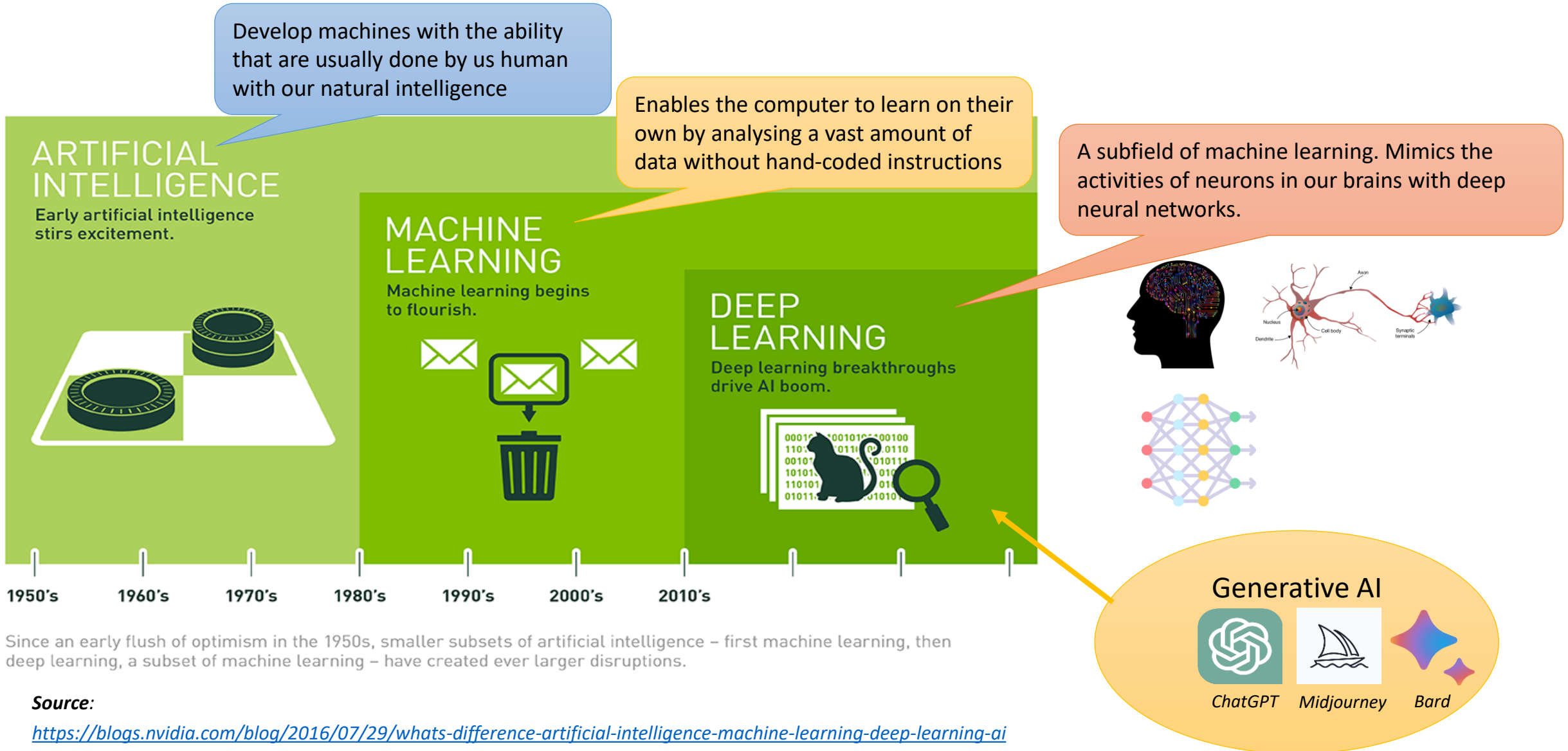
- Rise of deep learning
 - Availability of vast amounts of data & Advancement in computing power
 - Shows remarkable performance in tasks such as image recognition, natural language processing, and speech recognition.
- Siri, a personal assistant developed by Apple, was released on October 4, 2011, alongside the launch of the iPhone 4S,
 - Utilize natural language processing and machine learning to perform tasks, provide information, and interact with users on Apple devices.
- Google assistant was announced in May 2016



- AlphaGo
 - Developed by DeepMind
 - Utilized deep learning and defeated world champions Lee Sedol and Ke Jie in 2016 and 2017
- Generative AI
 - A new milestone where machines can generate new content that is indistinguishable from those created by humans.
 - Deep fake: First released in 2018, involves the use of artificial intelligence (AI) to create a fake event in photo, video, or audio format.
 - AI generated arts, GPT-3, ChatGPT, ...



