



Artificial Intelligence



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David



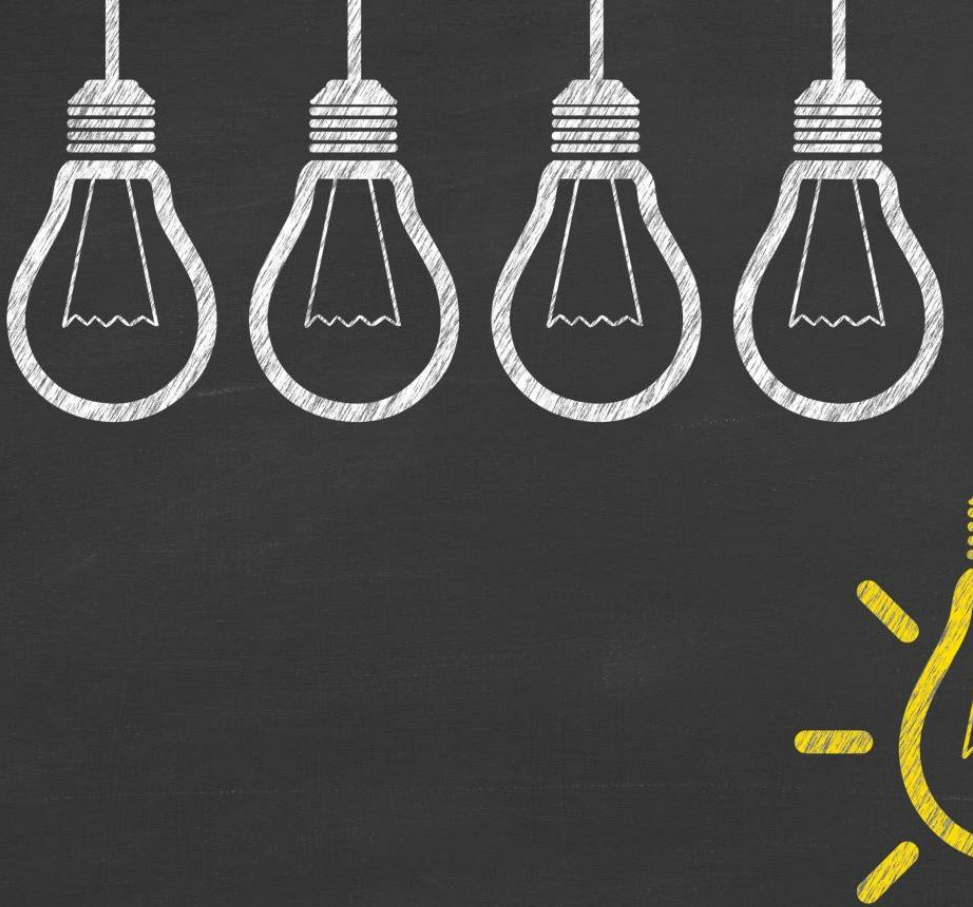
Lectures

- Tuesday 11am-1pm.
- Thursday 1-3pm



AIM(S)

- To develop the students' ability to solve complex problems using modern AI principles and practice



LEARNING OUTCOMES

- Upon the successful completion of this module, the student should be able to:
 - Critically analyse, evaluate and justify selected AI methods and techniques used to solve complex problems.
 - Analyse given problems and subsequently synthesise and evaluate appropriate solutions using selected AI methods and techniques.

ASSESSMENT

Assessment Component 1

Coursework

Mode of assessment	Volume	Weighting
Written Assignment	3,000 words	50%

Assessment Component 2

Written exam

Mode of assessment	Volume	Weighting
Exam	2 hours	50%

INDICATIVE READING LIST

Module Code	ACCA7026	
Module Title	Artificial Intelligence	
Classification	Reading List entry	Electronic*
Essential	Russell, S. and Norvig, P. (2009) Artificial Intelligence: A Modern Approach (3rd edition), Prentice Hall	☒
Essential	Goodfellow, I; Bengio, Y; Courville, A; Bach, F (2017), Deep Learning, MIT Press	☒
Further	Cormen, T; Leiserson, C; Rivest, R; Stein, C (2009) Introduction to Algorithms (3 rd edition), MIT Press	☒
Further	McKinney.W (2017) Python for Data Analysis (2 nd edition), O'Reilly	☒
Further	Barber, M. (2012) Bayesian Reasoning and Machine Learning, Cambridge University Press	☒
Further	Bishop, C.M. (2007) Pattern Recognition and Machine Learning, Springer	☐

Introduction to Artificial Intelligence

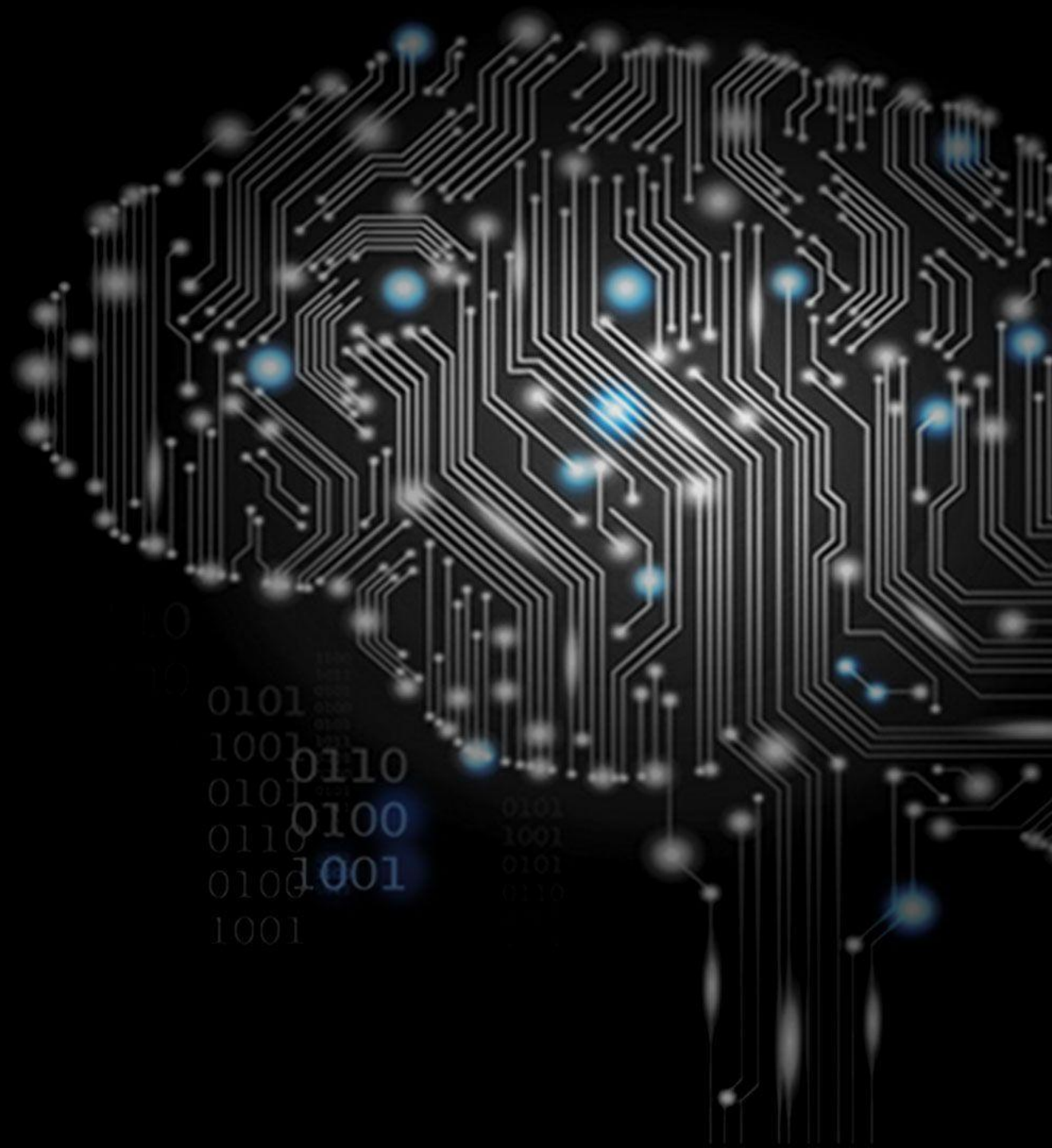
Dr Mohamed Bennasar



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Y Drindod Dewi Sant
University of Wales
Trinity Saint David



