



ARTIFICIAL INTELLIGENCE

INTRODUCTION

GOAL FOR TODAY

- Catching up!
- How will this online course look like?
- Syllabus
- Introduction to AI

COURSE DESCRIPTION

One-hour synchronous communication, readings, discussions, and evaluation

Lesson 1. Introduction

Lesson 2. Knowledge representation; Reasoning; Propositional Logic

Lesson 3. Predicate Logic

Lessons 4-5 Search Strategies; Prolog (I and II)

Lesson 6. Expert Systems

Lesson 7. Natural Language Processing

Lesson 8-9. Learning; Machine Learning; Python; Deep Learning (I and II)

Lesson 10. Catch-up; Presentations

- Regular readings and discussions in Slack (10%)
 - Individual
- Homeworks (30%)
 - Course notes
 - Exercises – Propositional logic / Predicate logic / Prolog / Grammars
 - To be provided in a shareable file
 - Individual
- (Directed) Labs and project (Python) (40%)
 - Deep learning example
 - To be explained in a 2-minute video
 - Individual
 - Project
 - To be presented (5 minutes per team)
 - Team of 2-3 students
- Exam (20%)
 - Quiz (only)

Tentative ! Done by June 19nd



LESSON I - INTRODUCTION

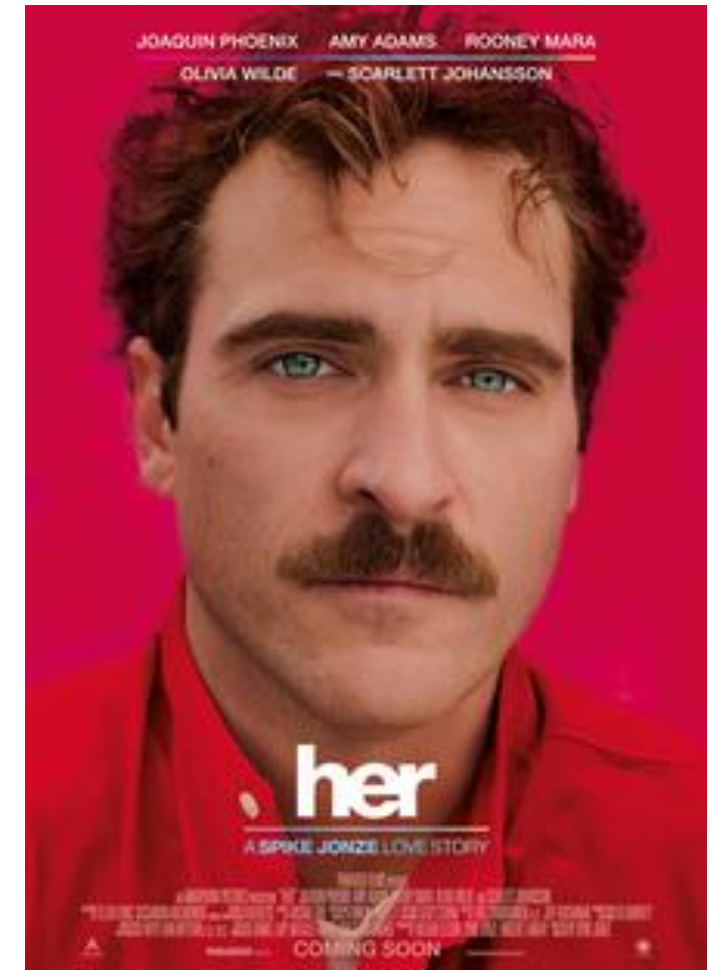
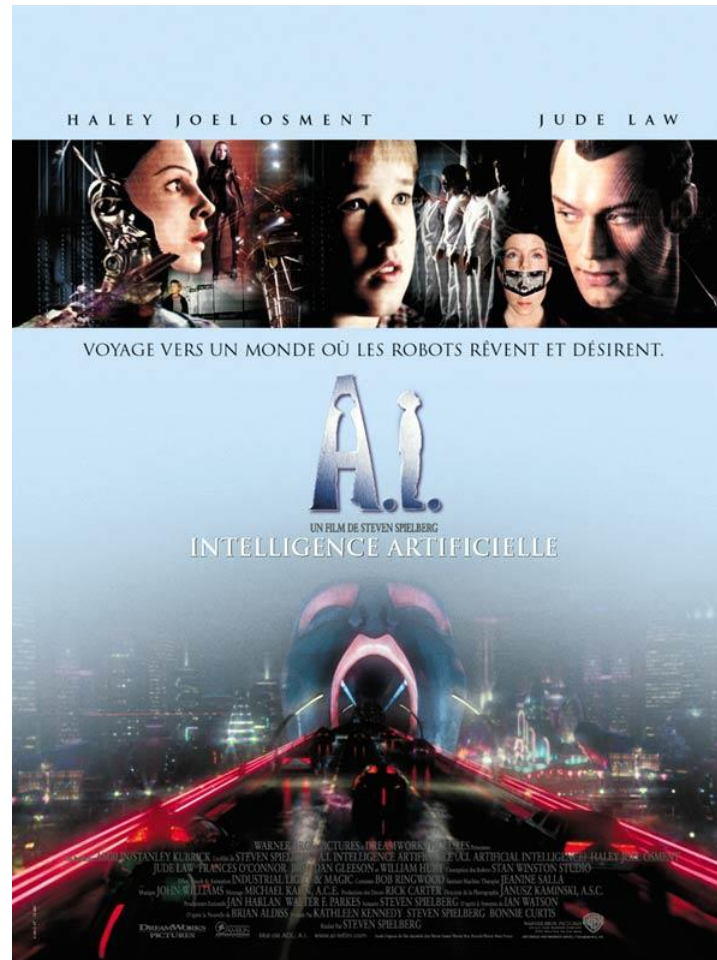
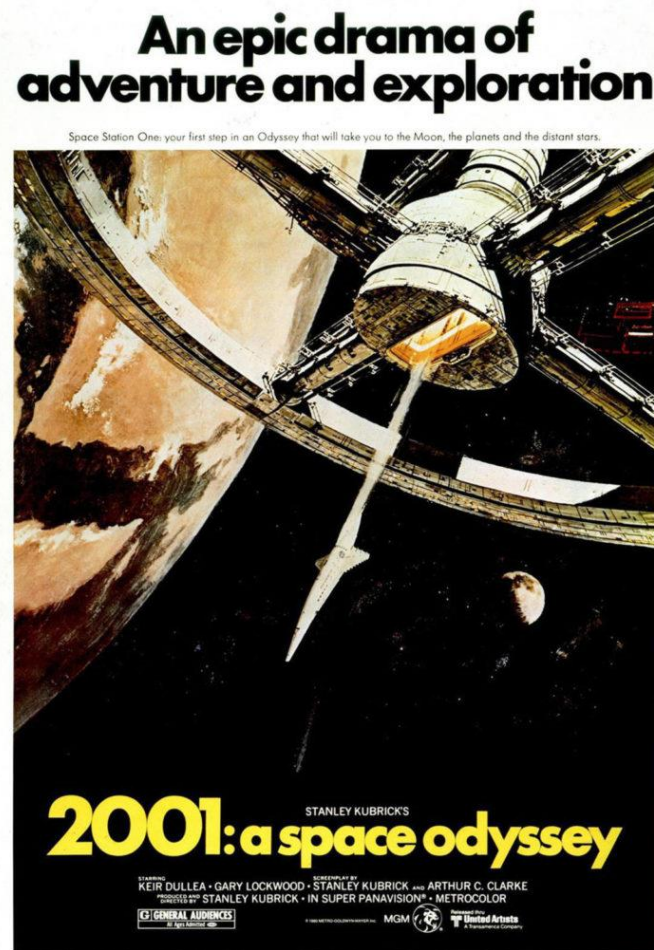