AI, Machine Learning and Deep Learning

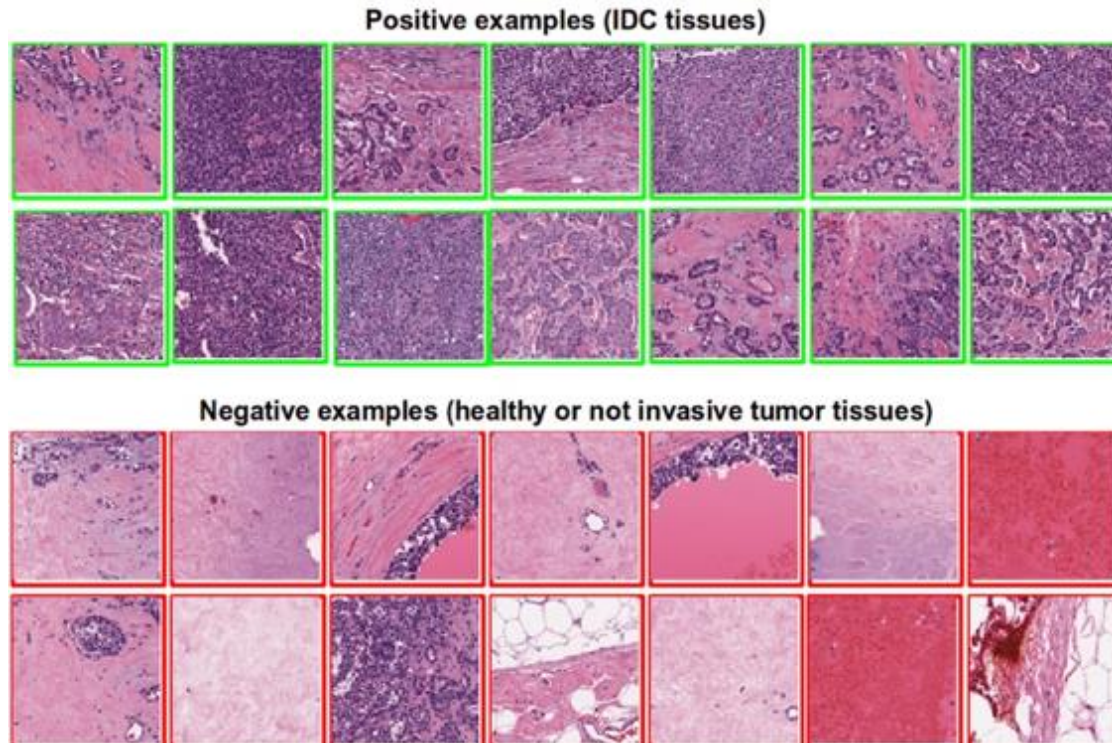


Subfields of AI

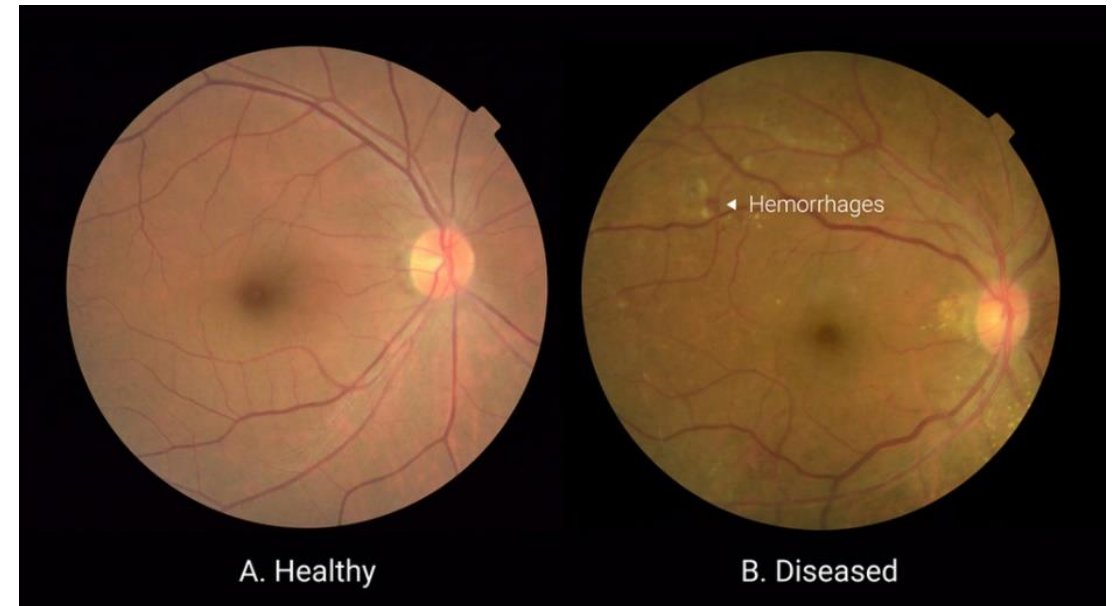
- Computer Vision
 - Enabling computers to derive information from images and videos
- Natural Language Processing (NLP)
 - Giving computers the ability to understand text and spoken words
- Speech Recognition
- Machine Learning
- Deep learning

Disease Detection

- Camels, Code & Lab Coats: How AI Is Advancing Science and Medicine
 - <https://www.youtube.com/watch?v=AbdVsi1VjQY>