- What is AI?
- History of AI
- State of AI
- Applications of AI

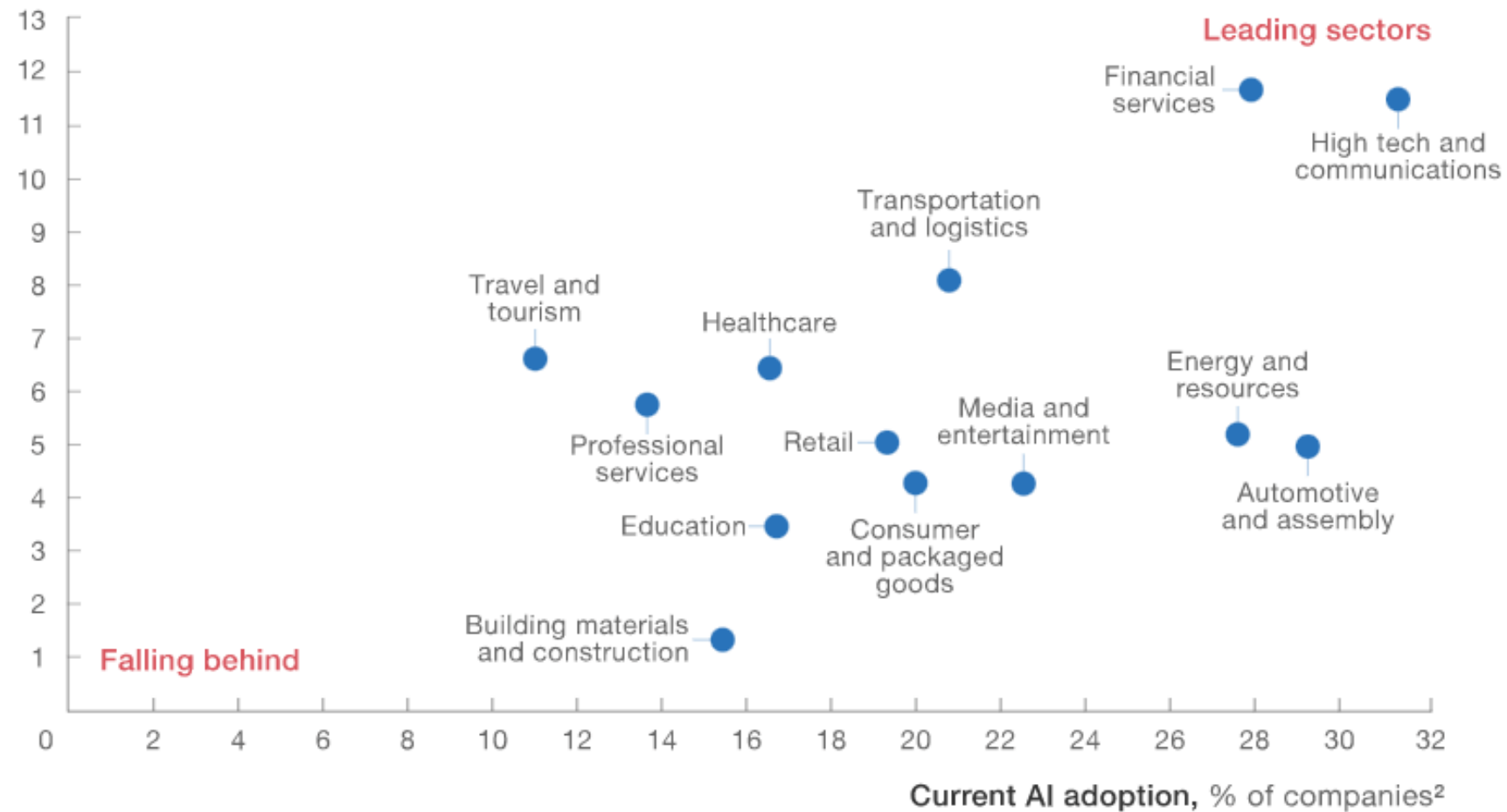


Artificial Intelligence Market Report Scope

Report Attribute	Details
Market size value in 2021	USD 93.53 billion
Revenue forecast in 2028	USD 997.77 billion
Growth Rate	CAGR of 40.2% from 2021 to 2028
Base year for estimation	2020

Leaders in the adoption of AI also intend to **invest more in the near future** compared with laggards.

Future AI demand trajectory, % change in AI spending over next 3 years¹



¹Estimated average, weighted by company size; demand trajectory based on midpoint of range selected by survey respondent.

²Adopting 1 or more AI technologies at scale or in business core; weighted by company size.

Source: McKinsey Global Institute AI adoption and use survey; McKinsey Global Institute analysis

What is AI?

An
attempt
of

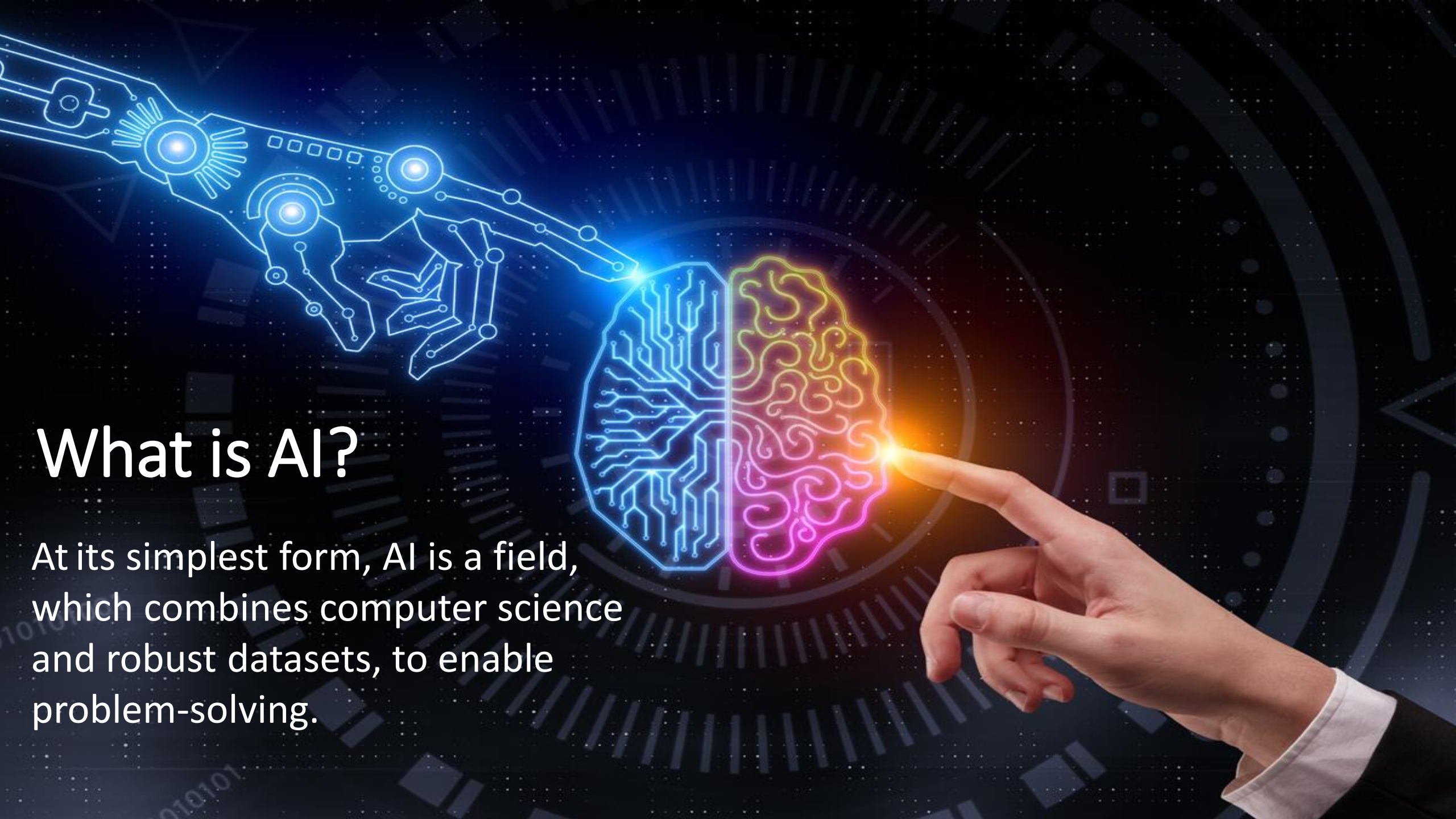
- AI is the reproduction of human reasoning and intelligent behavior by computational methods
- AI uses computers and machines to mimic the problem-solving and decision-making capabilities of the human mind.