WHAT IS AI?



WHAT IS AI?



WHAT IS INTELLIGENCE?

- Complex concept
- Different types of intelligence
 - Linguistic and verbal, logical, spatial, body/movement, musical, interpersonal, intrapersonal, emotional
- Content of intelligence
 - Reasoning, learning, logic, problem-solving, perception, and linguistic ability

NATURE OF INTELLIGENCE

- Learn from experience
- Apply knowledge acquired from experience
- Handle complex situation
- Solve problems when important information is missing
- Determine what is important
- React quickly and correctly to new situation
- Understand visual images
- Process and manipulate symbols
- Be creative and imaginative
- Use heuristics
- Making sense out of ambiguous, incomplete, or even contradictory messages and information

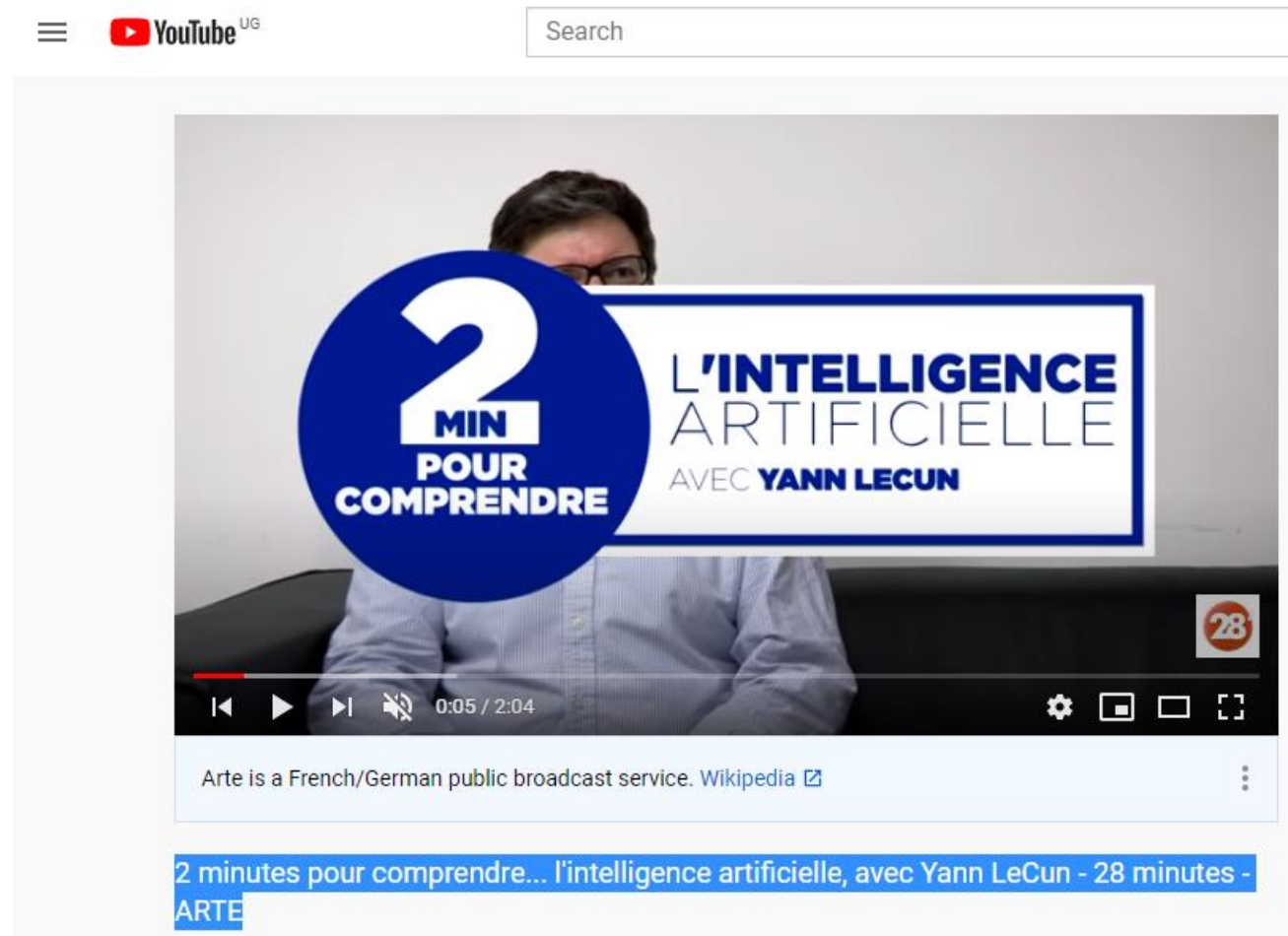
ARTIFICIAL INTELLIGENCE VERSUS HUMAN INTELLIGENCE

Area	AI	Human
Execution	Very fast	Can be slow
Emotions	Not yet	Can be positive or negative
Computation speed	Very fast	Slow, may have trouble
Imagination	Only what is programmed for	Can expand existing knowledge
Answers to questions	What is in the program	Can be innovative
Flexibility	Rigid	Large, flexible

Analytics, Data Science, & Artificial Intelligence: Systems for Decision Support. Ramesh Sharda, Dursun Delen, Efraim Turban. Pearson. <https://www.pearson.com/us/higher-education/program/Sharda-Analytics-Data-Science-Artificial-Intelligence-Systems-for-Decision-Support-11th-Edition/PGM2067063.html?tab=overview>

YANN LECUN [HTTP://YANN.LECUN.COM](http://YANN.LECUN.COM)

- 2 minutes pour comprendre... l'intelligence artificielle, avec Yann LeCun - 28 minutes - ARTE
- <https://youtu.be/8jQKRyZepJ0>



	Human performance	Rationality (ideal concept of intelligence – do the right think)
Thought process and reasoning	<p>“The exciting new effort to make computers think ... <i>machines with minds</i>, in the full and literal sense" (Haugeland, 1985)</p> <p>“The automation of activities that we associate with human thinking, activities such as decision-making, problem solving, learning ..." (Bellman, 1978)</p>	<p>“The study of mental faculties through the use of computational models" (Charniak and McDermott, 1985)</p> <p>“The study of the computations that make it possible to perceive, reason, and act" (Winston, 1992)</p>
Behavior	<p>“The art of creating machines that perform functions that require intelligence when performed by people" (Kurzweil, 1990)</p> <p>“The study of how to make computers do things at which, at the moment, people are better" (Rich and Knight, 1991)</p>	<p>“A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes" (Schalkoff, 1990)</p> <p>“The branch of computer science that is concerned with the automation of intelligent behavior" (Luger and Stubblefield, 1993)</p>