Cancer Detection

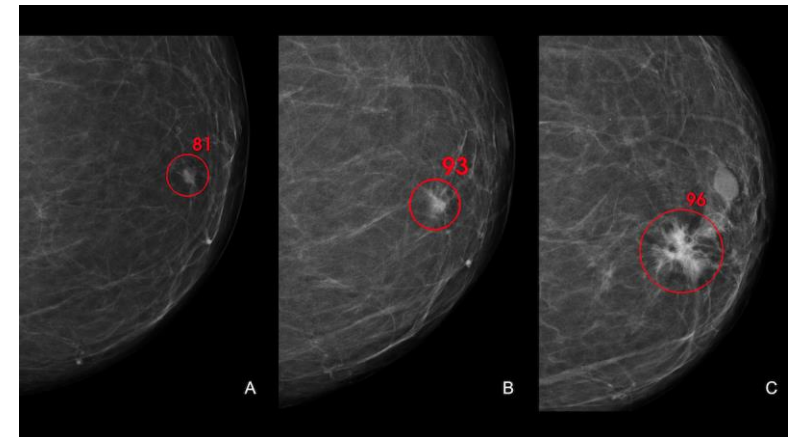


Detecting diabetic eye disease¹⁵

Cancer Diagnosis

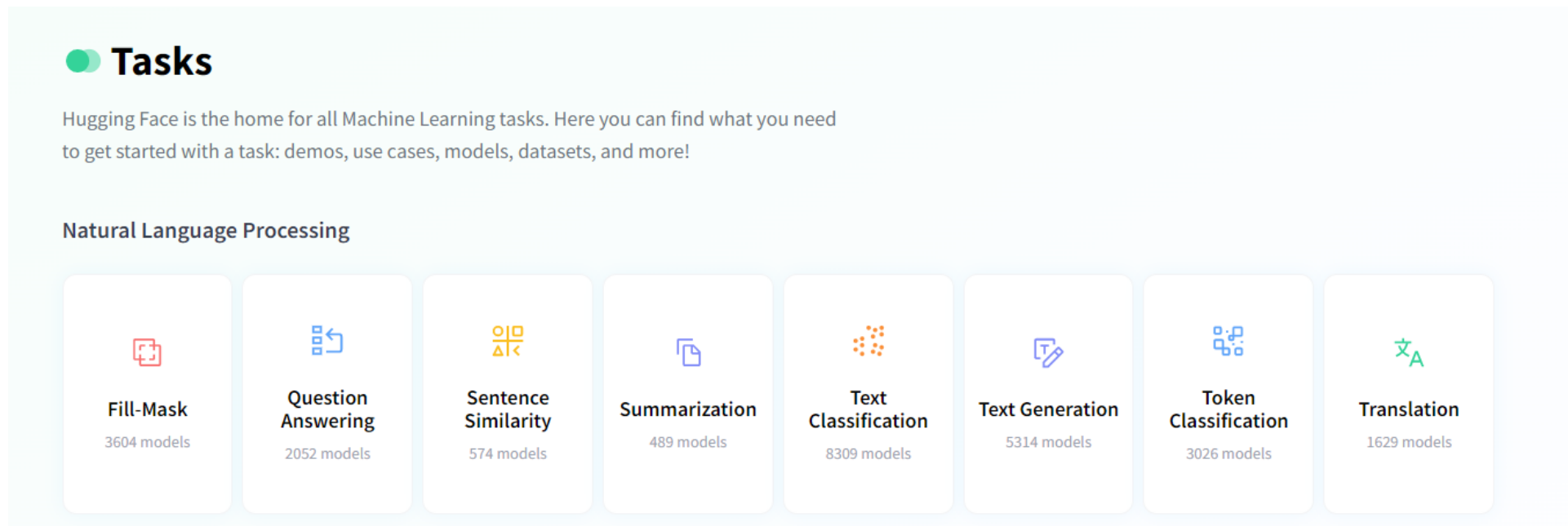
- Breast cancer causes more than 600,000 deaths annually worldwide
- Diagnose breast cancer from mammograms by Radiologist
- Researchers at Lund University in Sweden conducted a randomized, controlled, clinical trial to Determine whether an AI system could save radiologists' time without endangering patients
- AI saved 44.3 percent of the examination workload without increasing the number of misdiagnosed patients.
 - [Reference](#)

Video: [This AI Is Beating Doctors At Their Own Game](#)



Natural language processing (NLP)

- The branch of artificial intelligence (AI) concerned with giving computers the ability to understand text and spoken words in much the same way human beings can.