It is about
thinking only, or
it should include
acting ?

What is AI?

Stuart. Russell & Peter Norvig, 2010

Human approach	Ideal approach
Systems that think like humans	Systems that think rationally
Systems that act like humans	Systems that act rationally



What is AI?

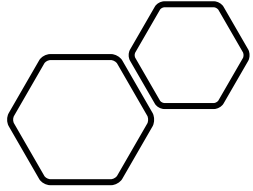
At its simplest form, AI is a field, which combines computer science and robust datasets, to enable problem-solving.

Why is AI important?

- AI automates repetitive learning and discovery through data.
- AI adds intelligence to existing products.
- AI adapts through progressive learning algorithms.
- AI analyses more and deeper data.
- AI achieves incredible accuracy.
- AI gets the most out of data.

Quiz: What Can AI do now?

- Play a decent game of table tennis? 
- Write software? 
- Drive safely on a motorway? 
- Drive safely on busy street? 
- Do creative writing? 
- Compose music? 
- Translate writing from language to another? 
- Perform a surgical operation? 
- Understand human's spoken language? 
- Make jokes? 



History of AI

- 1940-1950: Early Days
 - 1950: Turing's "Computing Machinery and Intelligence"
 - Turing Test

I.—COMPUTING MACHINERY AND INTELLIGENCE

By A. M. TURING

the Imitation Game.

I PROPOSE to consider the question, 'Can machines think?' should begin with definitions of the meaning of the words 'machine' and 'think'. The definitions might be framed so as to make it so far as possible the normal use of the words, but this side 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 of the words is to be found by examining how they are used in a statistical survey such as a Gallup poll. But this is not the way to proceed. Instead of attempting such a definition I shall replace it by another, which is closely related to it and is expressed in the following form.



The Conference that Started it AI

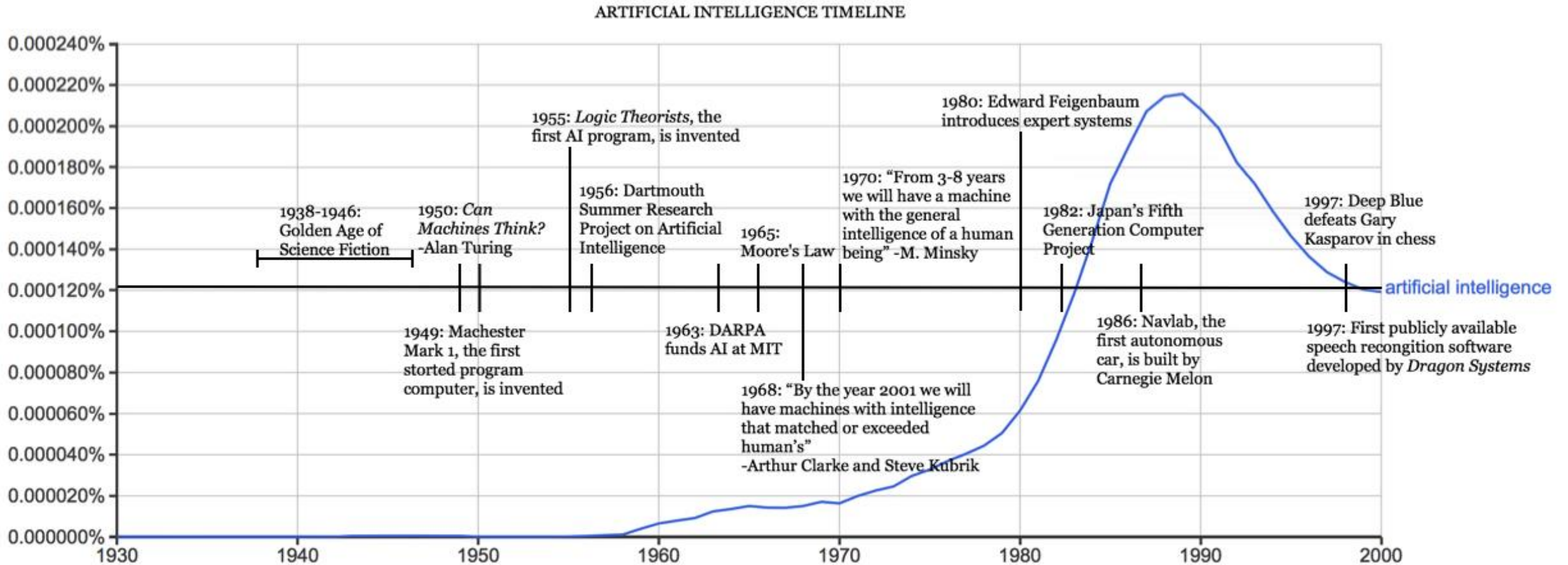
Dartmouth Summer Research Project on Artificial Intelligence

- Cross disciplinary
- Though no agreement on standard methods
- Generally all believed AI was achievable
- Allen Newell, Cliff Shaw, and Herbert Simon's, Logic Theorist program was presented here- the world's first AI program.
- The [*Logic Theorist*](#) program established the field of heuristic programming and soon proved 38 of the first 52 theorems in chapter 2 of the Principia Mathematica.



- *Figure 1. Trenchard More, John McCarthy, Marvin Minsky, Oliver Selfridge, and Ray Solomonoff.*
 - *Photographer, Joe Mehling.*

From 1957 to 1974 AI Time lines:



