



# COMP 6721 Introduction of AI

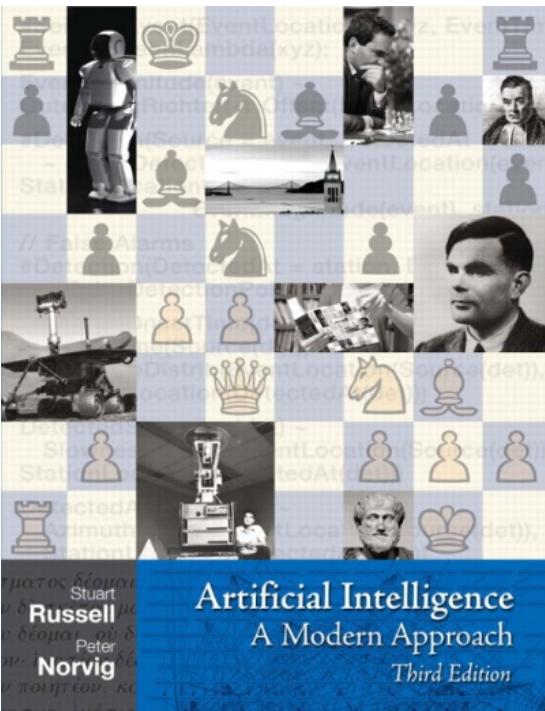
2019.9

# COMP 6721 Introduction of AI

- ▶ Instructor : Zixi Quan
- ▶ Email: zixi.quan @ concordia.ca
- ▶ Office Hours: Monday & Wednesday 3:00-4:30pm or by appointment  
  
(Note: no office hours for the first week)
- ▶ Course Webpage: Go to the Moodle page
- ▶ Midterm: **Wednesday, October 16, 2019**

# COMP 6721 Introduction of AI

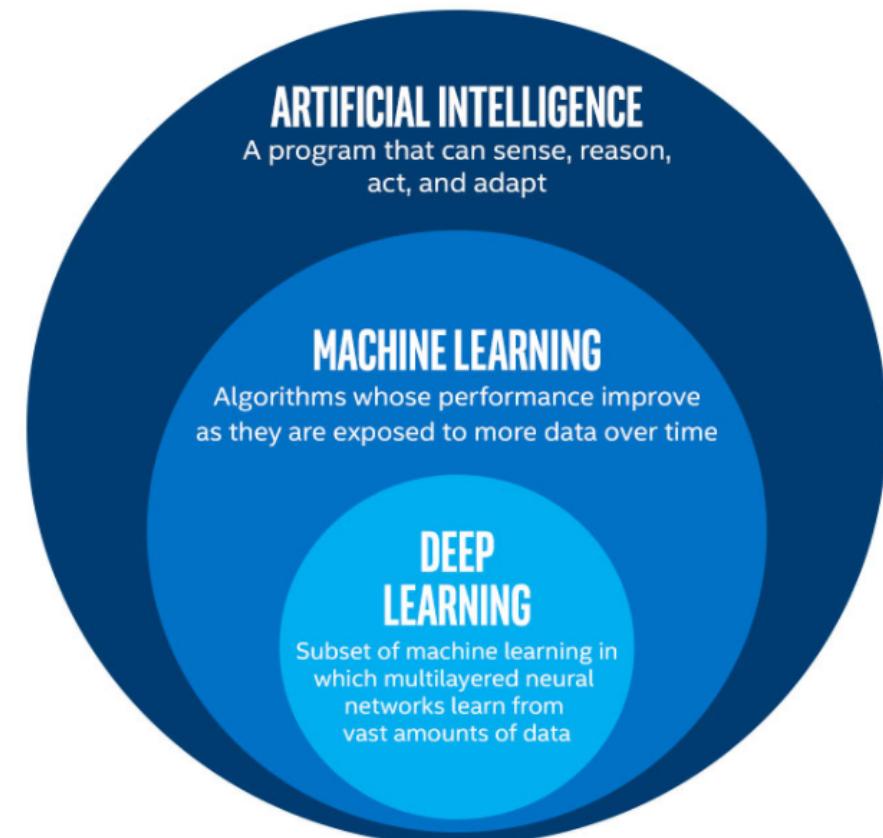
- Recommended book: *Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach 3<sup>rd</sup> Edition, Prentice Hall.*



- Not required, but for students who want to read more we recommend.
- Not a course textbook, so our presentation does not necessarily follow the presentation in the book.

# COMP6721 Introduction of AI

- ▶ Course outline (available on Moodle Page [moodle.concordia.ca](https://moodle.concordia.ca) )
- ▶ Topics includes:
  - Introduction of AI
  - State-Space Search
  - Adversarial Search
  - Machine Learning
  - Natural Language Processing
  - Deep Learning
  - Neural Networks



# COMP6721 Introduction of AI

- ▶ Evaluation scheme

**2 Projects (2 \*15%)** --- 30%

**1 Midterm exam** --- 30%

**1 Final exam** --- 40%

- ▶ Programming Language: Python

- ▶ Note: There is no fixed, a priori relationship between the numerical percentage and the final letter grades for this course. To pass the course, you must at least pass the projects and the final exam. Usually a score of 50% is required. There are no make-ups/alternates for missed exams or projects deadlines.

- ▶ There are **no make-ups/alternates** for missed exams or projects deadlines.

# COMP6721 Introduction of AI

- ▶ **Attention!!**
- ▶ All students must independently and separately prepare and hand in your assignments. The maximum is two students allowed for each project. Students should be aware of the University's academic code of conduct, especially the sections concerning cheating, plagiarism, and the possible consequences of violating this code. Please see the details from <https://www.concordia.ca/content/dam/common/docs/policies/official-policies/Academic-Code-Conduct-2015.pdf>.

# COMP6721 Introduction of AI

## ► Tentative Schedule

Week	Dates	Topic	Chapter	Assignment
1	Sep 3 - Sep 8	<b>Introduction of AI</b>	1, 26	
2	Sep 9 - Sep 15	<b>State-Space Search</b>	3, 4.1.1	
3	Sep 16 - Sep 22	<b>Adversarial Search</b>	5.1-5.4	Project1 available
4	Sep 23 - Sep 29	<b>Machine Learning</b>	18.1-18.2	
5	Sep 30 - Oct 6	<b>Machine Learning Algorithms</b>		
6	Oct 7 - Oct 13	<b>Machine Learning Algorithms</b> <b>Neural Networks</b>	19.1-19.6	
7	Oct 14 - Oct 20 Mon Oct 14 Wed Oct 16 <sup>1</sup>	<b>Thanksgiving – No class</b> <b>Midterm Exam</b>		Project1 due
8	Oct 21 - Oct 27	<b>Neural Networks</b> <b>Natural Language Processing</b>	22.1-22.3	Project2 available
9	Oct 28 - Nov 3	<b>NLP: N-gram Models</b>	23.1, 24.7	
10	Nov 4 - Nov 10	<b>NLP: Syntax and Semantics</b>	23	
11	Nov 11 - Nov 17	<b>Deep Learning</b>		
12	Nov 18 - Nov 24	<b>Deep Neural Networks</b>		Project2 due
13	Nov 25 - Dec 2 <sup>2</sup>	<b>Catch-Up and/or Review</b>		

# COMP6721 Introduction of AI

## ► Lab Session

Session FI Monday 9:35 – 11:35 H849 Andrés Lou

Session FJ Wednesday 16:15 – 18:15 H907 Pouria Chalangari

Session FK Wednesday 18:30 – 20:30 H843 Farhood Farahnak

► **Note:** All the lab sessions will start from next week September 9.  
There is no labs for the first week!