<https://huggingface.co/task>

Language Translation



<https://translate.google.com>

Detect language	Danish	Hmong	Lingala	Portuguese	Tatar
Afrikaans	Dhivehi	Hungarian	Lithuanian	Punjabi	Telugu
Albanian	Dogri	Icelandic	Luganda	Quechua	Thai
Amharic	Dutch	Igbo	Luxembourgish	Romanian	Tigrinya
Arabic	English	Ilocano	Macedonian	Russian	Tsonga
Armenian	Esperanto	Indonesian	Malithili	Samoan	Turkish
Assamese	Estonian	Irish	Malagasy	Sanskrit	Turkmen
Aymara	Ewe	Italian	Malay	Scots Gaelic	Twi
Azerbaijani	Filipino	Japanese	Malayalam	Sepedi	Ukrainian
Bambara	Finnish	Javanese	Maltese	Serbian	Urdu
Basque	French	Kannada	Maori	Sesotho	Uyghur
Belarusian	Frisian	Kazakh	Marathi	Shona	Uzbek
Bengali	Galician	Khmer	Meiteilon (Manipuri)	Sindhi	Vietnamese
Bhojpuri	Georgian	Kinyarwanda	Mizo	Sinhala	Welsh
Bosnian	German	Konkani	Mongolian	Slovak	Xhosa
Bulgarian	Greek	Korean	Myanmar (Burmese)	Slovenian	Yiddish
Catalan	Guarani	Krio	Nepali	Somali	Yoruba
Cebuano	Gujarati	Kurdish (Kurmanji)	Norwegian	Spanish	Zulu
Chichewa	Haitian Creole	Kurdish (Sorani)	Odia (Oriya)	Sundanese	
Chinese	Hausa	Kyrgyz	Oromo	Swahili	
Corsican	Hawaiian	Lao	Pashto	Swedish	
Croatian	Hebrew	Latin	Persian	Tajik	
Czech	Hindi	Latvian	Polish	Tamil	

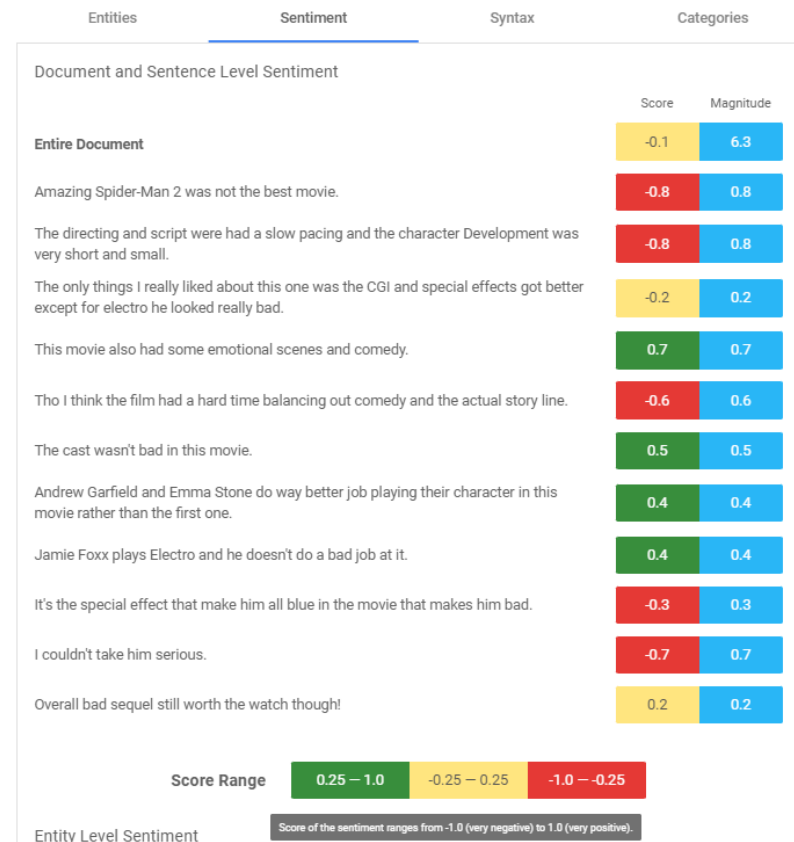
Sentiment analysis

- Extract subjective qualities (e.g. attitude, emotion) from text.
- Predict whether a movie review is positive or negative, based on the words in the movie review

Amazing Spider-Man 2 was not the best movie. The directing and script were had a slow pacing and the character Development was very short and small.

The only things I really liked about this one was the CGI and special effects got better except for electro he looked really bad. This movie also had some emotional scenes and comedy. Tho I think the film had a hard time balancing out comedy and the actual story line. The cast wasn't bad in this movie.

Andrew Garfield and Emma Stone do way better job playing their character in this movie rather than the first one. Jamie Foxx plays Electro and he doesn't do a bad job at it. It's the special effect that make him all blue in the movie that makes him bad. I couldn't take him serious. Overall bad sequel still worth the watch though!



Named Entity Recognition (NER)