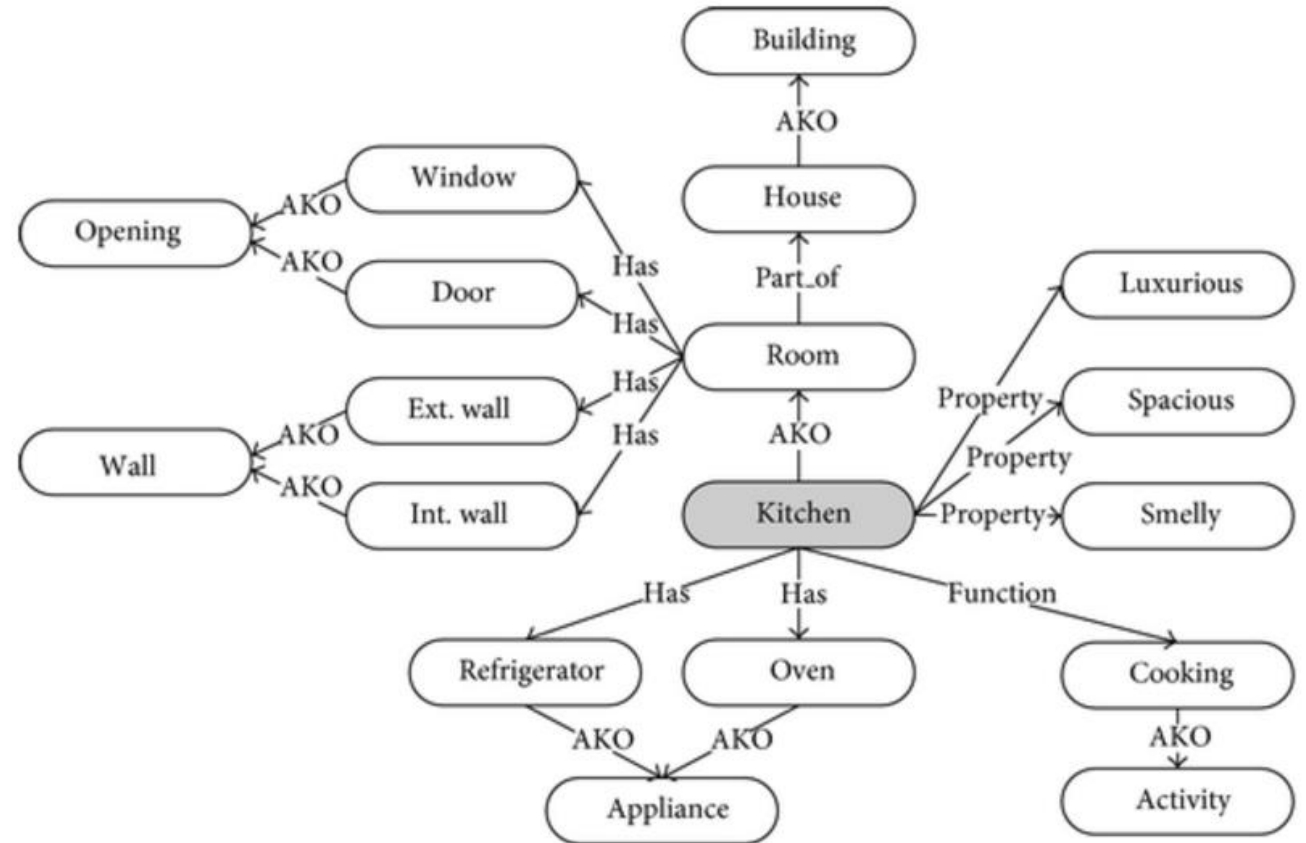
History of AI

- 1990-present: Semantic Era

- Logic can reason about knowledge graphs
- Meaning is well defined
- Deduction is reliable

But:

- Graphs are expensive to build
- Logical reasoning is inefficient
- Deduction is rigid