# Chapter 1 Introduction of AI

COMP 6721 Introduction of AI

# History of AI



Ancient Greek Temple  
of Hephaestus

- ✓ Mechanical men and artificial beings appear in Greek myths, such as the golden robots of Hephaestus and Pygmalion's Galatea.
- ✓ In the Middle Ages, there were rumors of secret mystical or alchemical means of placing mind into matter



Talos was a giant animated bronze warrior programmed to guard the island of Crete created by Hephaestus

dated to around 400 BCE

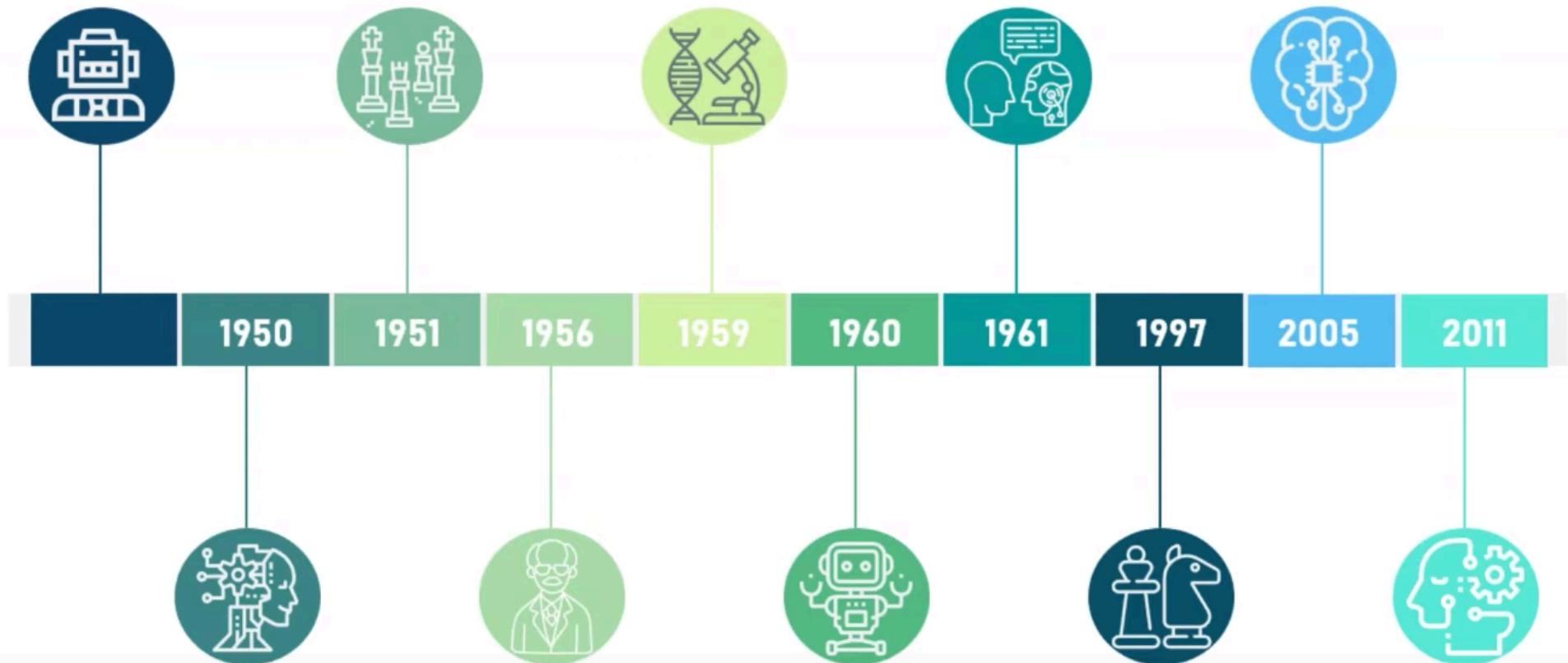
# History of AI

In 1950, Alan Turing proposed the Turing Test as a measure of machine intelligence and it is still used today to determine a machine's ability to "think" like a human.



Turing said that if the interrogator couldn't distinguish between them simply by the answers given then we could call the computer intelligent as it "thinks" and answers like a person.

# History of AI



- 2011 IBM Watson

**IBM's question answering system. Watson, defeated the two greatest Jeopardy! champions, Brad Rutter and Ken Jennings.**

# History of AI

## 2011 - Today

- ▶ Deep Learning
  - ▶ Development of “deep neural networks”
  - ▶ Trained on massive data sets
  - ▶ Use of GPU for computations
  - ▶ Use of “generic networks” for many applications
    - ▶ Image recognition
    - ▶ Self driving cars
    - ▶ Machine translation
    - ▶ Speech recognition & synthesis
    - ▶ Chatbots
    - ▶ Game playing
    - ▶ ...



# History of AI

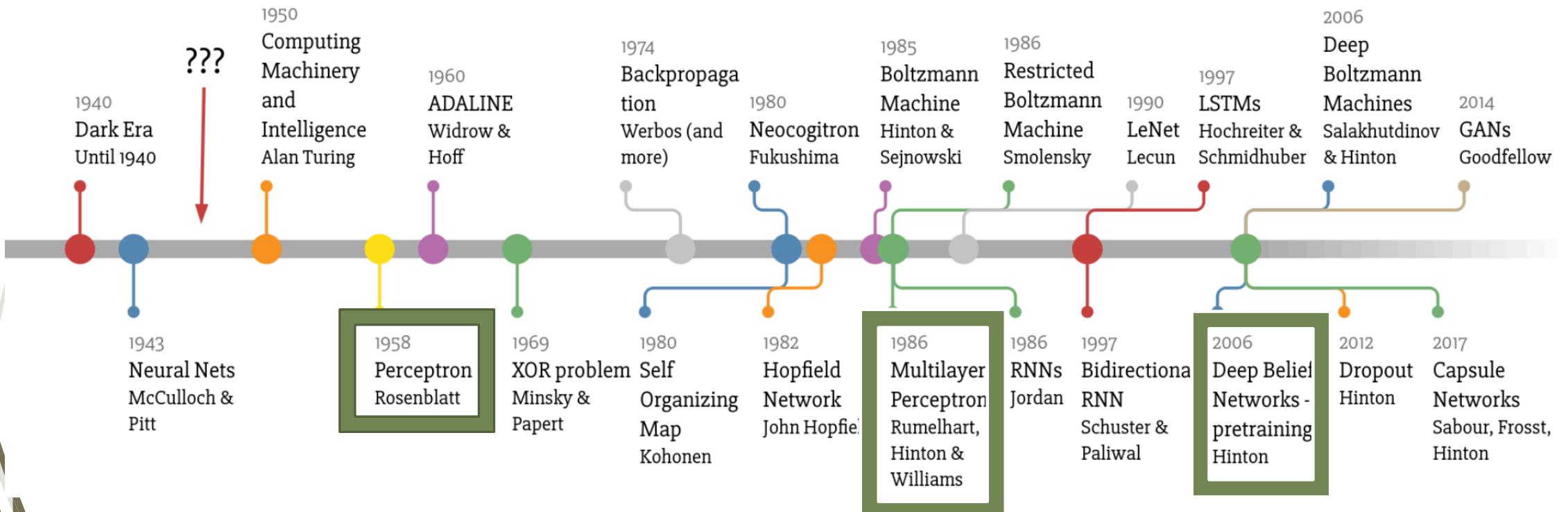
2011 - Today



- ▶ **Winners of Turing Award 2018**
  - ▶ Yann LeCun  
Prof. @ New York University
  - ▶ Geoffrey Hinton  
Prof. @ University of Toronto
  - ▶ Yoshua Bengio  
Prof. @ Université de Montréal
- ▶ **Andrew Ng – did not win ☹**