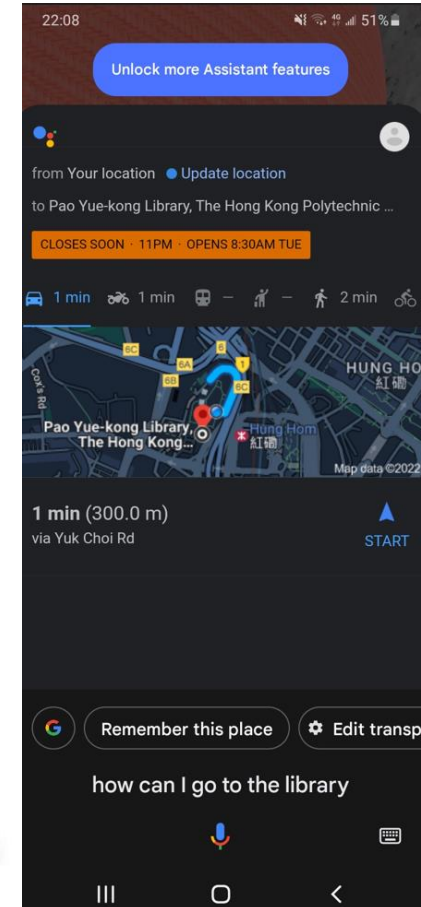
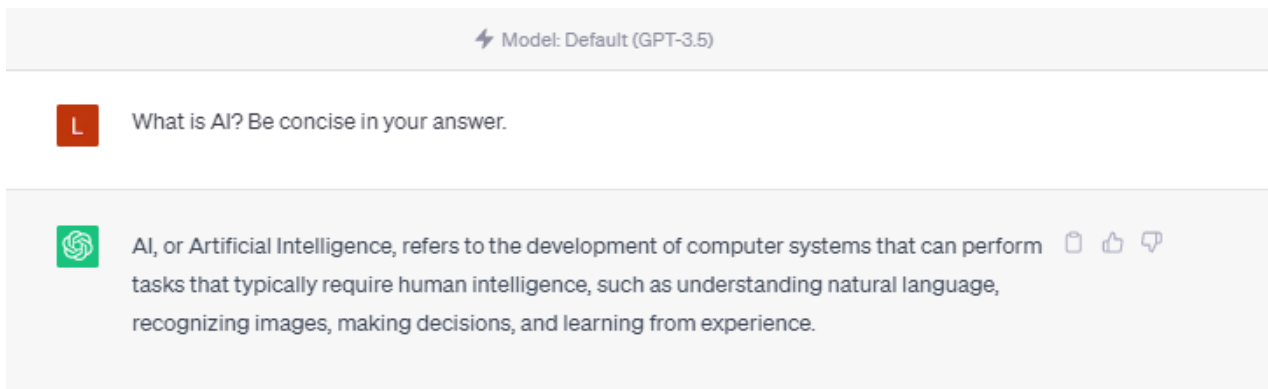
- Identify specific entities in a text, such as dates, individuals and places

Entities	Sentiment	Syntax	Categories
<p>(Amazing Spider-Man 2)₄ (2)₃₃ was not the best (movie)₁. The (directing)₇ and (script)₈ were had a slow (pacing)₆ and the (character Development)₉ was very short and small. The only (things)₁₀ I really liked about this (one)₃₁ was the (CGI)₂₄ and (special effects)₁₃ got better except for (electro)₁₇ he looked really bad. This (movie)₁₂ also had some emotional (scenes)₂₀ and (comedy)₁₅. Tho I think the (film)₁₈ had a hard time balancing out (comedy)₁₆ and the actual (story line)₂₁. The (cast)₁₉ wasn't bad in this (movie)₂. (Andrew Garfield)₂₆ and (Emma Stone)₂₅ do way better (job)₁₄ playing their (character)₃₀ in this (movie)₂ rather than the first (one)₂₉ (one)₃₂. (Jamie Foxx)₃ plays (Electro)₁₁ and he doesn't do a bad (job)₂₂ at it. It's the special (effect)₅ that make him all (blue)₂₃ in the (movie)₂ that makes him bad. I couldn't take him serious. Overall bad (sequel)₂₈ still worth the (watch)₂₇ though!</p>			
1. movie Saliency: 0.16	WORK OF ART	2. movie Saliency: 0.15	WORK OF ART
3. Jamie Foxx Wikipedia Article Saliency: 0.12	PERSON	4. Amazing Spider-Man Wikipedia Article Saliency: 0.07	PERSON
5. effect Saliency: 0.05	OTHER	6. pacing Saliency: 0.05	OTHER
7. directing Saliency: 0.05	OTHER	8. script Saliency: 0.05	WORK OF ART
9. character Development Saliency: 0.02	EVENT	10. things Saliency: 0.02	OTHER
11. Electro Wikipedia Article Saliency: 0.02	OTHER	12. movie Saliency: 0.02	WORK OF ART

19. cast Saliency: 0.01	PERSON	20. scenes Saliency: 0.01	WORK OF ART
21. story line Saliency: 0.01	OTHER	22. job Saliency: 0.01	OTHER
23. blue Saliency: 0.01	OTHER	24. CGI Saliency: 0.01	ORGANIZATION
25. Emma Stone Wikipedia Article Saliency: 0.01	PERSON	26. Andrew Garfield Wikipedia Article Saliency: 0.01	PERSON
27. watch Saliency: 0.01	CONSUMER GOOD	28. sequel Saliency: 0.01	WORK OF ART
29. one Saliency: 0.00	OTHER	30. character Saliency: 0.00	PERSON

Chatbots

- Software application built to simulate a human-like conversation.
- Involve speech recognition, natural language processing and speech synthesis
- Examples
 - Amazon Alexa, Google Assistant, Siri
- Alexa brings out the best you | Alexa for your kitchen | Amazon Alexa
 - https://www.youtube.com/watch?v=GTFmGsiXC_U



Text to speech

- Text-to-Speech (TTS) is the task of generating natural sounding speech given text input.
- May generates speech for multiple speakers and multiple languages.