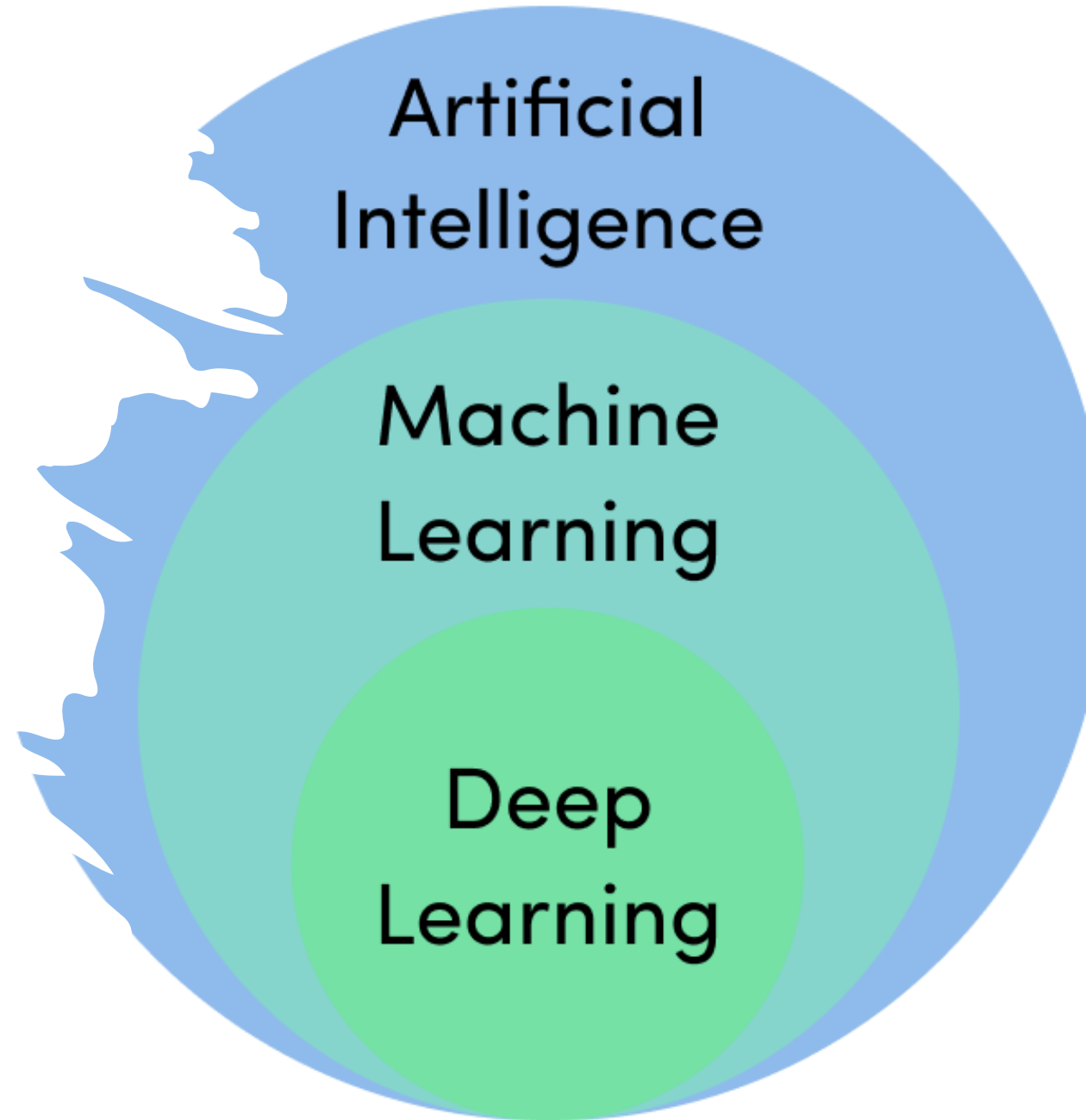


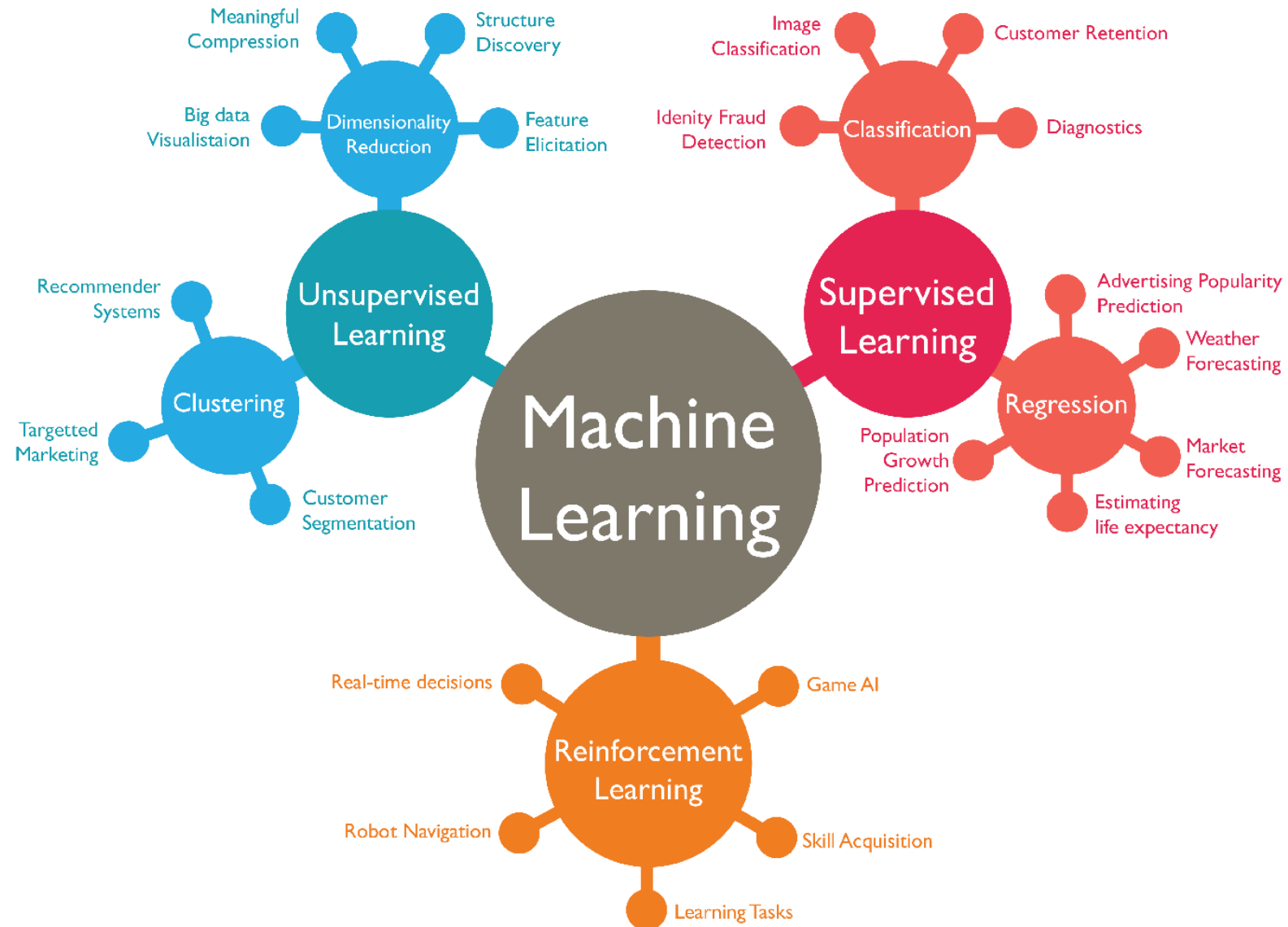


Issues with 1970s and 1980s AI

- Capture and representation of knowledge manually.
- It concentrated on specific tasks that rely on explicit and logical reasoning.

The Machine Learning Era (1990-present)





Source: <https://wordstream-files-prod.s3.amazonaws.com/s3fs-public/machine-learning.png>

AI beating humans in some domains



- Gary Kasparov vs Deep Blue 1997



AlphaGo beats Lee Sedol in 2016

Ethics in Design of AI

How can we...

- build systems that have ethical and moral foundation?
- that are transparent to users?
- extend and advance healthcare?
- increase safety in dangerous work?
- ...



Guiding principles – Ethical AI

- Purpose
 - Aid humans, no replace them
 - Symbiotic relationship
- Transparency
 - How was AI taught?
 - What data was used?
- Regulations
 - Almost everyone agrees they are necessary
 - Who will create regulations?
 - Who will enforce regulations?



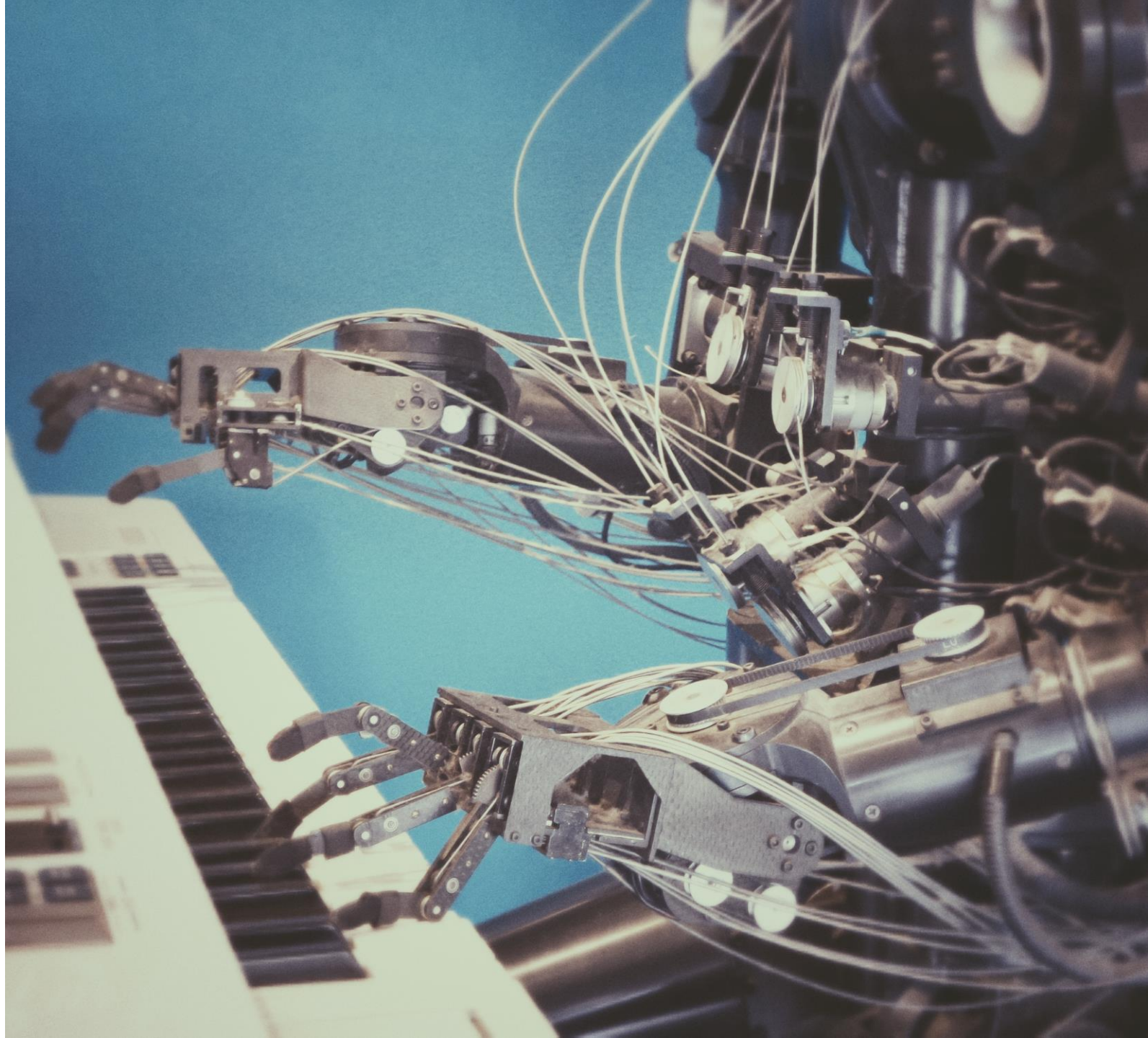
Ethical AI

- ML has potential to make less biased decisions than humans
- Algorithms trained with biased data pick up and replicate biases and develop new ones.
- Don't fear AI – explore AI
 - Try the tools
 - Pair with others
 - IBM Watson Develop Tools (free trials) and many other free ML tools

<https://cloud.ibm.com/catalog?category=ai>

Creating AI requires

- Hardware/computers
- Data (annotated)
- Algorithms



Hardware: The human brain

- human brain comprise approximately 10^{11} neurons.
- 1,000 synapses per neuron
- 10^{14} interconnections between the neurons.
- 100-1000 peta-FLOPs of information processing



Hardware: CPU

- Intel Core i9: 0.9 tera-FLOPS
- NVIDIA 3080ti GPU: 34 tera-FLOPS
- NVIDIA DGX-2™ : 2 peta-FLOPS
- Since 2017, there are supercomputers which can perform up to nearly a 100 peta-FLOPS.



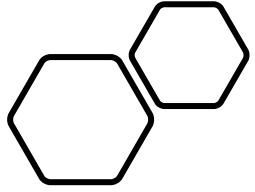
Data...Big Data

- The New York Stock Exchange is an example of Big Data that generates about one terabyte of new trade data per day.
- The statistic shows that **500+terabytes** of new data get ingested into the databases of social media site **Facebook**, every day.