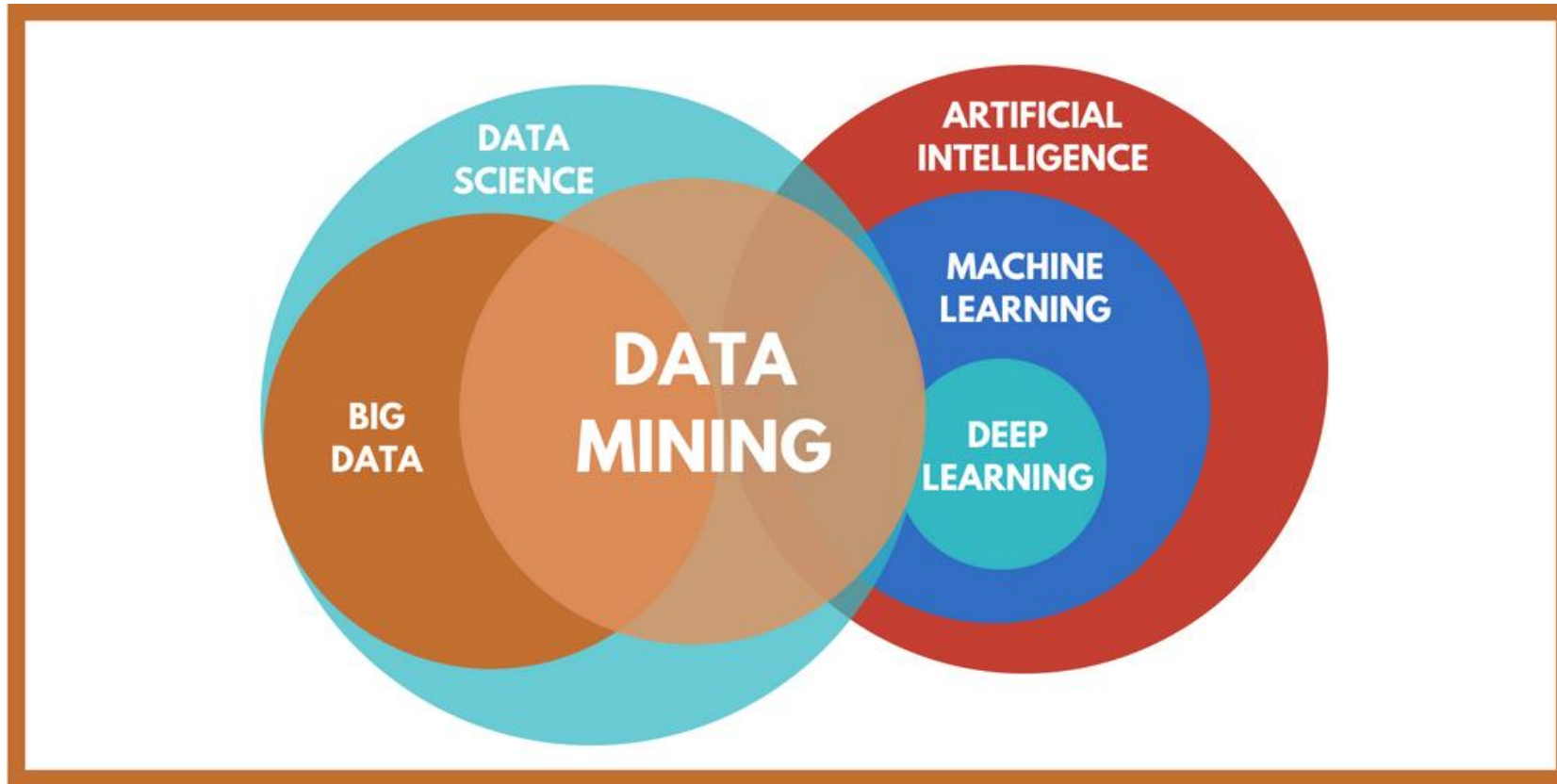
Definitions

GOALS TO PURSUE IN AI

	Human performance	Rationality (ideal concept of intelligence – do the right think)
Thought process and reasoning	Systems that think like humans.	Systems that think rationally.
Behavior	Systems that act like humans	Systems that act rationally

Thinking / Acting

BIG PICTURE



https://static.wixstatic.com/media/e51000_6ece3dc065b3446e9d23fab418bf856f~mv2.png/v1/fit/w_1024,h_512,al_c,q_80/file.png

EXAMPLES

- Artificial Intelligence
 - Write a software that solves math theorems (using logic)
- Machine Learning
 - Learn to make decision to detect financial fraud
- Deep Learning
 - Learn to recognize a picture of cat (based on neural networks)
- Data Science
 - Predicting the traffic on the street of Dakar at 5 pm on a Friday
- Big Data
 - Save data in a datawarehouse and query it to know the sales for the first quarter of 2025 (query)
- Data Mining
 - Make recommendation on TV shows based on the behavior of customers who watched the same movies as me (finding patterns)



HISTORY



HISTORY [FROM [HTTPS://BUILTIN.COM/ARTIFICIAL-INTELLIGENCE](https://builtin.com/artificial-intelligence)]