DEMO



Put Text-to-Speech into action

Type what you want, select a language then click "Speak It" to hear.

Text to speak:

Google Cloud Text-to-Speech enables developers to synthesize natural-sounding speech with 100+ voices, available in multiple languages and variants. It applies DeepMind's groundbreaking research in WaveNet and Google's powerful neural networks to deliver the highest fidelity possible. As an easy-to-use API, you can create lifelike interactions with your users, across many applications and devices.

text [ssml](#)

Language / locale	Voice type	Voice name	
English (United States) ▼	WaveNet ▼	en-US-Wavenet-D ▼	
Audio device profile	Speed:	1.00	Pitch: 0.00
Default ▼			

[Show JSON](#) ▼

[▶ RESUME](#)

<https://cloud.google.com/text-to-speech>

Speech to text

- Convert voice to text

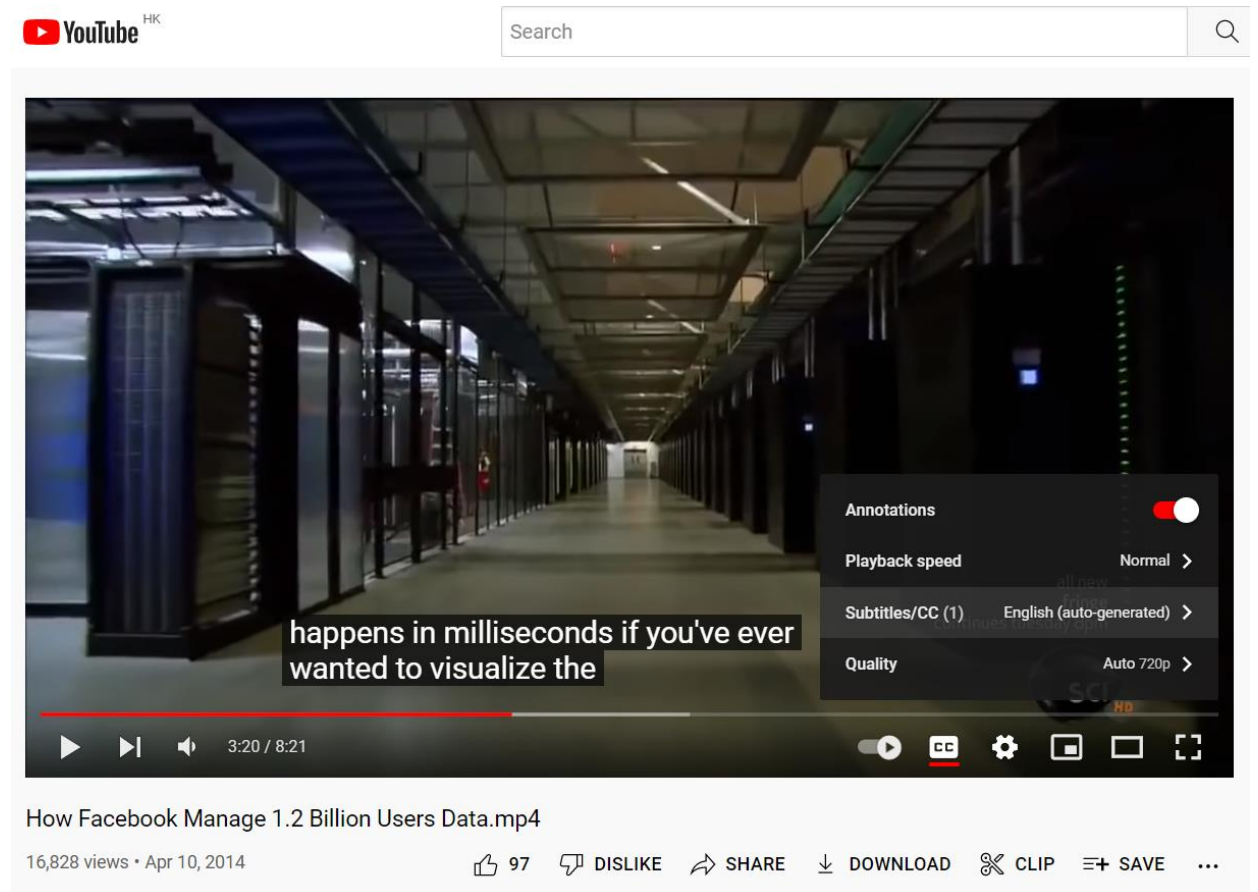
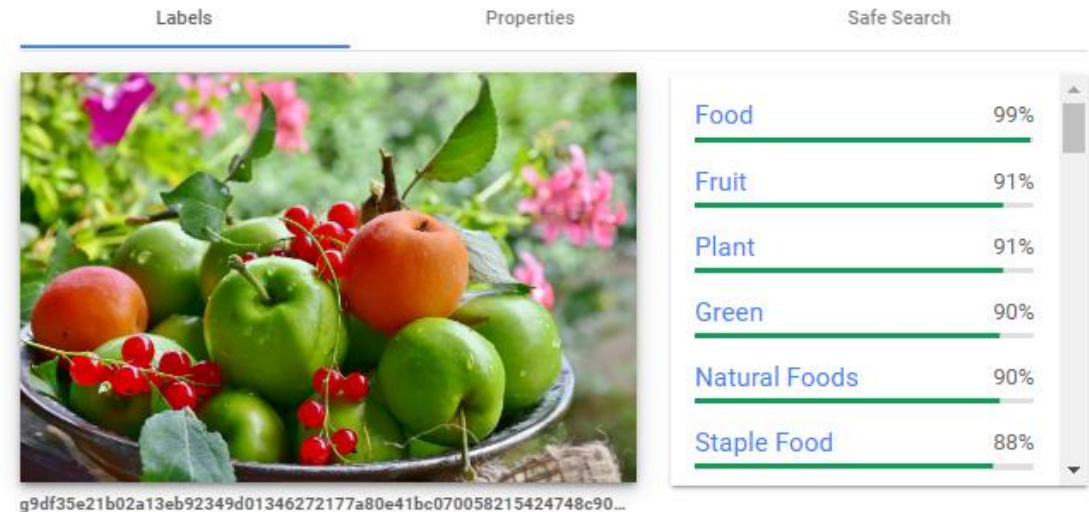


