NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

Introduction to Data Science and Artificial Intelligence

State-of-the-Art in DS&AI *(Review Lecture)*

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Lesson Outline

- A brief history of AI
- The state of the art

One way Lecture is Boring, Let's Interact

How to participate?

Copy participation link

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2 Enter the event code in the top banner

Event code
EESQHO

What is Artificial Intelligence?

AI is intelligence demonstrated by machines, in contrast to the **natural intelligence** (**NI**) displayed by humans and other animals.

Birth of Artificial Intelligence

"We can only see a short distance ahead, but we can see plenty there that needs to be done."

Alan Turing

Father of Modern Computer Science

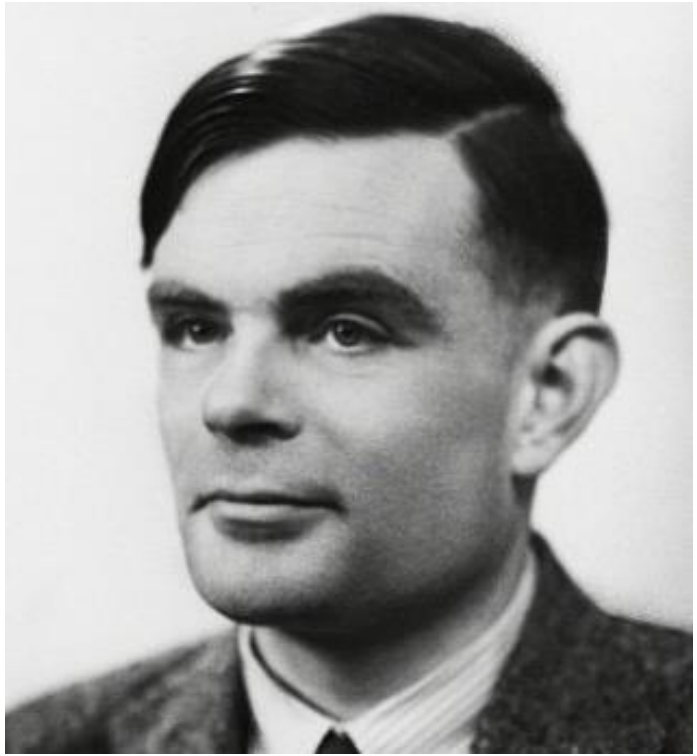


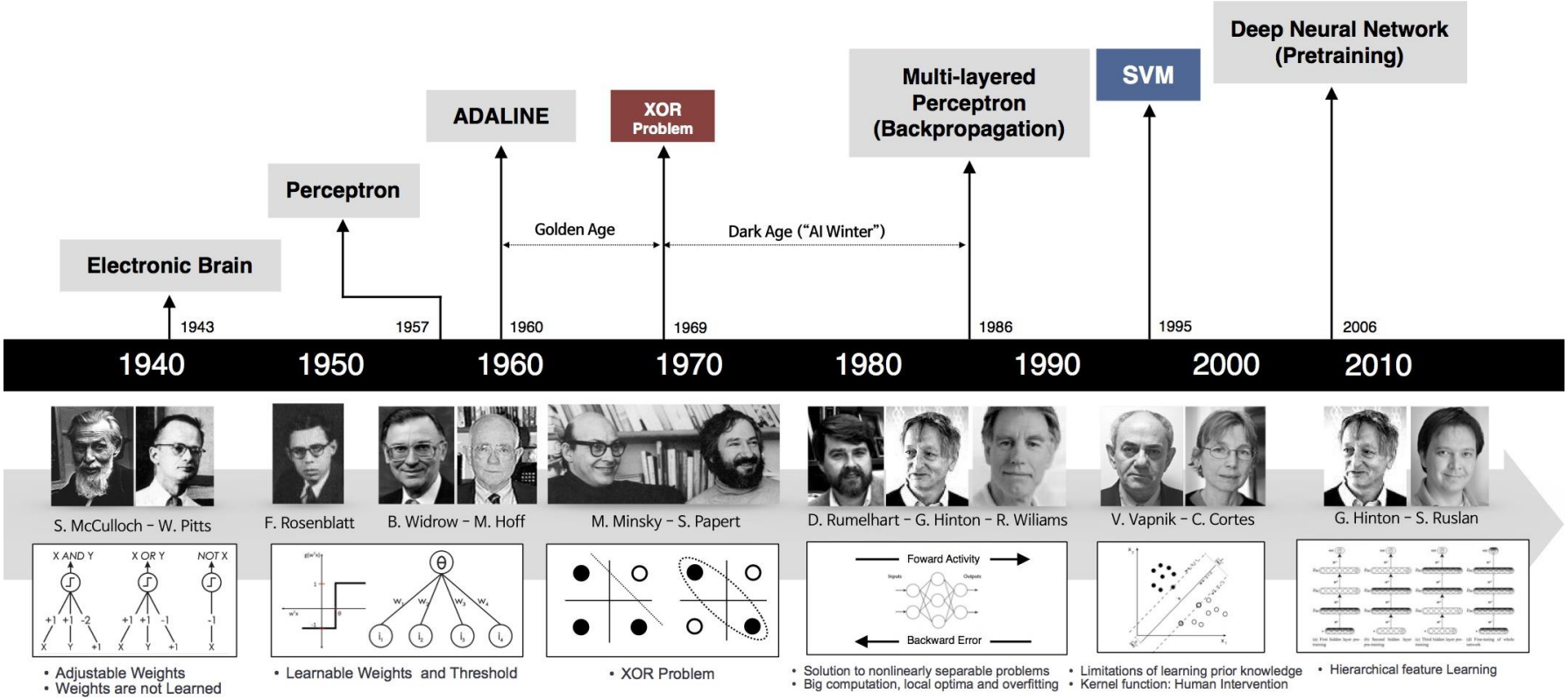
Image source: https://www.flickr.com/photos/23925401@N06/23022750663

Founding Fathers of AI

1956 Dartmouth Conference

Image source: https://www.scienceabc.com/innovation/what-is-artificial-intelligence.html

Timeline of AI Development



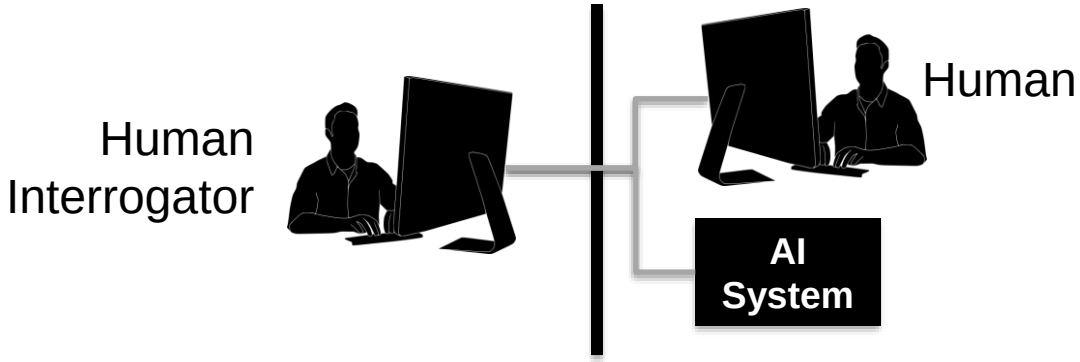
Views of AI

Views of AI fall into four categories:

1. Thinking Humanly
2. Acting Humanly
3. Thinking Rationally
4. Acting Rationally

Acting Humanly: Turing Test

- Turing (1950) "Computing machinery and intelligence"
- Operational test for intelligent behavior: the Imitation Game



- Suggested major components of AI: knowledge, reasoning, language understanding, learning

Image source: https://svgsilh.com/image/2763393.html

Can Siri Pass The Turing Test?