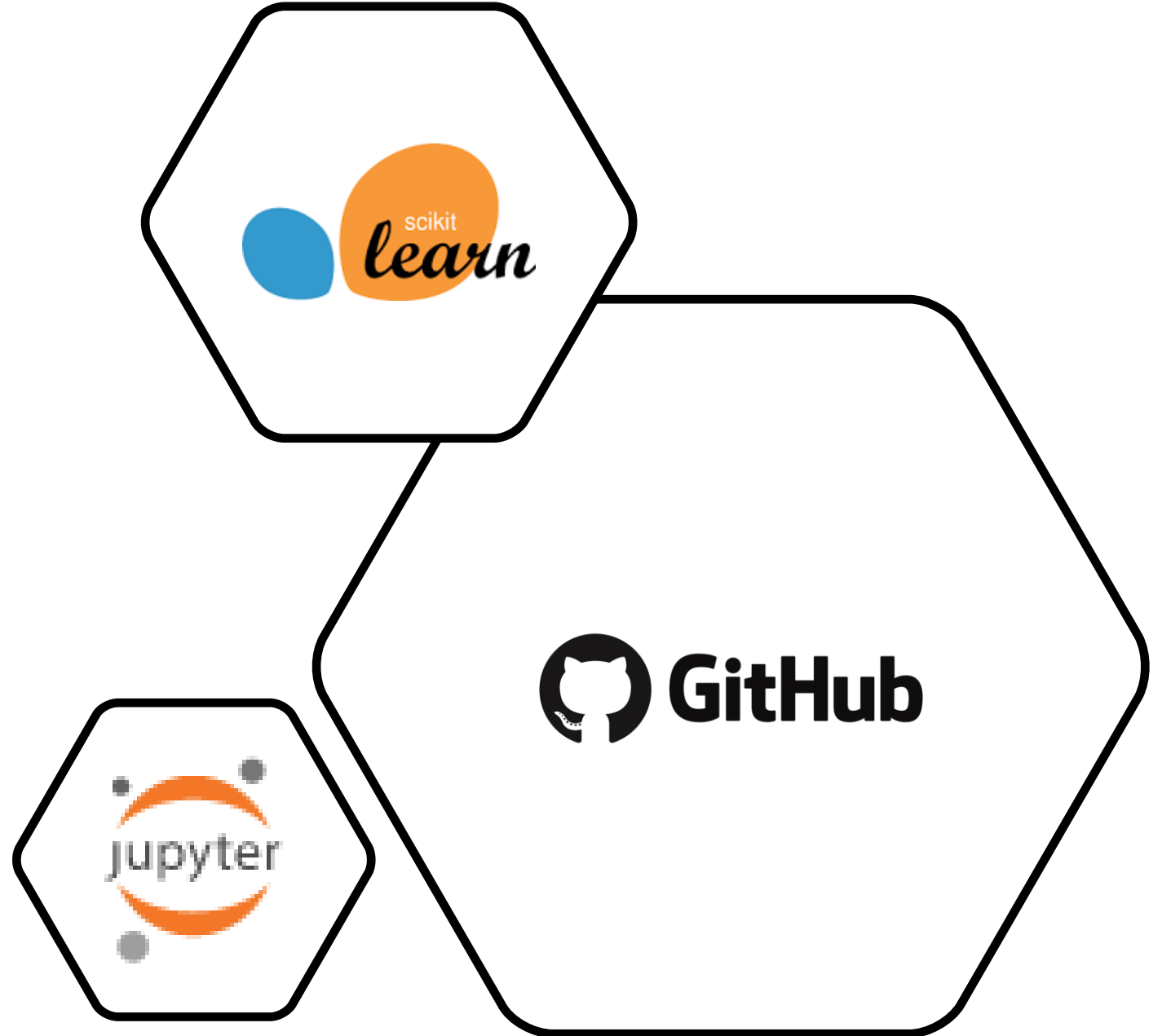
https://en.wikipedia.org/wiki/New_York_Stock_Exchange

<https://www.internetmatters.org/parental-controls/social-me>



Software

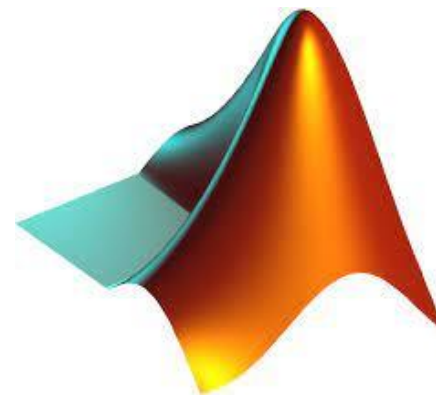
- Open Source
- GitHub
- Open DataScience Tools
(Jupyter, SciKitLearn, NLTK,
etc...)



Machine/Deep Learning frameworks



theano



ONNX



Examples of AI and Cognitive Computing

Think about these things:

- what type of the data used to train the AI techniques?
- What kind of intelligence does the system need?
- Is it a single AI technique that performs the task ?

Self Driving Vehicles

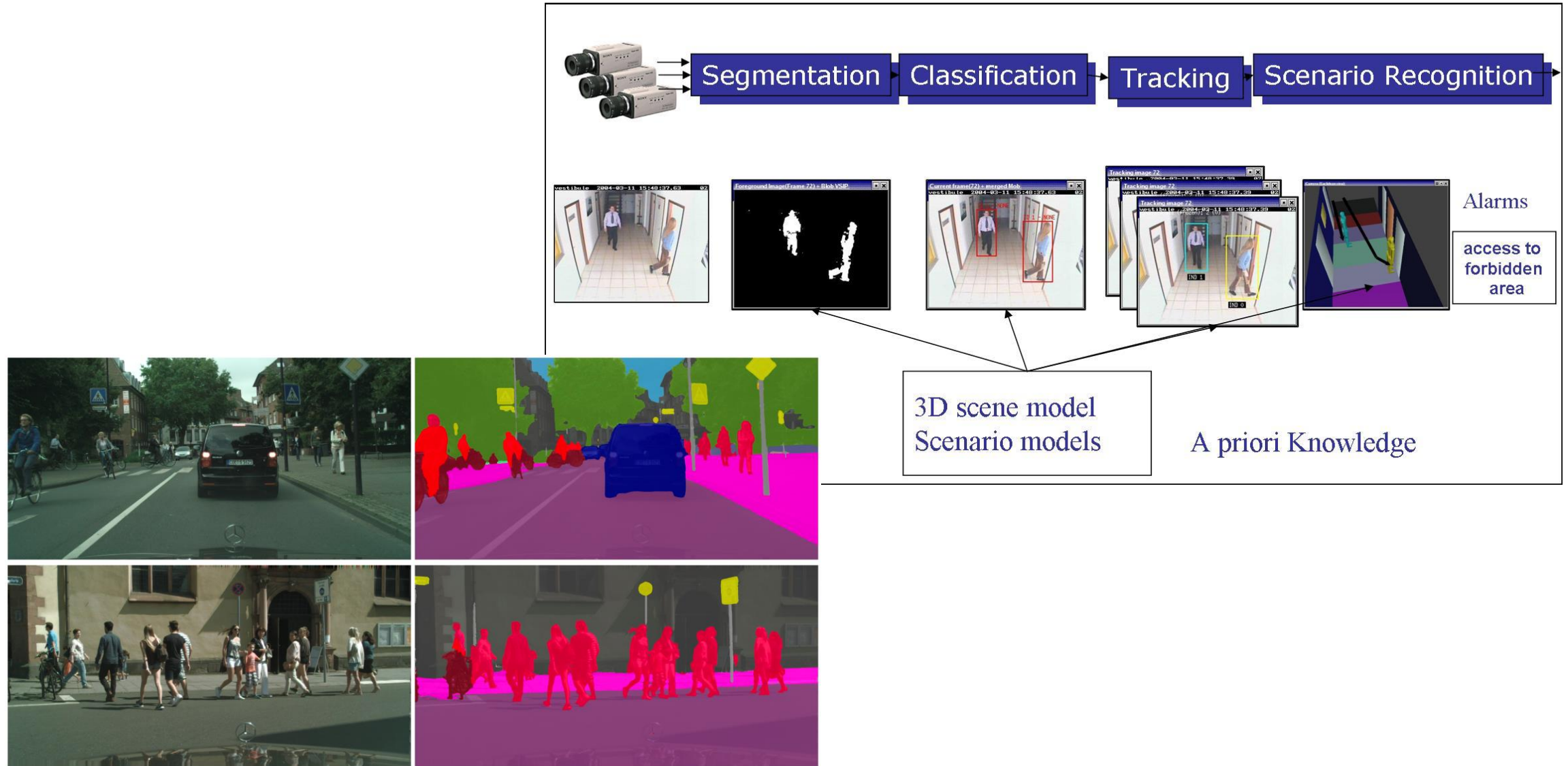
- Google Self Driving Car
- **Google self-driving car** is a project started in 2009 by google that involves developing technology for mainly electric cars.