Image classification

- Image classification models take an image as input and return a prediction about which class the image belongs to.
- Images are expected to have only one class for each image.



<https://cloud.google.com/vision>

Object Detection

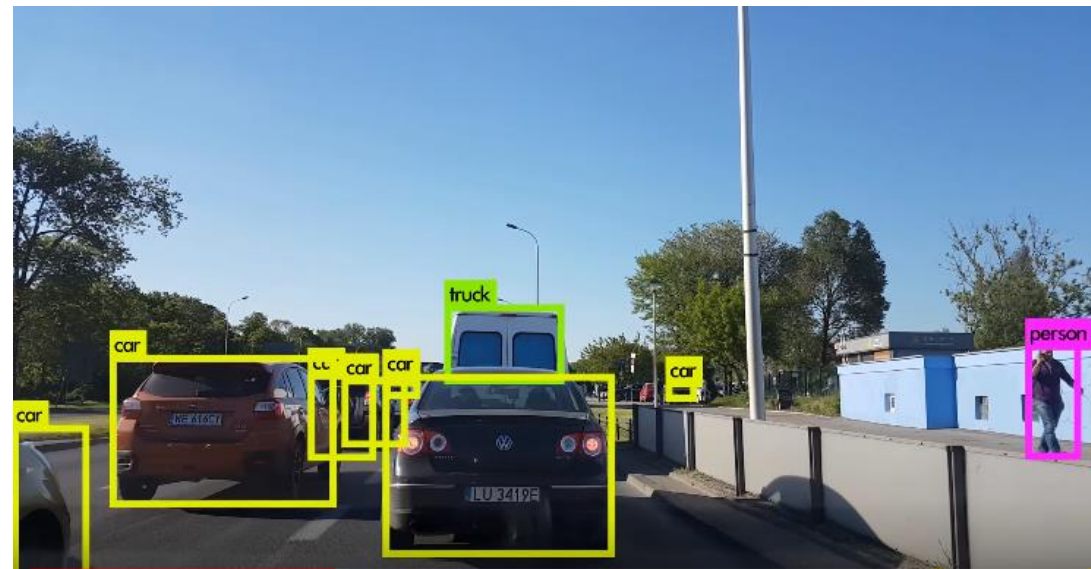
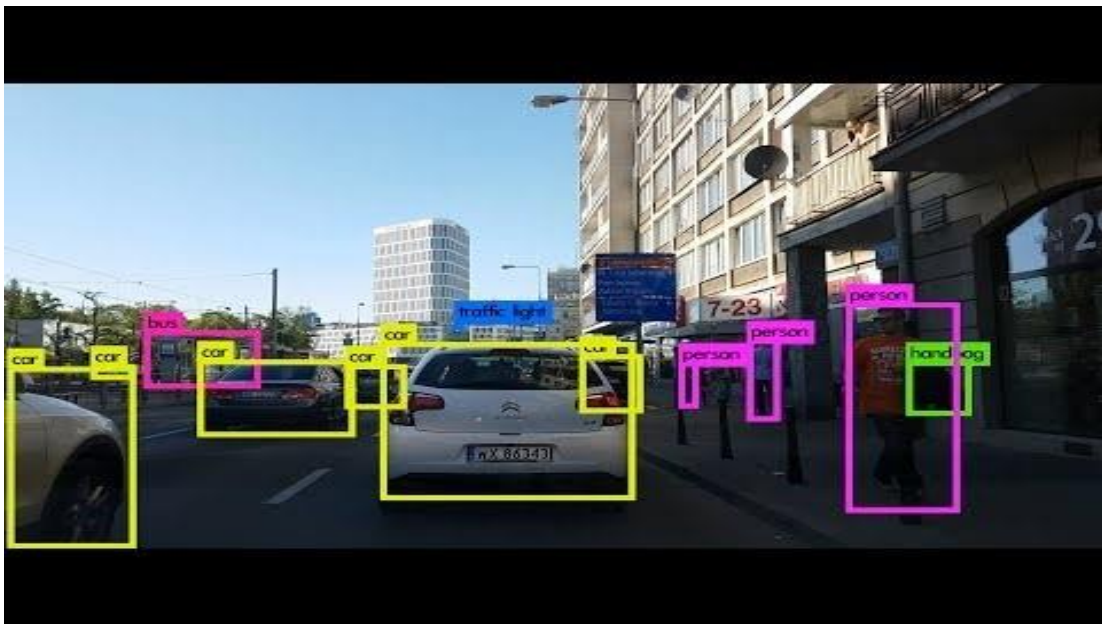
- Takes an image as input and output the images with bounding boxes and labels on detected objects.