https://www.youtube.com/watch?v=0qcHhBSbyVw

Thinking Humanly: Cognitive Modeling

- 1960s "cognitive revolution": information-processing psychology
- Requires scientific theories of internal activities of the brain
- Both approaches (Cognitive Science and Cognitive Neuroscience) are now distinct from AI

Thinking Rationally: "Laws of Thought"

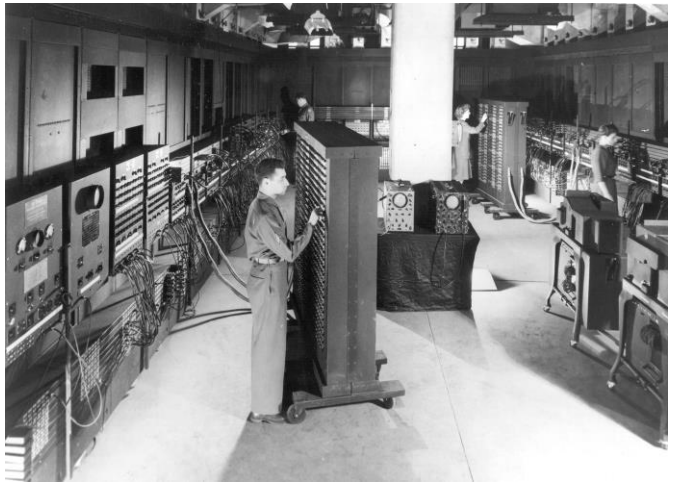
- Aristotle: what are correct arguments/thought processes?
  - Several Greek schools developed various forms of logic: notation and rules of derivation for thoughts; may or may not have proceeded to the idea of mechanization
- Direct line through mathematics and philosophy to modern AI
- Problems:
  - Not all intelligent behavior is mediated by logical deliberation
  - What is the purpose of thinking? What thoughts should I have?

Acting Rationally: Rational Agents

- Rational behavior: doing the right thing
- The right thing: that which is expected to maximise goal achievement, given the available information
- This course is about designing rational agents
- For any given class of environments and tasks, we seek the agent(s) with the best performance

Computer Chess

Garry Kasparov VS Deep Blue



VS

ENIAC 1946

Deep Blue 1997

Image Sources:
https://www.flickr.com/photos/gageskidmore/37137186253
https://en.wikipedia.org/wiki/Deep_Blue_(chess_computer)#/media/File:Deep_Blue.jpg

Robot Soccer

TED talk by
Peter Stone
from UT Austin

http://www.youtube.com/watch?v=FXhw0_-iKwQ

Image source: https://www.flickr.com/photos/vintagedept/21540115539

Game Show

Image source: https://commons.wikimedia.org/wiki/File:IBM_Watson_w_Jeopardy.jpg

IBM's Watson Destroys Humans in Jeopardy

https://www.youtube.com/watch?v=P18EdAKuC1U

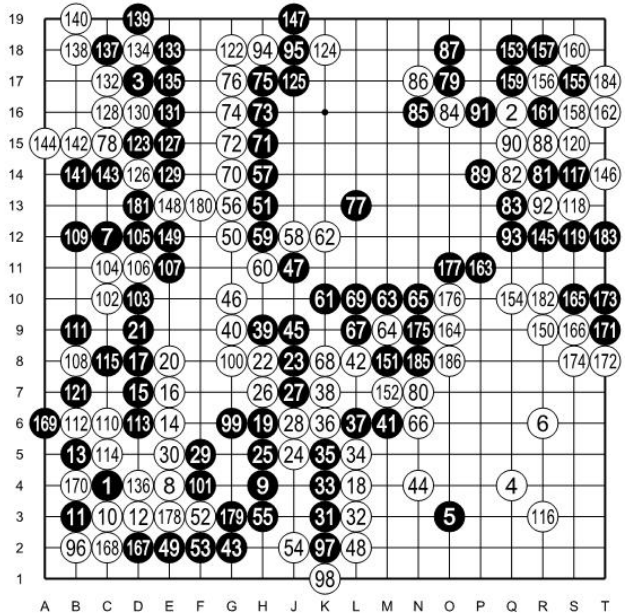
AlphaGo vs World Champions

March 9 – 15, 2016 (Lee Sedol)