# History of AI

## Deep Learning Timeline



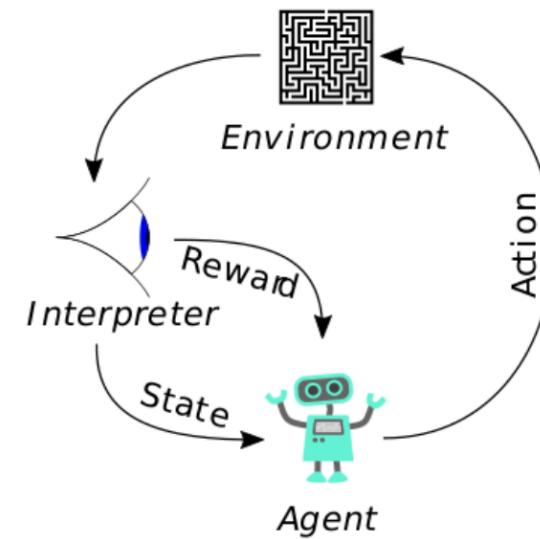
# History of AI

## 2011 - Today

- **Rich Sutton**

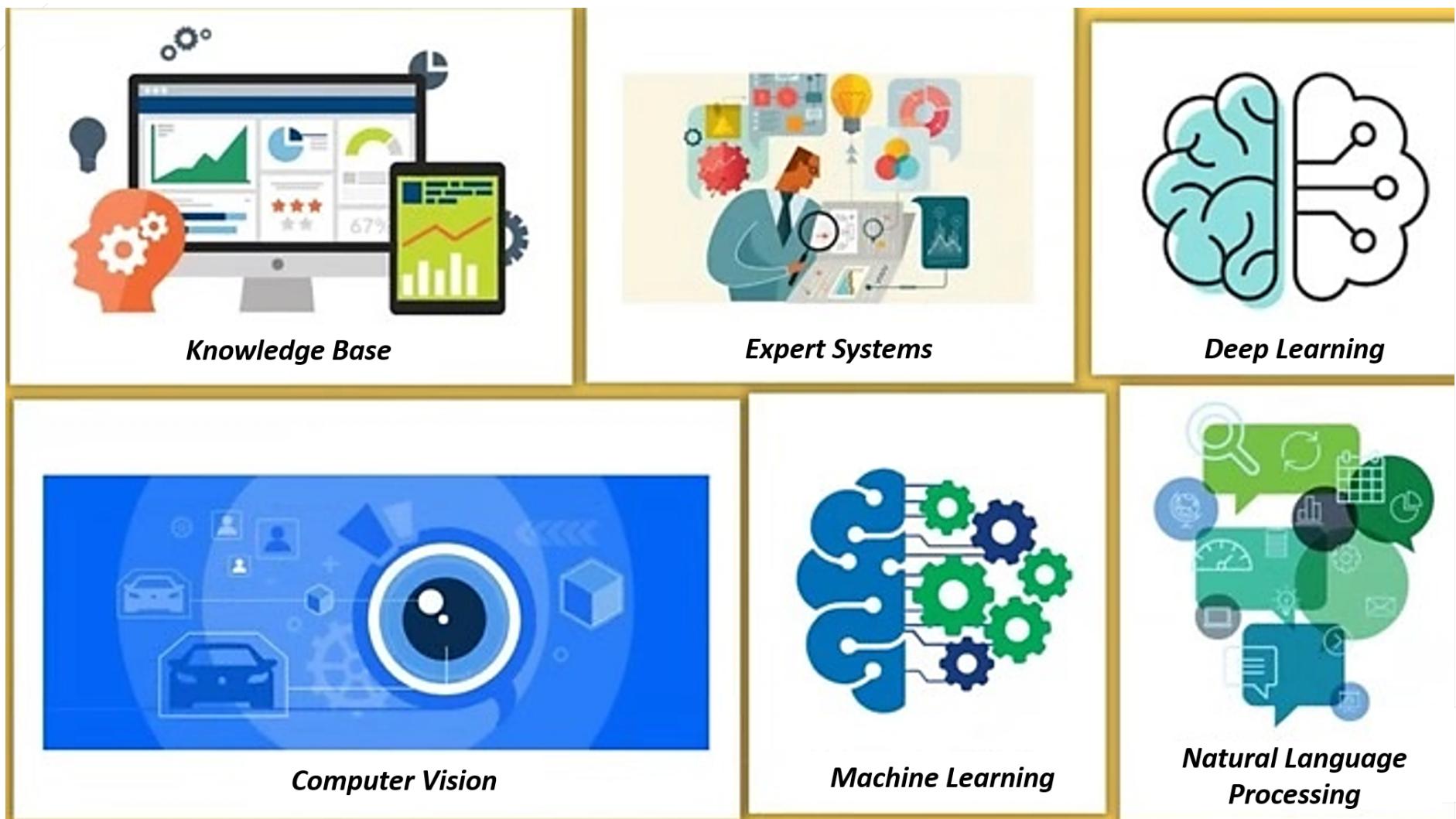
Prof. @ University of Alberta

- Proposed “Reinforcement Learning” (RL)
- He proposed the idea that instead of learning from data, it is necessary learn naturally from experience.
- AI singularity in 2040 coming with smart robot



The typical RL scenario: an agent takes actions in an environment, which is interpreted into a reward and a representation of the state, which are fed back into the agent.

# AI Domains



# AI Conference Topics

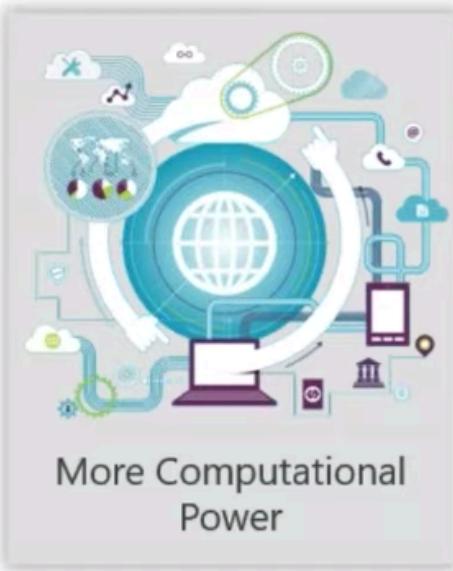
1. Automated Reasoning
2. Bioinformatics and BioNLP
3. Case-based Reasoning
4. Cognitive Models
5. Constraint Satisfaction
6. Data Mining
7. E-Commerce
8. Evolutionary Computation
9. Games
10. Information Retrieval and Search
11. Information and Knowledge Management
13. Knowledge Representation
14. **Machine Learning**
15. Multimedia Processing
16. **Natural Language Processing**
17. **Neural Networks and Deep Learning**
18. Planning
19. Privacy-preserving
20. Robotics
21. Uncertainty
22. User Modeling
23. Web Mining and Applications



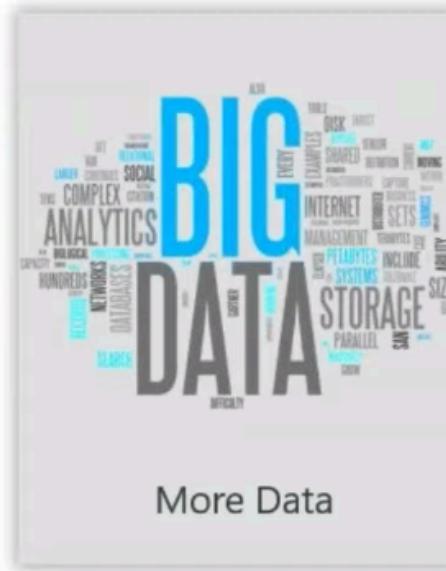
A cartoon illustration of a man with brown hair, wearing glasses, a blue shirt, and a blue jacket. He has a brown beard and is resting his chin on his hand, looking thoughtful. A thought bubble above him contains the text "Why are we talking about AI now?!"

Why are we talking about  
AI now?!