- **1943** McCulloch & Pitts: Boolean circuit model of brain
- **1950**
 - Turing publishes “Computing Machinery and Intelligence” (Turing Test)
 - Harvard undergraduates Marvin Minsky and Dean Edmonds build SNARC, the first neural network computer
 - Claude Shannon publishes the paper "Programming a Computer for Playing Chess"
 - Isaac Asimov publishes the "Three Laws of Robotics"
- **1952** Arthur Samuel develops a self-learning program to play checkers
- **1954** IBM machine translation experiment automatically translates 60 carefully selected Russian sentences into English
- **1956 Artificial Intelligence is coined at the "Dartmouth Summer Research Project on Artificial Intelligence"**
- **1958** John McCarthy develops the AI programming language **Lisp** and publishes the paper "Programs with Common Sense."
- **1959**
 - Allen Newell, Herbert Simon and J.C. Shaw develop the General Problem Solver (GPS), a program designed to imitate human problem-solving
 - Herbert Gelernter develops the Geometry Theorem Prover program.
 - Arthur Samuel coins the term **machine learning** while at IBM
 - John McCarthy and Marvin Minsky found the MIT Artificial Intelligence Project

HISTORY

- **1963** John McCarthy starts the AI Lab at Stanford
- **1966** The Automatic Language Processing Advisory Committee (ALPAC) report by the U.S. government details the lack of progress in machine translations research, a major Cold War initiative with the promise of automatic and **instantaneous translation of Russian**
- **1969** The first successful **expert systems** are developed in DENDRAL, a XX program, and MYCIN, designed to diagnose blood infections, are created at Stanford
- **1972** The logic programming language **PROLOG** is created
- **1973** The "Lighthill Report," detailing the disappointments in AI research, is released by the British government and leads to severe cuts in funding for artificial intelligence projects
- **1974-1980** Frustration with the progress of AI development leads to major DARPA cutbacks in academic grants. Combined with the earlier ALPAC report and the previous year's "Lighthill Report," artificial intelligence funding dries up and research stalls. This period is known as the "First AI Winter."

HISTORY

- **1980** Digital Equipment Corporations (DEC) develops R1 (also known as XCON), the first successful commercial **expert system**. Designed to configure orders for new computer systems, R1 kicks off an investment boom in expert systems that will last for much of the decade, effectively ending the first "AI Winter"
- **1982** Japan's Ministry of International Trade and Industry launches the ambitious Fifth Generation Computer Systems project. The goal of FGCS is to develop supercomputer-like performance and a platform for AI development
- **1983** In response to Japan's FGCS, the U.S. government launches the Strategic Computing Initiative to provide DARPA funded research in advanced computing and artificial intelligence
- **1985** Companies are spending more than a billion dollars a year on expert systems and an entire industry known as the Lisp machine market springs up to support them. Companies like Symbolics and Lisp Machines Inc. build specialized computers to run on the AI programming language Lisp
- **1987-1993** As computing technology improved, cheaper alternatives emerged and the Lisp machine market collapsed in 1987, ushering in the "Second AI Winter."
- **1991** U.S. forces deploy DART, an automated logistics planning and scheduling tool, during the Gulf War.
- **1997 IBM's Deep Blue** beats world chess champion Gary Kasparov

HISTORY

- **2005**
 - STANLEY, a **self-driving car**, wins the DARPA Grand Challenge.
 - The U.S. military begins investing in autonomous robots like Boston Dynamic's "Big Dog" and iRobot's "PackBot."
- **2008 Google** makes breakthroughs in speech recognition and introduces the feature in its phone
- **2011 IBM's Watson** trounces the competition on *Jeopardy!*.
- **2012** Andrew Ng, founder of the Google Brain Deep Learning project, feeds a neural network using **deep learning** algorithms 10 million YouTube videos as a training set. The neural network learned to recognize a cat without being told what a cat is, ushering in breakthrough era for neural networks and deep learning funding
- **2014 Google** makes first self-driving car to pass a state driving test.
- **2016** Google DeepMind's **AlphaGo** defeats world champion Go player Lee Sedol. The complexity of the ancient Chinese game was seen as a major hurdle to clear in AI.

1956 DARTMOUTH CONFERENCE



1956 Dartmouth Conference: The Founding Fathers of AI



John MacCarthy



Marvin Minsky



Claude Shannon



Ray Solomonoff



Alan Newell



Herbert Simon



Arthur Samuel



Oliver Selfridge



Nathaniel Rochester



Trenchard More

DARTMOUTH SUMMER RESEARCH PROJECT ON ARTIFICIAL INTELLIGENCE

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 pre-
cisely 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 in one or more of these problems if a carefully selected group of scientists work on it together for a summer.

A PROPOSAL FOR THE
DARTMOUTH SUMMER RESEARCH PROJECT
ON ARTIFICIAL INTELLIGENCE

Solomonoff

March 6, 1956

PLANS FOR THE DARTMOUTH SUMMER RESEARCH PROJECT ON
ARTIFICIAL INTELLIGENCE

A. Newell and H.A. Simon

U

An approach to the artificial intelligence problem

J. McCarthy

(I underline terms with which the reader may have difficulty. Consult the vocabulary if you aren't sure we agree on meaning.)

1. Basic objective: To write a calculator program which can solve intellectual problems as well as or better than a human being.

Method: Choose a suitable* class of problems.