- Time limit: 2 hours
- Venue: Seoul, Four Seasons Hotel
- AlphaGo Wins (4:1)

May 23 – 27, 2017 (Ke Jie)

- Venue: Wuzhen, China
- AlphaGo Wins (3:0)



Lee Sedol (B) vs AlphaGo (W) - Game 1

Image source: https://commons.wikimedia.org/wiki/File:Lee_Sedol_(B)_vs_AlphaGo_(W)_-_Game_1_-_BW.jpg

Libratus vs World Champions

The first AI to defeat top human poker players

January 11 to 31, 2017

- Venue: Pittsburgh
- 120,000 hands

- Has nothing to do with deep learning
- Algorithms for solving large scale games

Google Driverless Car

TED talk by Sebastian Thrun from Stanford

https://www.youtube.com/watch?v=bp9KBrH8H04

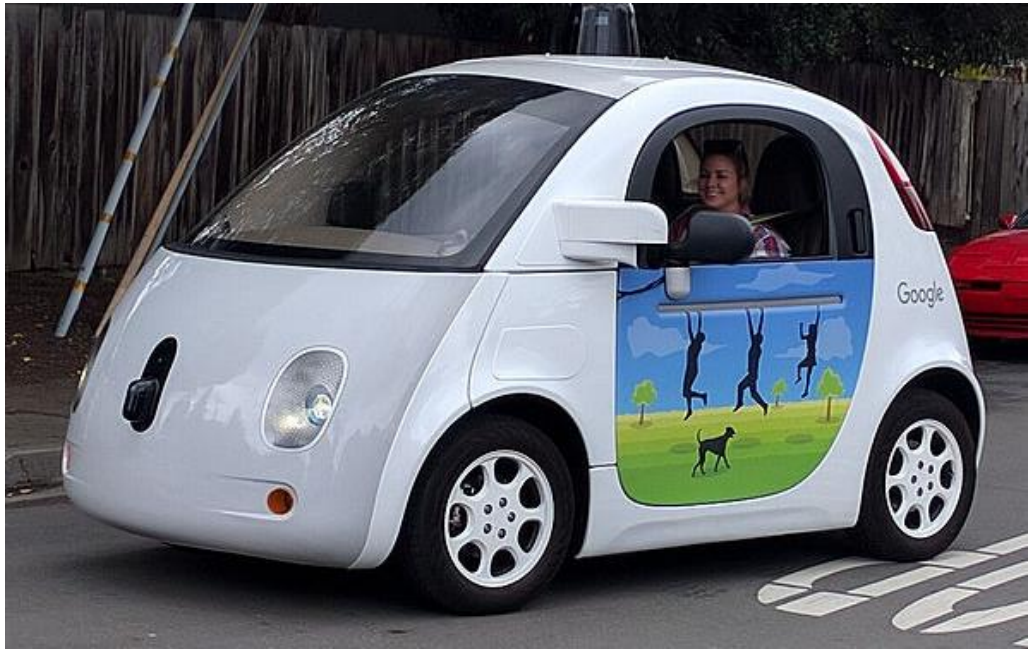


Image source: https://commons.wikimedia.org/wiki/File:Google_driverless_car_at_intersection.gk.jpg