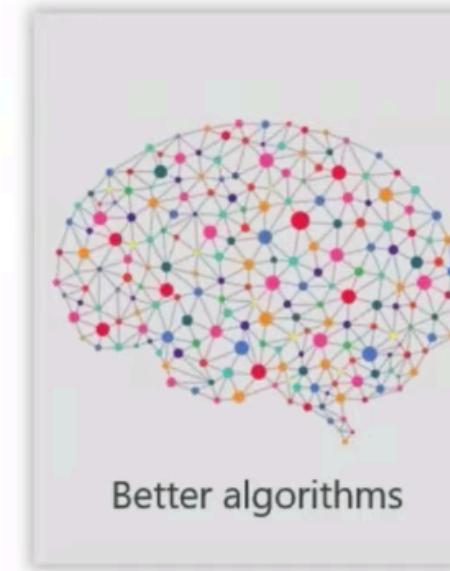
# Demands for AI



GPU



Social Media  
IoT  
Image Processing



Neural Networks  
Deep Learning



Governments  
Universities  
Companies

# What is AI ?

*"The term artificial intelligence was first coined by John McCarthy in 1956 when he held the first academic conference on the subject."*



## A PROPOSAL FOR THE DARTMOUTH SUMMER RESEARCH PROJECT ON ARTIFICIAL INTELLIGENCE

J. McCarthy, Dartmouth College  
M. L. Minsky, Harvard University  
N. Rochester, I.B.M. Corporation  
C.E. Shannon, Bell Telephone Laboratories

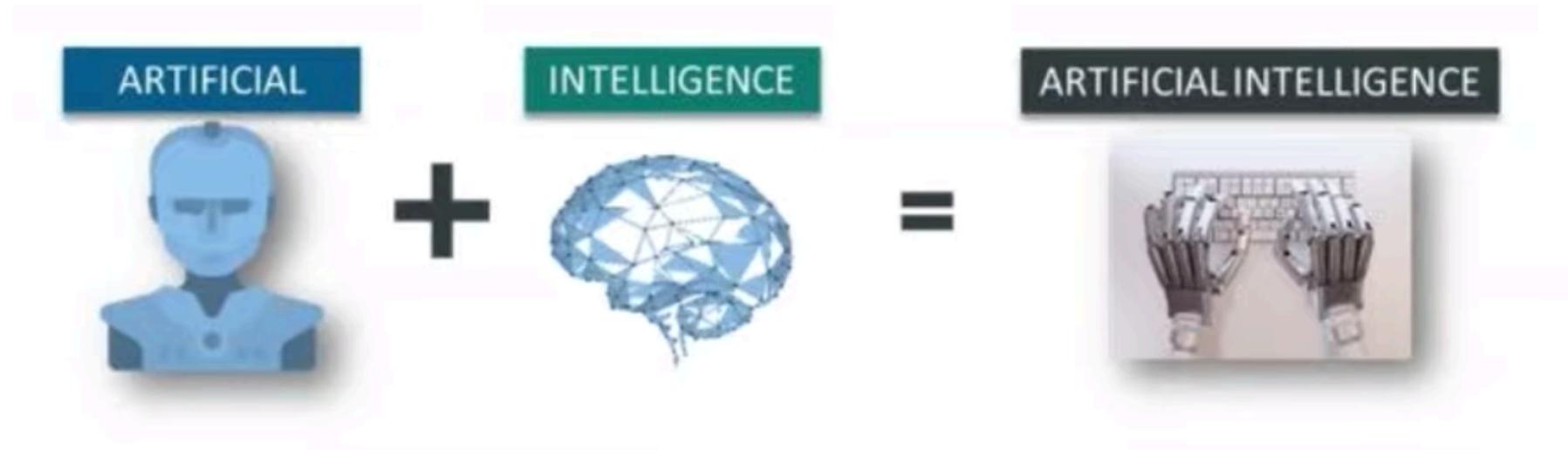
August 31, 1955

We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made

**John McCarthy defined Artificial Intelligence as the science and engineering of making intelligent machines.**

# What is AI ?

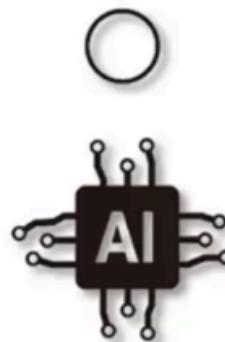
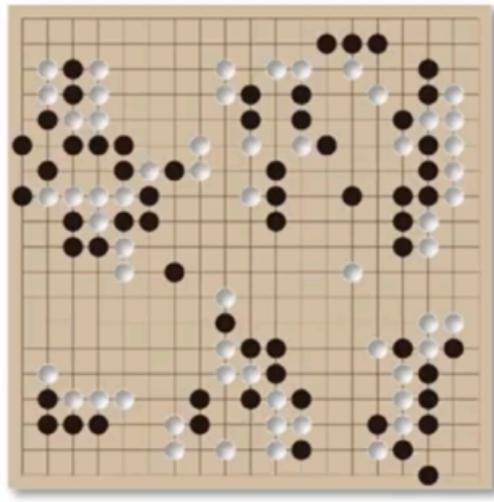
- ▶ AI is the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making and translation between languages. (source - Wikipedia)



# AI Applications



Google



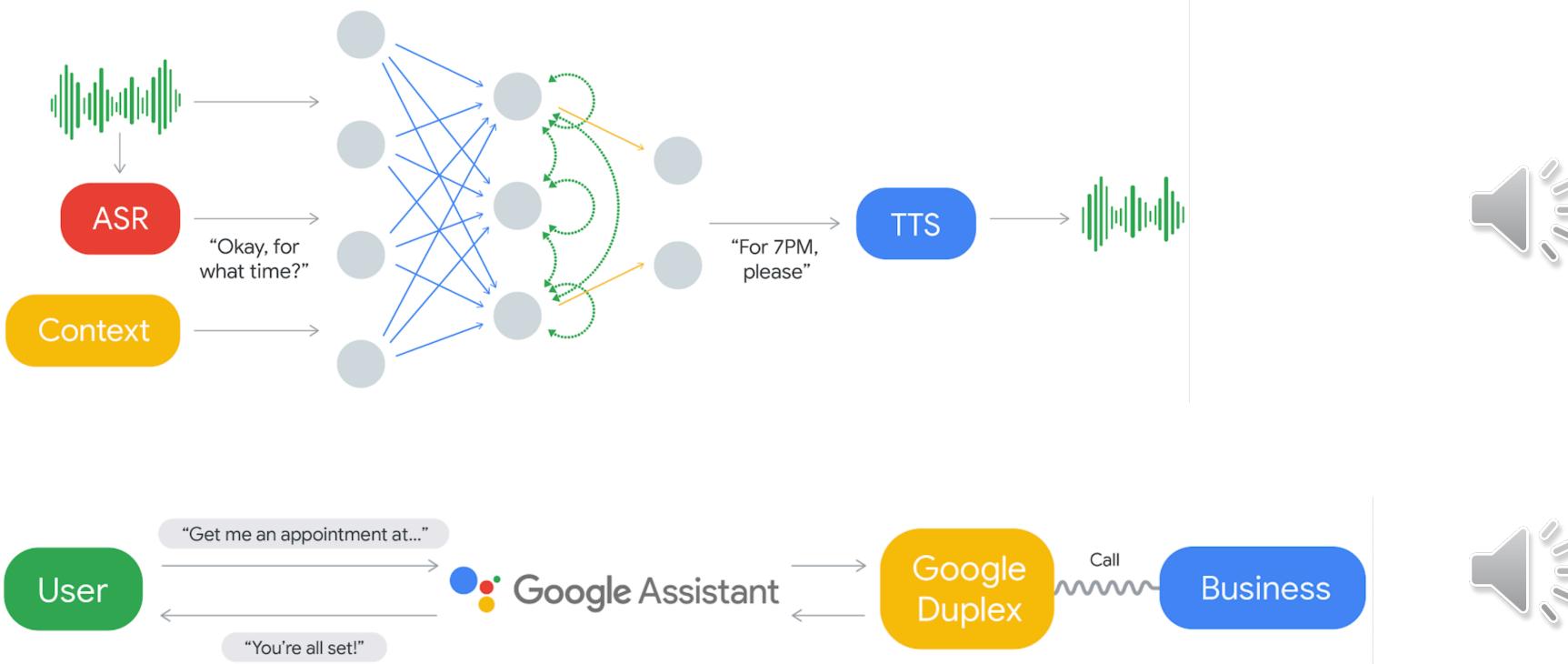
- ▶ GO was always considered a much harder game to automate than chess because of its very high branching factor (35 for chess vs 250 for Go!)
- ▶ In 2016, AlphaGo beat Lee Sedol in a five-game match of GO.
- ▶ In 2017 AlphaGo beat Ke Jie, the world No.1 ranked player at the time.