Companies Investing in Autonomous Vehicles

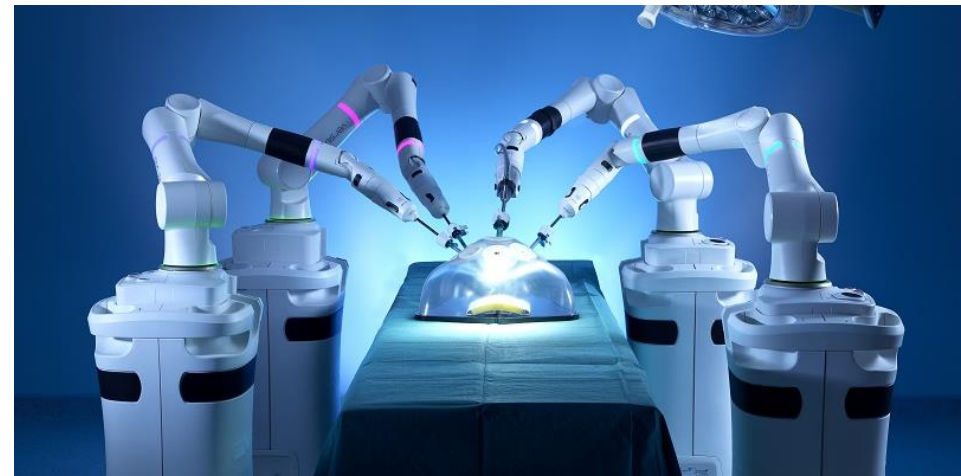
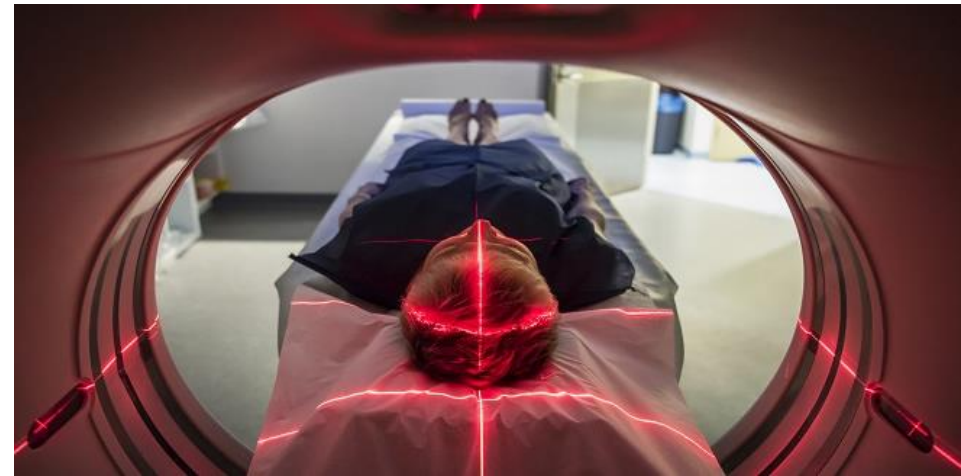
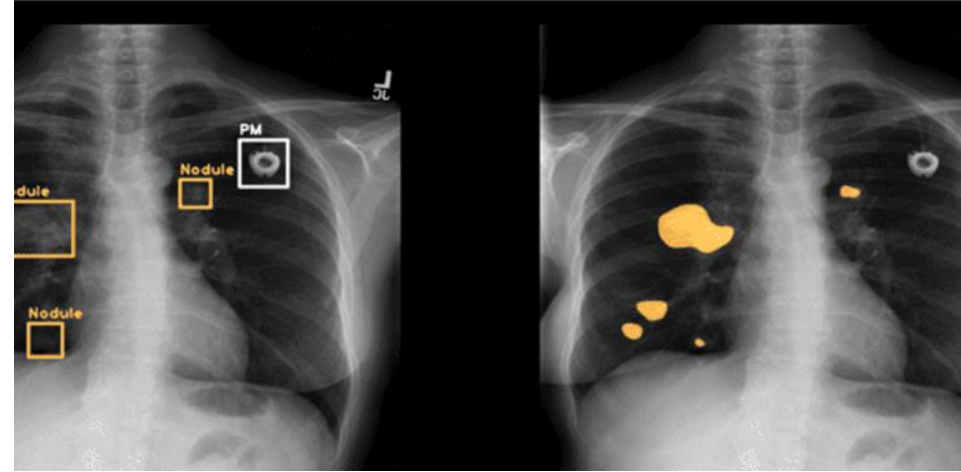


Scene understanding



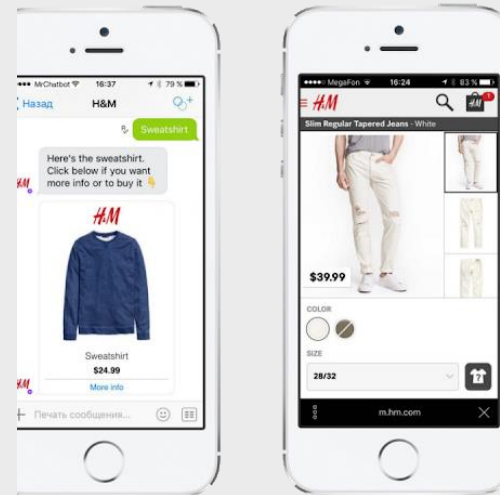
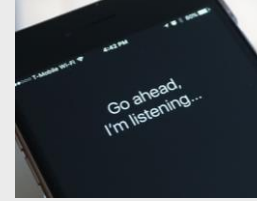
AI in Healthcare

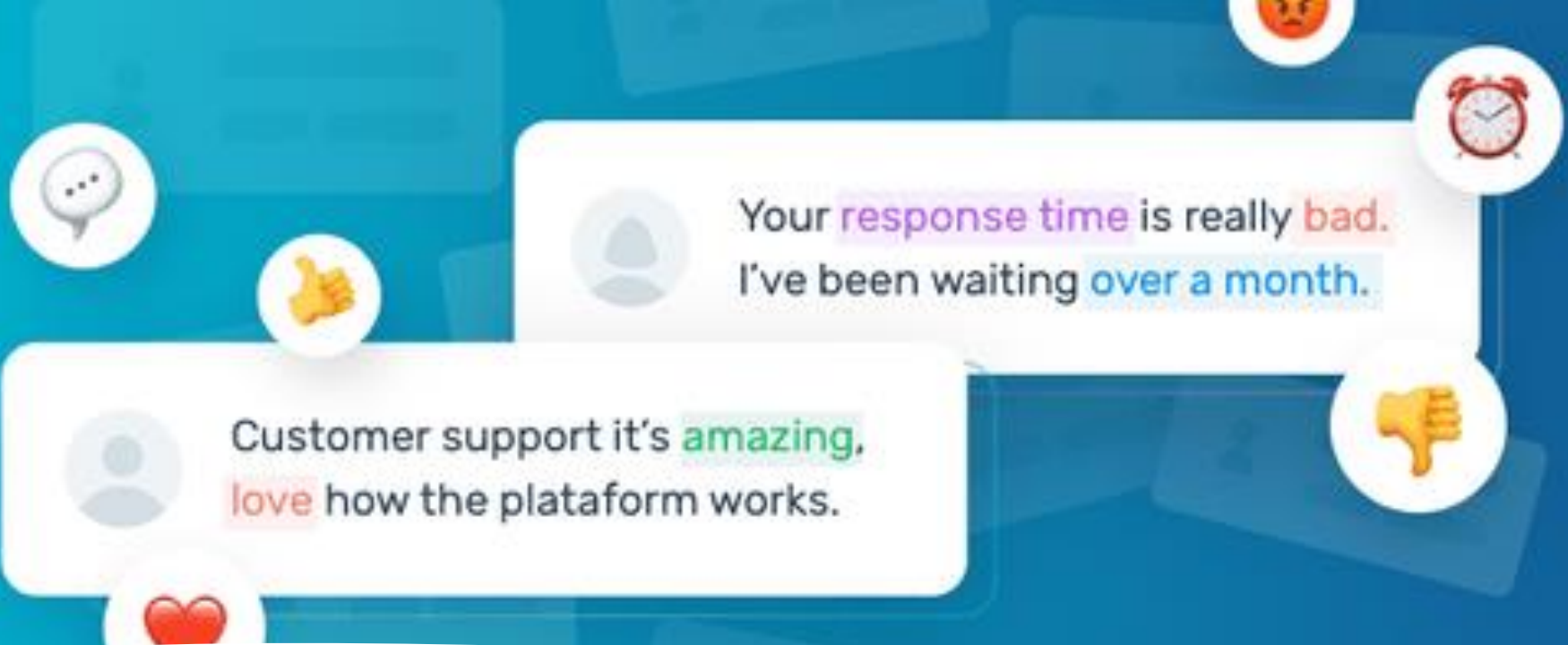
- Disease Identification and Diagnosis
- Medical Imaging Diagnosis (Trauma, Tumor classification)
- Robotic Surgery