2. Devise a specific routine for solving them. program it. and



IN THIS BUILDING DURING THE SUMMER OF 1956

JOHN McCARTHY (DARTMOUTH COLLEGE), MARVIN L. MINSKY (MIT)
NATHANIEL ROCHESTER (IBM), AND CLAUDE SHANNON (BELL LABORATORIES)
CONDUCTED

THE DARTMOUTH SUMMER RESEARCH PROJECT ON ARTIFICIAL INTELLIGENCE

FIRST USE OF THE TERM "ARTIFICIAL INTELLIGENCE"

FOUNDING OF ARTIFICIAL INTELLIGENCE AS A RESEARCH DISCIPLINE

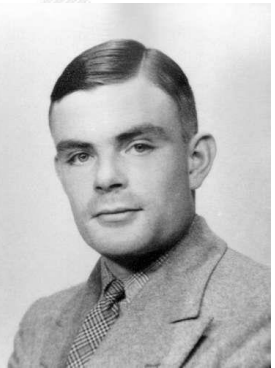
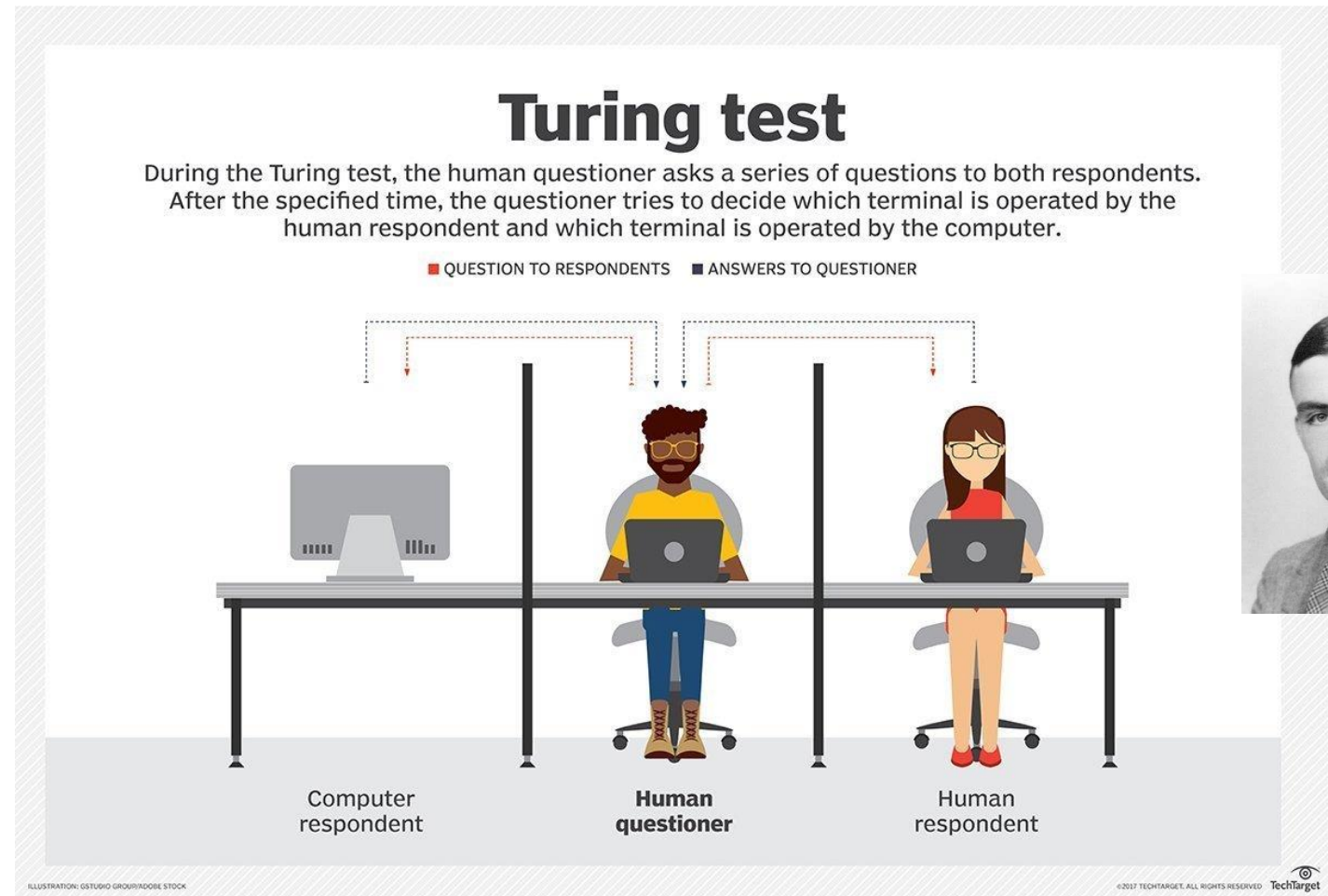
"To proceed on the basis of the conjecture
that every aspect of learning or any other feature of intelligence
can in principle be so precisely described that a machine can be made to simulate it."