*AlphaGo uses a Monte Carlo tree search algorithm to find its moves based on knowledge previously "learned" by deep learning.*

# AI Applications

Google

► Google Duplex can not only respond to calls and book appointments for you, it adds a human touch.



# AI Applications

- ▶ J.P.Morgan Chase's Contract Intelligence (COiN) platform uses AI, machine learning and image recognition software to analyze legal documents.



# AI Applications



New York City Real Estate Report

Property sales in New York City surged higher in October. This marks the second month in a row that the market's transaction volume has increased.

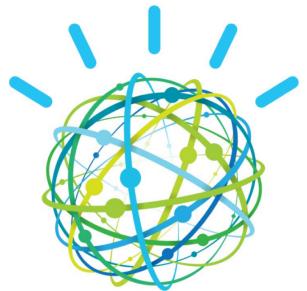
In addition to the increase in housing turnover, there was also a rise in average home value. Among all homes sold in the month, the mean price reached \$578,232, up from \$575,680.

At the current rate of sales, there are now four months of inventory.

A screenshot of a news article titled "New York City Real Estate Report". The article discusses a surge in property sales in October, marking the second consecutive month of increased transaction volume. It notes a rise in average home values, with the mean price reaching \$578,232, up from \$575,680. It also mentions that at the current rate of sales, there are now four months of inventory.

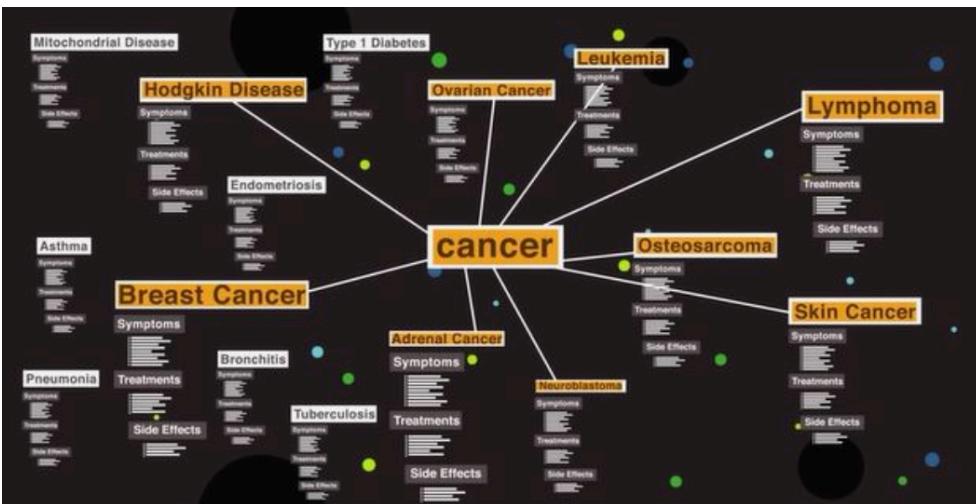
Wordsmith, an automated Insights' software platform, is used for writing car descriptions and Fantasy Football recaps. Forbes uses this technology for creating earnings previews.

# AI Applications



IBM Watson™

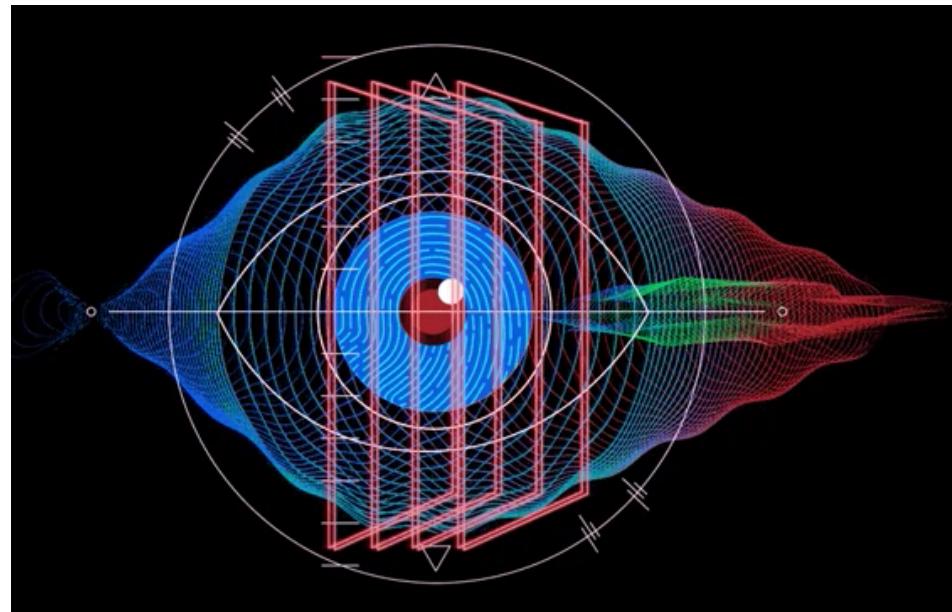
- ▶ Healthcare organizations use IBM AI (Watson) technology for medical diagnosis.
- ▶ E.g. IBM Watson went through 20 million records in a few minutes and correctly diagnosed that the woman was suffering from some rare leukemia type and suggested a cure.



# AI Applications

Google

- Google AI Eye Doctor – can examine retina scans and identify a condition called diabetic retinopathy which can cause blindness. It works with an India eye care chain to develop the AI System .



# AI Applications



**There is an interesting example of artificial intelligence technology created for stopping hijackers. This machine combines functions of a drone, helicopter, and trained snipers. This helicopter is called Vigilante.**

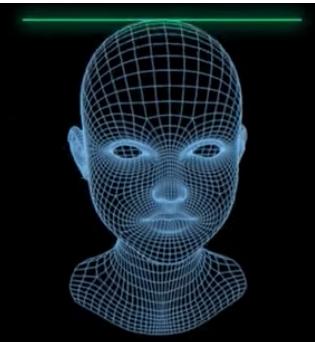
# AI Applications



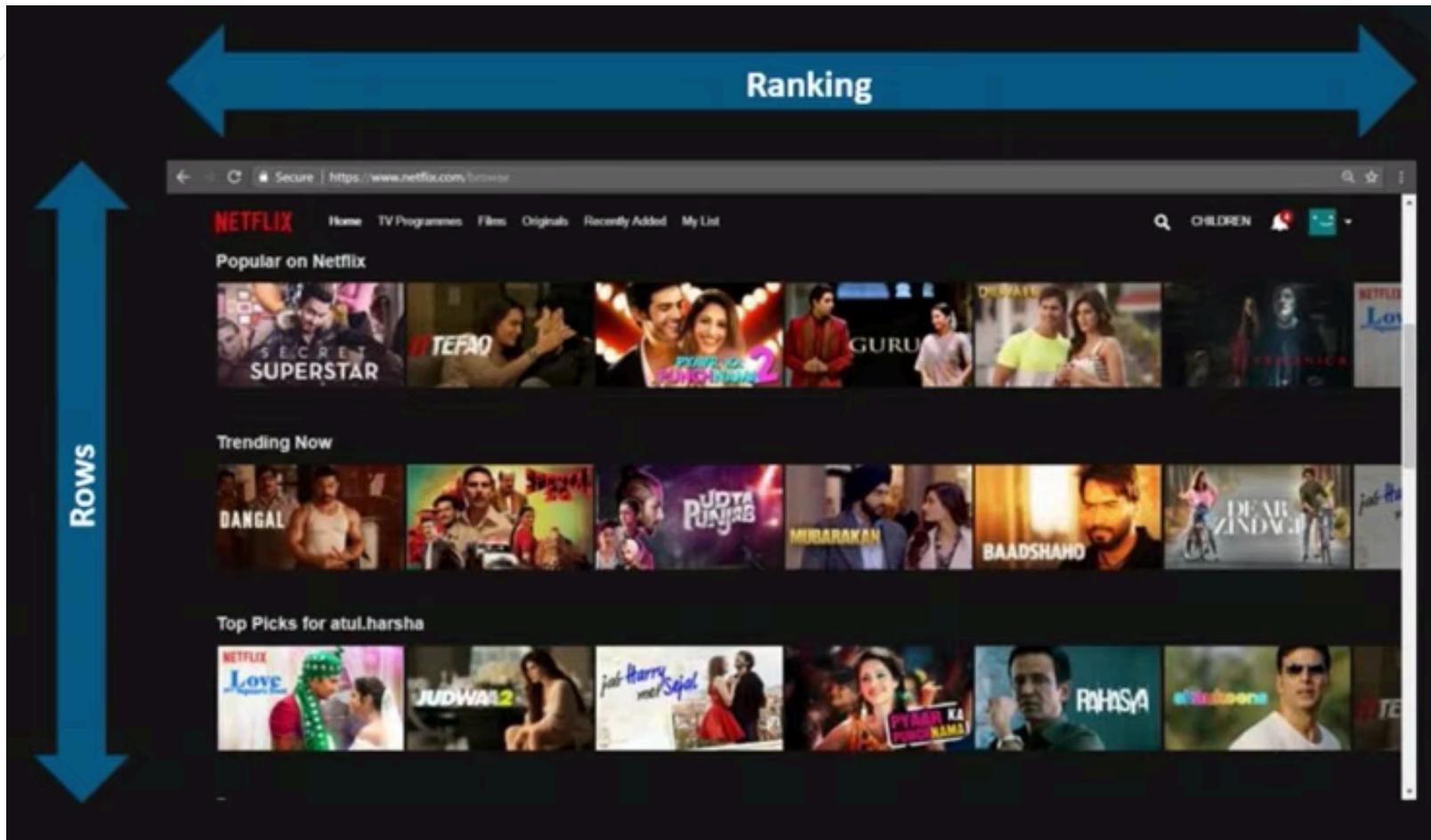
***“Tesla will have fully self-driving cars ready by the end of the year and a “robot taxi” version – one that can ferry passengers without anyone behind the wheel – ready for the streets next year.” -- Elon Musk***