Google Robot Dog

https://www.youtube.com/watch?v=4NzcB6TMzjw

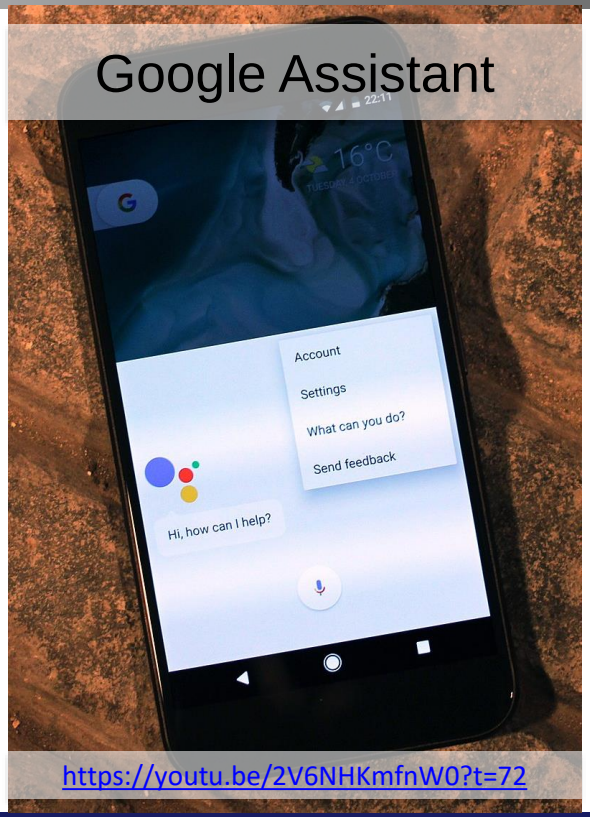
Image source: https://commons.wikimedia.org/wiki/File:Bio-inspired_Big_Dog_quadruped_robot_is_being_developed_as_a_mule_that_can_traverse_difficult_terrain.tiff

Natural Language Processing

Mi Box Voice Assistant

https://youtu.be/S38ZJELrMmQ?t=16

Google Assistant



https://youtu.be/2V6NHKmfnW0?t=72

Alexa Amazon

Manufacturing

Tesla
https://www.youtube.com/watch?v=8_lfxPI5ObM

Image source: https://www.flickr.com/photos/jurvetson/7408451314

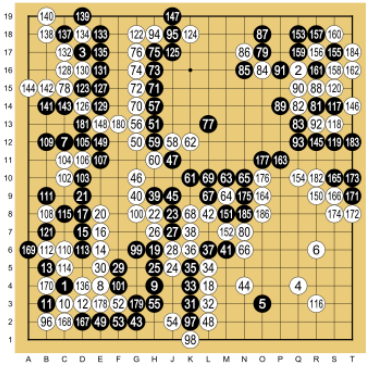
Artificial Intelligence for Finance

Source: World Economic Forum, 2015

AI for Complex Interactions

Recent AI breakthrough

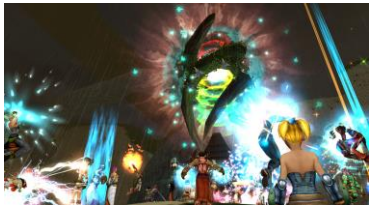
IMAGENET



What's Next?

For AI Complex Interactions

- Stochastic, open environment
- Multiple players
- Sequential decision, online
- Strategic (selfish) behaviour
- Distributed optimisation



In Summary

- AI is intelligence demonstrated by machines, in contrast to the natural intelligence (NI) displayed by humans and other animals.
- Views of AI fall into four categories:
  - Thinking Humanly, Acting Humanly, Thinking Rationally, ***Acting Rationally***.
- **Rational behavior**: doing the right thing
- The right thing: that which is expected to maximise goal achievement, given the available information
- AI is applicable in all kind of fields.

Image sources:

- https://en.wikipedia.org/wiki/RoboCup_Standard_Platform_League#/media/File:SPL_Team_B-Human,_RoboCup_2016.jpg
- https://en.wikipedia.org/wiki/Massively_multiplayer_online_role-playing_game#/media/File:Ryzom_screenshot_4.png
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- https://commons.wikimedia.org/wiki/File:Lee_Sedol_(B)_vs_AlphaGo_(W)_-_Game_1.svg