Chatbots

- simulates human conversation through voice commands or text chats or both. They have many applications:
 - Bank chatbot
 - Customer Service Chatbot
 - Siri, Google Assistant, and Alexa
 - Car voice assistant





Sentiment analysis

- **Sentiment analysis:** is a method for gauging opinions of individuals or groups, such as a segment of a brand's audience or an individual customer in communication with a customer support representative.

Machine Translation

Google Translate



Automatic Image Captioning

- Image captioning is the task of describing the image with text as shown

Describes without errors	Describes with minor errors	Somewhat related to the image
 A person riding a motorcycle on a dirt road.	 Two dogs play in the grass.	 A skateboarder does a trick on a ramp.
 A group of young people playing a game of frisbee.	 Two hockey players are fighting over the puck.	 A little girl in a pink hat is blowing bubbles.

Precision farming

Fighting weeds: Can we reduce, or even eliminate, herbicides by utilizing robotics and AI?

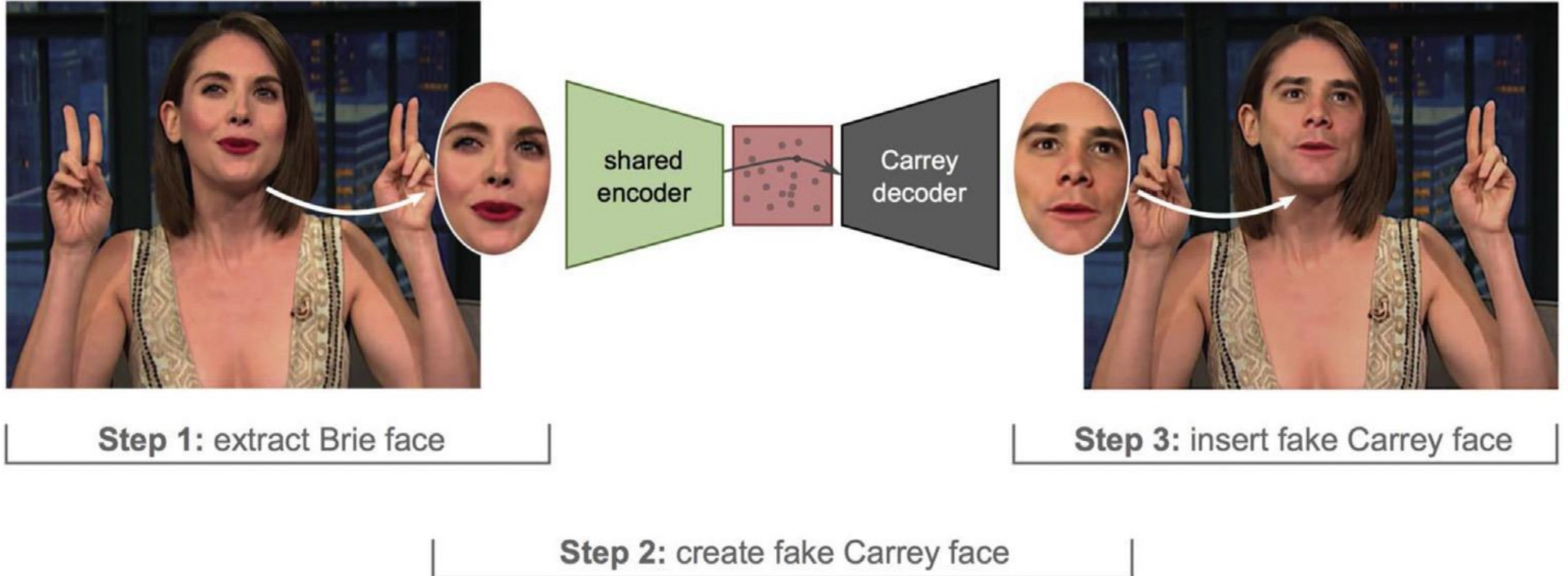


Music composition

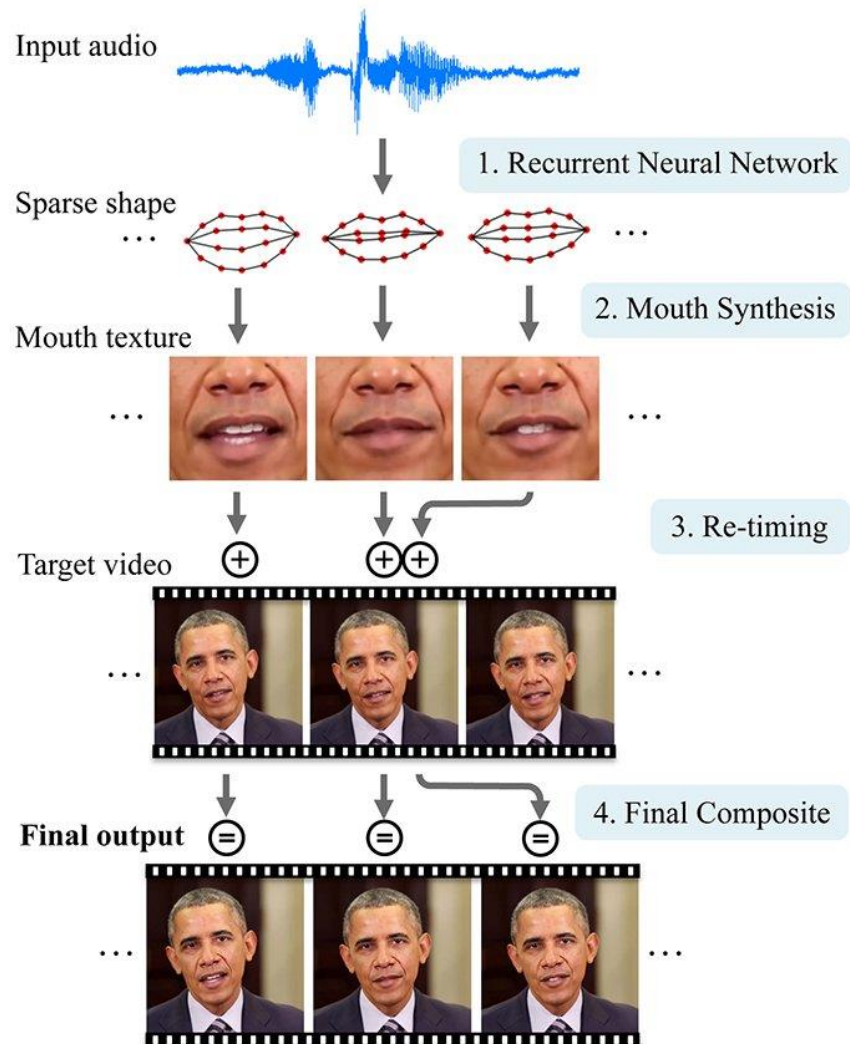


Deepfake

1- Face swapping



2- Voice and Video Cloning



https://www.youtube.com/watch?v=MVB6_o4cMI&t=18s

<https://www.washington.edu/news/2017/07/11/lip-syncing-obama-new-tools-turn-audio-clips-into-realistic-video/>

Some more references:

- [Deep Learning](#), Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.
Available free from: <http://www.deeplearningbook.org/>
- Machine Learning depository: <https://bit.ly/MLops>