IN COMMEMORATION OF THE PROJECT'S 50th ANNIVERSARY
JULY 13, 2006



TURING TEST

- The test was invented by Turing in 1950 in the paper “Computing Machinery and Intelligence”
- Am I talking to a human?
- Turin predicted that by 2000 a machine might have a 30% chance of fooling an interrogator for 5 minutes
- Given up
 - The Imitation Game
- Annual Loebner Prize \$100,00
 - 2019 - Mitsuku



ELIZA

- “**ELIZA** is an early natural language processing computer program created from 1964 to 1966 at the MIT Artificial Intelligence Laboratory by [Joseph Weizenbaum](#).^[2] Created to demonstrate the superficiality of communication between humans and machines, Eliza simulated conversation by using a "[pattern matching](#)" and substitution methodology that gave users an illusion of understanding on the part of the program, but had no built in framework for contextualizing events”
- <https://en.wikipedia.org/wiki/ELIZA>
- Try it out here : <http://www.med-ai.com/models/eliza.html>

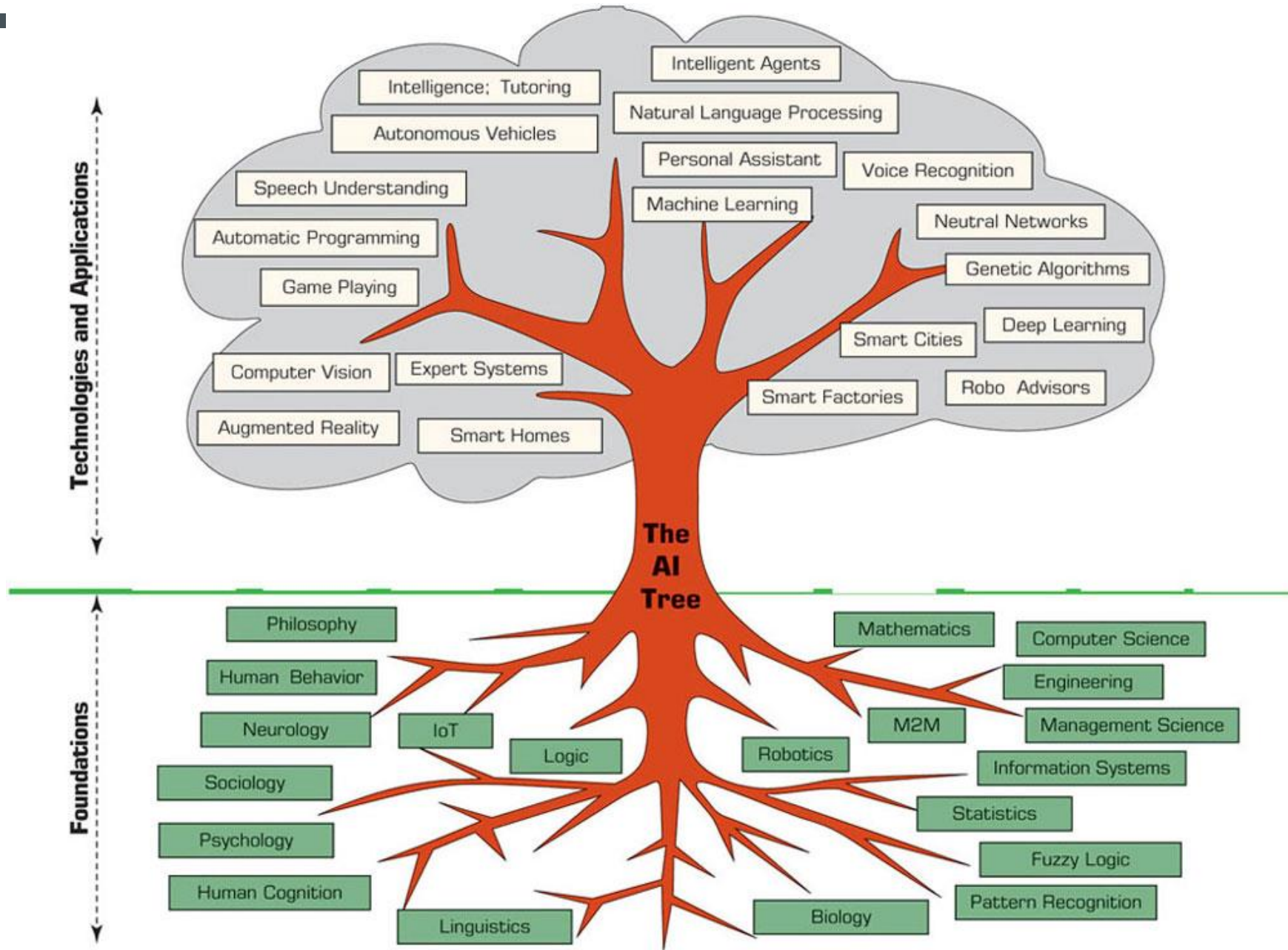
TELL ME ABOUT YOUR PROBLEM
men are all alike
HOW DO YOU FEEL ABOUT MEN?
none of them can be trusted
NOT ANY?
well very few
COULD YOU BE MORE PRECISE PLEASE?
my grandfather was trustworthy
TELL ME ABOUT YOUR GRANDFATHER
he is dead
HOW LONG HAS HE BEEN DEAD?
a couple of years – he was my mother’s father
TELL ME ABOUT YOUR MOTHER
she is very nice
CAN YOU THINK OF A SPECIFIC EXAMPLE?
she is always glad to see me
IS YOUR FATHER ALSO ALWAYS GLAD TO SEE YOU?
most of the time
HOW DID YOUR PARENTS TREAT YOU AS A CHILD?