# AI Applications

**facebook** uses artificial intelligence techniques to detect facial features for face recognition.

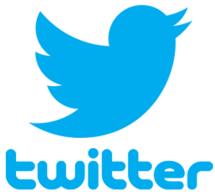


# AI Applications



- Over 75% of what you watch is recommended by Netflix.

# AI Applications



is using AI to identify hate speech and terroristic language in tweets.

The image displays three tweets from different users, each accompanied by an AI-generated emoji indicating sentiment. The first tweet from Sara Stewart shows a sad face emoji. The second tweet from Andy Williams shows a neutral face emoji. The third tweet from Nancy Perez shows a happy face emoji.

User	Role	Tweet Content	Sentiment Icon	Likes	Retweets
Sara Stewart	Event Manager, BrandEquity	That last session wasn't bad, but it could have used more audience participation.		0	0
Andy Williams	CTO, Market Tech	Does anyone know when the shuttles leave this morning?		0	3
Nancy Perez	Paid Media Manager, Qualzen	What a great first day! Can't wait for the networking event tonight.		20	78

***The company discovered and banned 300,000 terrorist-linked accounts, 95 % of which were found by non-human, artificially intelligent machines.***

# AI Applications

- ▶ Lyrebird is an AI application used for creating the most realistic artificial voices in the world. Clone your own voice or get a unique custom voice for your business.
- ▶ “Good Morning everyone, welcome to COMP6721 Introduction of AI Course. Today is our first session. Let's get started now!”
- ▶ “I hope all of you can learn some useful popular AI knowledge to apply in your future career.”

# AI Applications

- ▶ Sophia is a social humanoid robot developed by Hong Kong based company Hanson Robotics. Sophia made its first public appearance in mid-March 2016 in US.



<https://www.youtube.com/watch?v=78-1Mlkxyql>

# What is AI ?

**AI is a thread to humanity**



**Elon Musk**

**AI is the future of humanity**



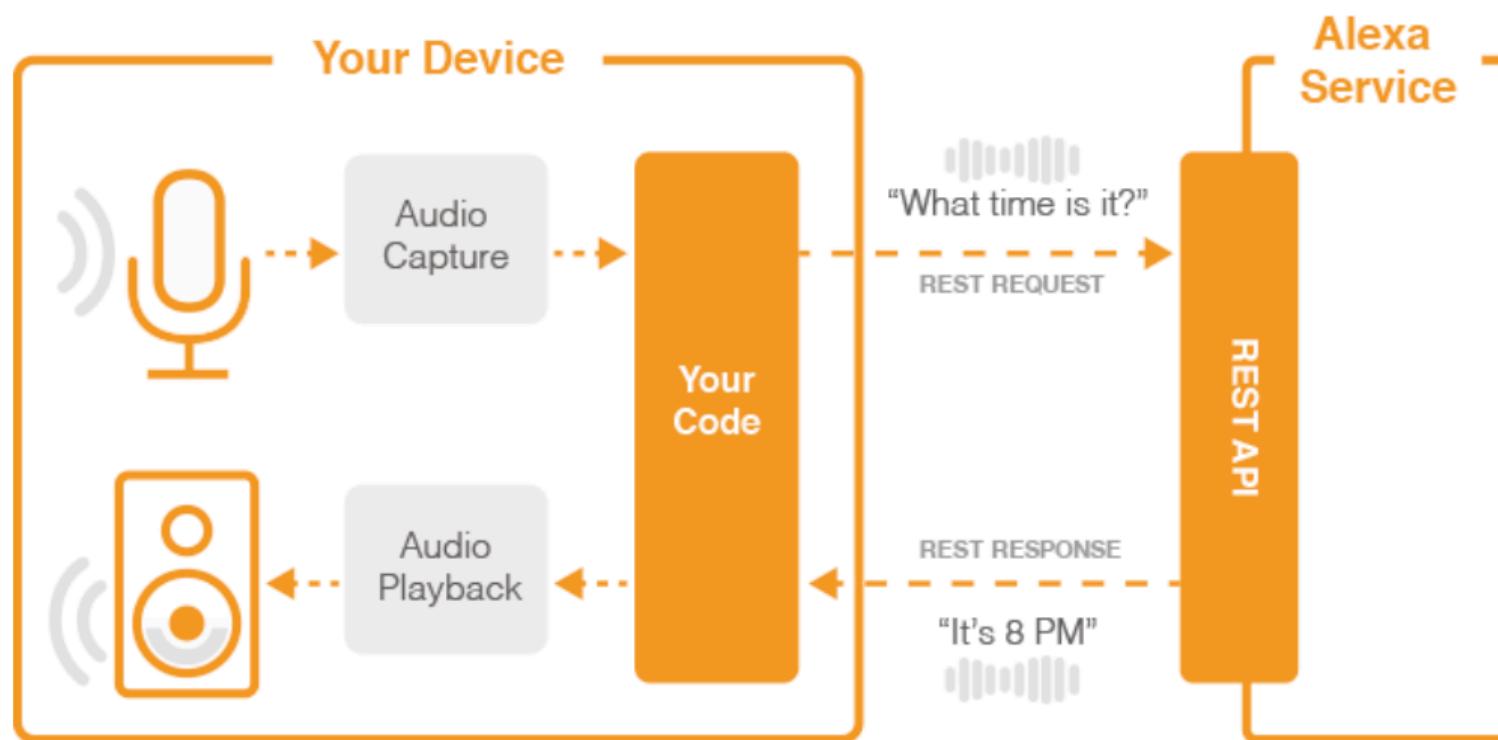
**Mark Zuckerberg**

# Types of AI

- ▶ Artificial **Narrow** Intelligence (ANI)
  - also known as weak AI involves applying AI only to specific tasks.
  - ▶ A system whose capabilities are **not** intended to match or exceed the capabilities of human beings.
  - ▶ A system that can perform **a specific** intellectual task as well as a human would