Video: [How computers learn to recognize objects instantly](#)

Vehicle/Object Detection

- Classify and detect the objects in the image.
- Assign a class to each object and draw a bounding box around it.



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

Autonomous Driving Car

- Self-driving vehicles or “driverless” cars
- Combine sensors and software to control, navigate, and drive the vehicle.
- Drivers are **NOT** required to take control to safely operate the vehicle.




Dave-2 A Neural Network Drives A Car

https://www.youtube.com/watch?time_continue=438&v=NJU9ULQUwng

Demo: Steering angle prediction with deep learning

```
File Edit View Search Terminal Help
Steering angle: -5.302398369199135 (pred)    -8.570000000000002 (actual)
Steering angle: -6.99451284927268 (pred)    -8.570000000000002 (actual)
Steering angle: -6.099878876971954 (pred)    0.0 (actual)
Steering angle: -3.666547999300395 (pred)    -8.570000000000002 (actual)
Steering angle: -2.528775941133317 (pred)    -8.570000000000002 (actual)
Steering angle: -2.200181730022939 (pred)    -8.570000000000002 (actual)
Steering angle: -0.8611707411227176 (pred)    -8.570000000000002 (actual)
Steering angle: -1.1304594868069329 (pred)    -8.570000000000002 (actual)
Steering angle: -1.2303128696364807 (pred)    -8.570000000000002 (actual)
Steering angle: -1.7625696956312238 (pred)    -8.570000000000002 (actual)
Steering angle: -1.4805045474159708 (pred)    -8.570000000000002 (actual)
Steering angle: -1.518850403355186 (pred)    -8.570000000000002 (actual)
Steering angle: -1.3093517462030873 (pred)    -8.570000000000002 (actual)
Steering angle: -2.0625463746146004 (pred)    -8.570000000000002 (actual)
Steering angle: -1.8152570278367617 (pred)    -8.570000000000002 (actual)
Steering angle: -0.9600503225199345 (pred)    -8.570000000000002 (actual)
Steering angle: -0.6599400813217723 (pred)    -8.570000000000002 (actual)
Steering angle: -0.6624321932343278 (pred)    -8.570000000000002 (actual)
Steering angle: -0.570201093221514 (pred)    -8.570000000000002 (actual)
Steering angle: 0.020910624143994038 (pred) -8.570000000000002 (actual)
Steering angle: -0.38195130206097394 (pred) -8.67 (actual)
Steering angle: -0.0741251553789989 (pred) -8.97 (actual)
Steering angle: -0.1999083378456736 (pred) -9.18 (actual)
Steering angle: 0.3703405407609076 (pred)    -9.380000000000003 (actual)
Steering angle: -0.0791576102720033 (pred) -9.58 (actual)
Steering angle: -0.3494621198916331 (pred) -9.78 (actual)
Steering angle: -1.008590555960511 (pred)    -10.00 (actual)
Steering angle: -1.268955446130693 (pred)    -10.49 (actual)
Steering angle: -1.2145662228830583 (pred)    -11.089999999999998 (actual)
Steering angle: -0.8918621427973171 (pred)    -11.8 (actual)
Steering angle: -0.7002978206454625 (pred)    -12.910000000000002 (actual)
Steering angle: -1.21524315866283 (pred)    -14.02 (actual)
Steering angle: -1.8507161683562945 (pred)    -14.420000000000002 (actual)
Steering angle: -4.134333995176228 (pred)    -14.62 (actual)
Steering angle: -5.128361734052626 (pred)    -14.62 (actual)
Steering angle: -8.779486739320308 (pred)    -14.62 (actual)
Steering angle: -10.888500362561035 (pred)    -14.82 (actual)
Steering angle: -7.171001949218048 (pred)    -15.230000000000002 (actual)
Steering angle: -5.2161121625275415 (pred)    -15.33 (actual)
Steering angle: -5.501181633402240 (pred)    -15.53 (actual)
```



The image shows a terminal window with two columns of steering angle data. The left column contains predicted values in degrees, and the right column contains actual values in degrees. The predicted values range from approximately -5.3 to -15.5 degrees, while the actual values range from 0.0 to -15.53 degrees. To the right of the terminal are two image windows. The top window, titled 'frame', shows a car driving on a road. The bottom window, titled 'steering wheel', shows a steering wheel.