Did Eliza pass
the Turing
Test?



FOUNDATIONS AND APPLICATIONS





<https://www.youtube.com/watch?v=e6Gv2okwMlw>



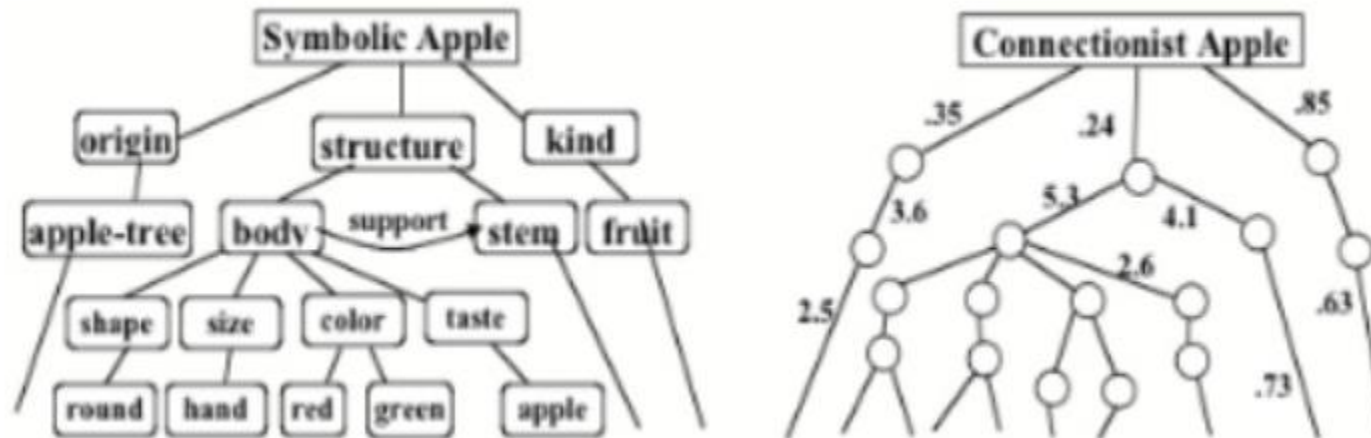
FUTURE OF AI



SYMBOLIC AI VERSUS NON-SYMBOLIC AI

- Symbolic / Classical AI A General I / Strong AI - Search for a "universal algorithm for learning and acting in any environment" (Russel and Norvig)
 - Intelligence is computation
 - The brain is a computer
 - Everything is transformed into a proposition that requires computation
 - Use of symbols to represent things in the human thoughts and the reasoning process
 - Create explicit structures and behavior rules based on symbols
 - Not there yet!
- Non-symbolic / Connectionist AI / Narrow AI / Weak AI
 - Focus on performing specific tasks
 - Intelligence is an adaptive behavior
 - Deal with messy and unstructured data
 - Algorithms are opaque, hard to communicate and difficult to troubleshoots
 - Perform calculations according some principles that have demonstrated to be able to solve problems, without exactly understanding how to arrive at their solutions.
 - Most successful realization of artificial intelligence to date
 - Deep learning
 - Examples: Siri, Alexa, Watson

SYMBOLIC AI VERSUS NON-SYMBOLIC AI



Symbolic and non-symbolic representation of an apple

<https://web.media.mit.edu/~minsky/papers/SymbolicVs.Connectionist.html>

YANN LECUN [HTTP://YANN.LECUN.COM](http://YANN.LECUN.COM)

- Intelligence artificielle : Yann LeCun évoque ses futurs développements – 5 min 30
- <https://youtu.be/D07w4finekw>



GOOGLE AI IN GHANA

- <https://www.blog.google/around-the-globe/google-africa/google-ai-ghana/>
- Jeff Dean
 - Senior Fellow, Google AI
- Moustapha Cisse
 - Staff Research Scientist and Lead of Google AI Center Accra



HOMEWORK



HOMEWORK

- READ : Slides; Chapitre I, Pearson France – Intelligence artificielle – Stuart Russell, Peter Norvig © 2010
- WATCH : Slide videos; Conférence de Jean-Paul HATON : Questions réponses - Intelligence artificielle pour tous - ROTARY I780. 17 Novembre 2018 <https://youtu.be/OR7NgCuKuDs> (1h23)
- POST : One example of AI in Slack channel #AileconI. What is the example? How does it work? What are the strengths? What are the weaknesses?