# Types of AI

## ► Artificial **Narrow** Intelligence (ANI) - Example



# Types of AI

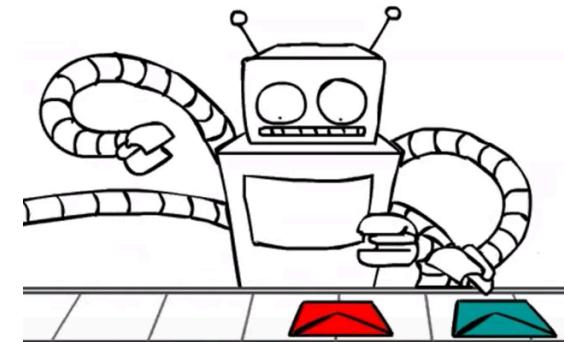
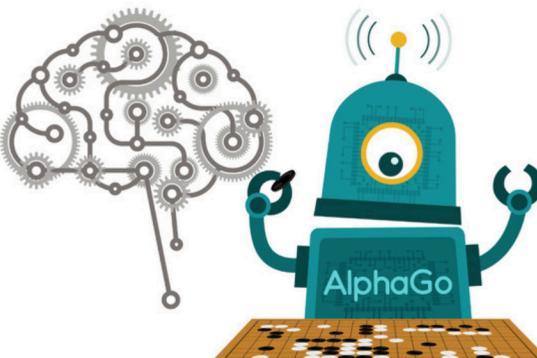
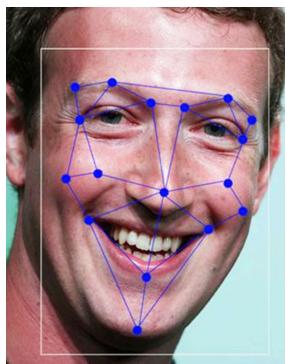
- ▶ Artificial **General** Intelligence (AGI)
  - also known as strong AI involves machines that process the ability to perform any intellectual task that a human being can.  
e.g. ??? reasoning and thinking like a human being???

# Types of AI

- ▶ Artificial **Super** Intelligence (ASI)
  - is a term referring to the time when the capability of computers will surpass humans.
  - ▶ typically used in science fiction
  - ▶ A system that matches or exceeds human intelligence in **any** intellectual task – “general intelligence”
  - ▶ A system that could have: consciousness, self-awareness, the ability to *feel* sentiments, ...

# Types of AI

► Which type of AI applied for these applications?



"I was a human being."

"Am I a human being ?"

# Types of AI

► Which type of AI applied for these applications?



The Terminator



I, Robot



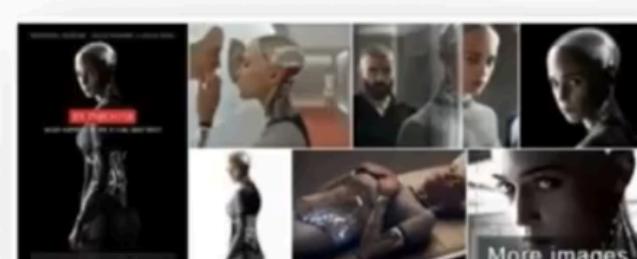
The Matrix



Tron: Legacy

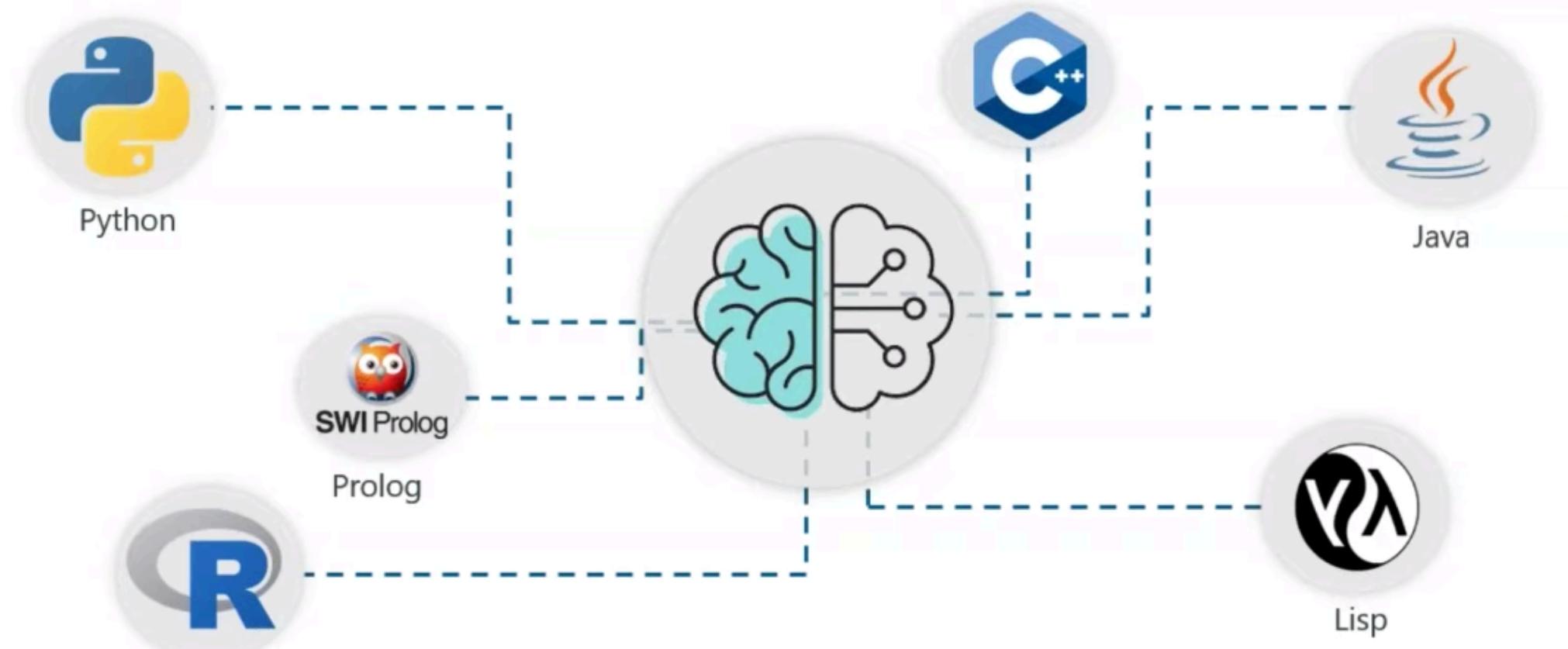


War Games



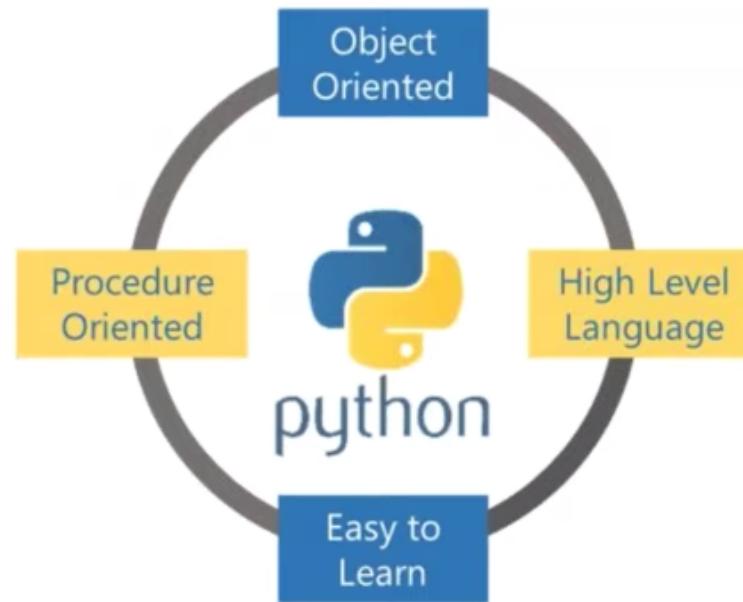
Ex Machina

# Programming Languages for AI



# Programming Languages for AI

- ▶ Python is an interpreted, object-oriented, high-level programming language with dynamic semantics.
- ▶ Python was created by Guido Rossum in 1989 and is very easy to learn.



# Programming Languages for AI

- ▶ Simple and Easy to learn
- ▶ Free and Open Source
- ▶ High-level Language
- ▶ Portable
- ▶ Support different Programming Paradigm
- ▶ Extensible



Python code can invoke C and C++ libraries, can be called from C++ program, can integrate with Java and .NET components.

***Python is the required programming language for this course!!***

C/C++



.NET

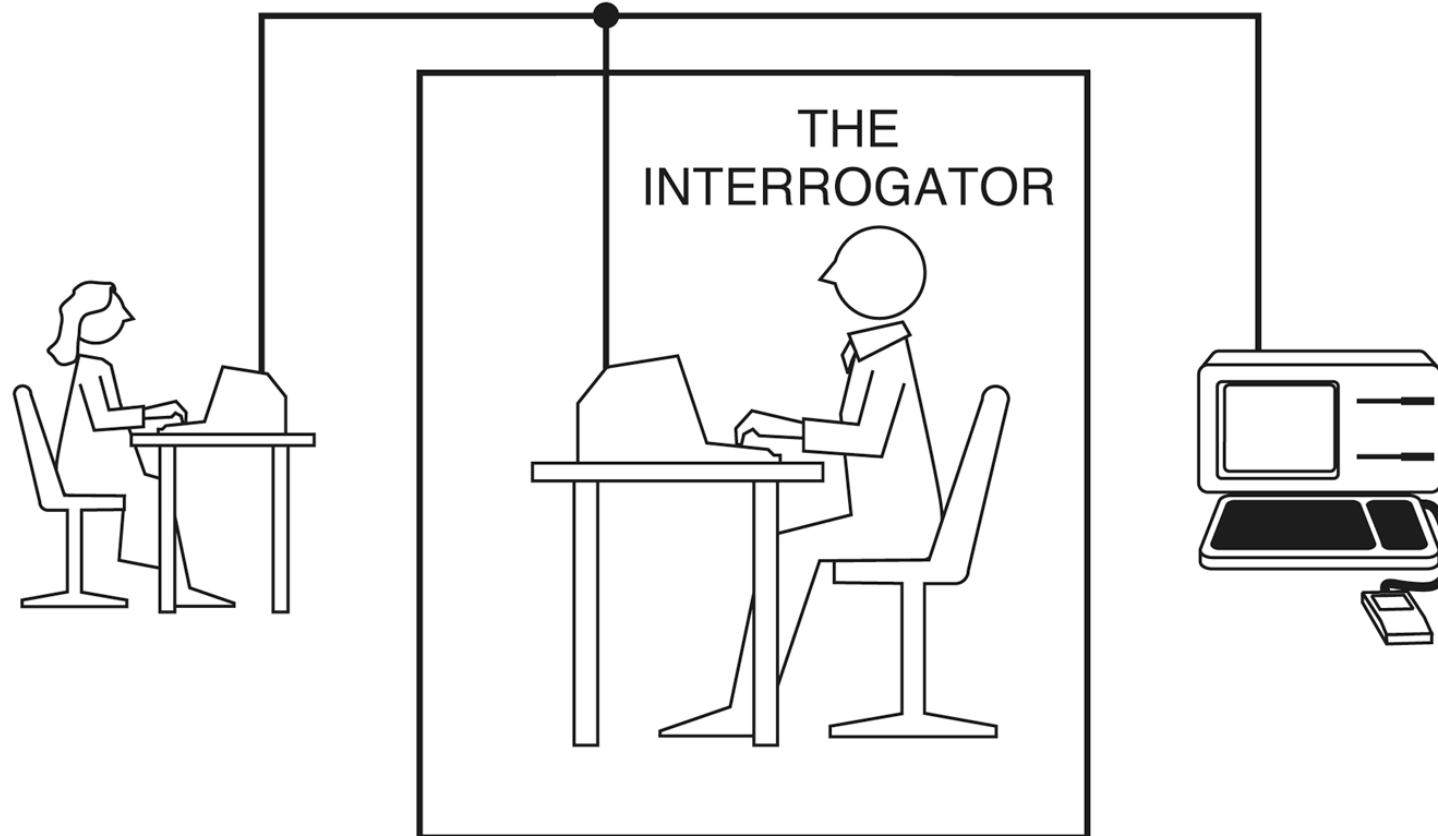
# A Test for Intelligence

## ► The Turing Test

- The “imitation game”
- Proposed by Alan Turing in 1950
- If a human interrogator cannot tell the computer and human apart, then the computer is intelligent
- Measures the intelligence of a computer vs. a human
- Turing predicted that by 2000, a machine might have a 30% chance of fooling a person for 5 minutes



# A Test for Intelligence



- A human mediates between the interrogator and the machine

# The Turing Test

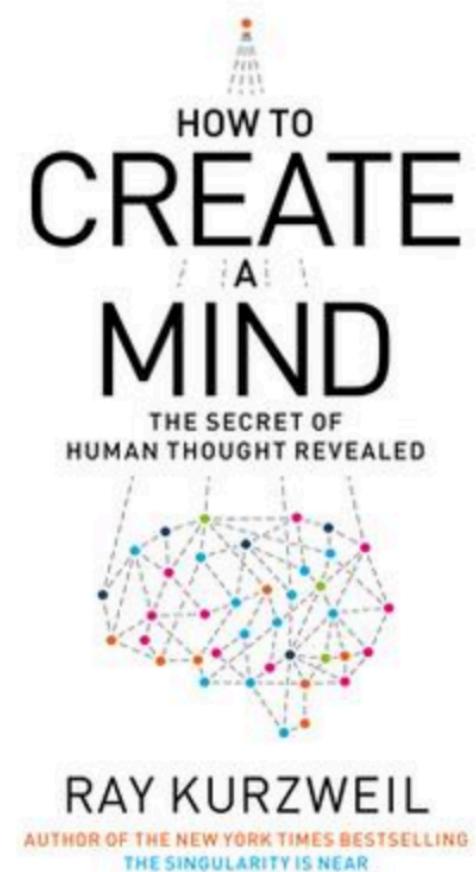
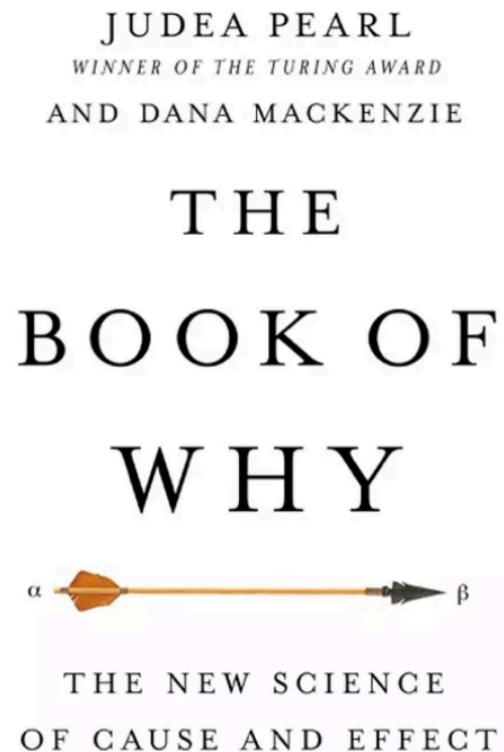
- ▶ Some capabilities required to pass the Turing test:
  - ▶ Natural Language Processing (NLP) to communicate
  - ▶ Knowledge Representation to store knowledge
  - ▶ Automated Reasoning to infer new knowledge
  - ▶ Machine Learning
  - ▶ ...

# Current Turing Test

## CAPTCHA:

- ▶ Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA)
- ▶ the system asks a user to complete a test which the computer is able to generate and grade, but not able to solve.
- ▶ Because computers are unable to solve the CAPTCHA, any user entering a correct solution is presumed to be human.
- ▶ also known as **reverse Turing test**, because it is:
  - ▶ given by a machine and targeted to a human
  - ▶ in contrast to the Turing test that is given by a human and targeted to a machine.

# Before the End



# The End

