

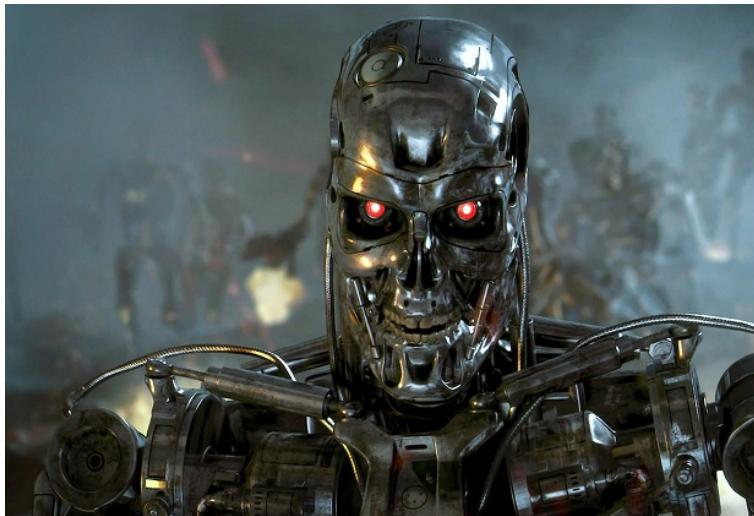
Introduction to Artificial Intelligence

魏忠钰

March 7th 2018



- **What is artificial intelligence?**
- **What can AI do and can not do?**
- **What is this course about?**



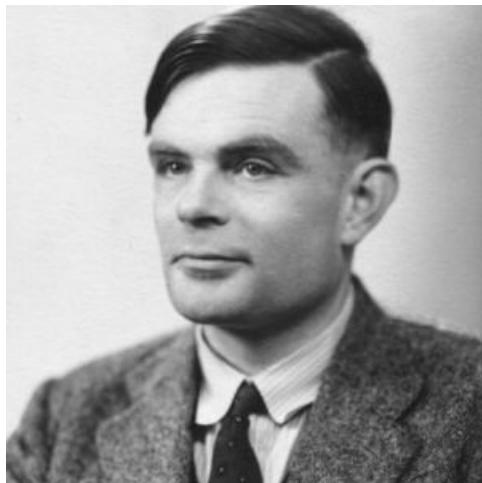


“It is the *science and engineering of making intelligent machines*, especially *intelligent computer programs*. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable,” by John McCarthy, 1956.

“Broadly, AI is the *computer-based exploration* of methods for *solving* challenging tasks that have traditionally depended on people for solution. Such tasks include complex *logical inference*, *diagnosis*, *visual recognition*, *comprehension of natural language*, *game playing*, *explanation*, and *planning*” by Eric Horvitz, 1990.

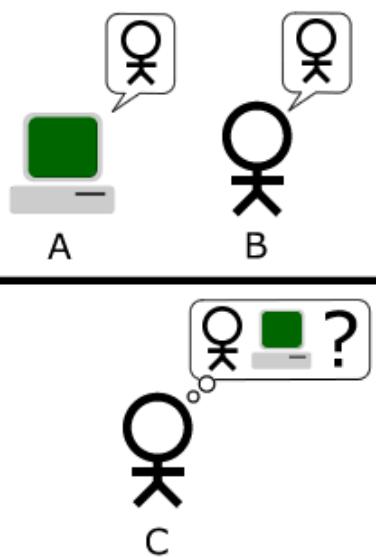


- 1950 – Alan Turing (1912 - 1954)



A. M. Turing (1950) Computing Machinery and Intelligence. Mind 49: 433-460.

Can machines think?



Q: Please write me a sonnet on the subject of the Forth Bridge.

A : Count me out on this one. I never could write poetry.

Q: Add 34957 to 70764.

A: (Pause about 30 seconds and then give as answer) 105621.

Imitation Game



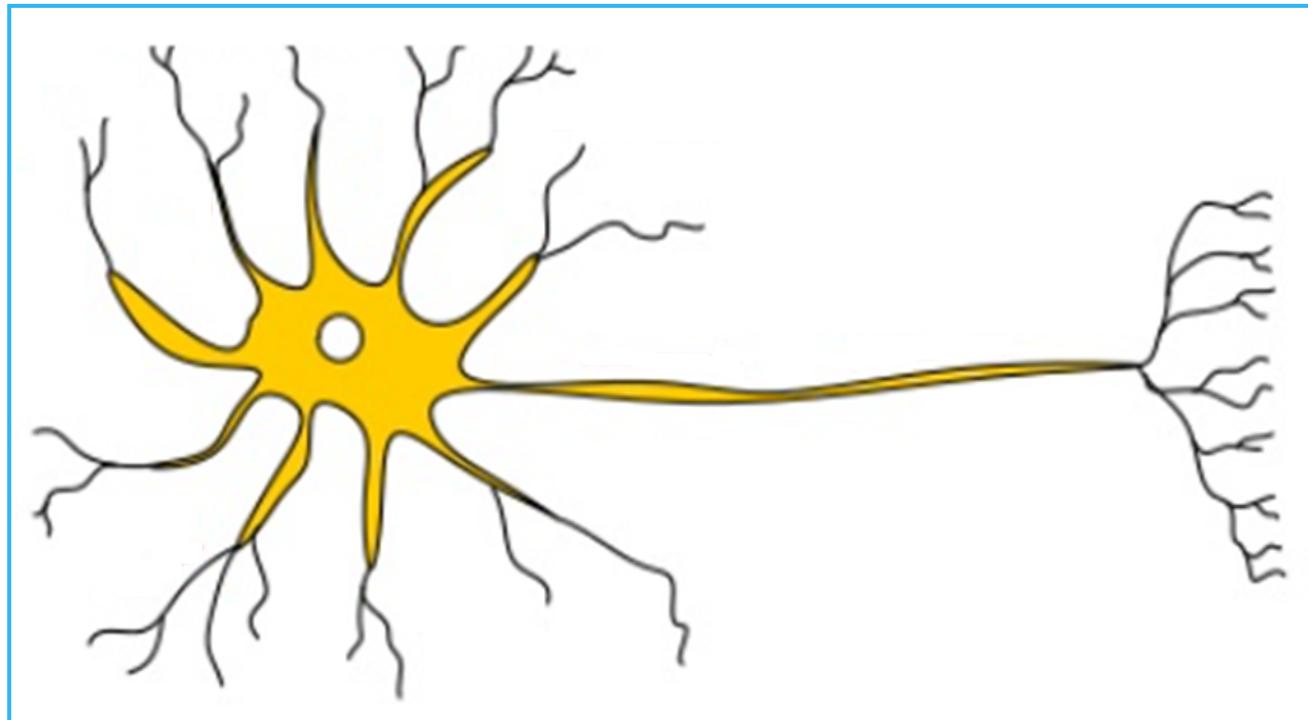
■ Age of Mythology

- 1770 : The Turk by Wolfgang von Kempelen (Hungarian)





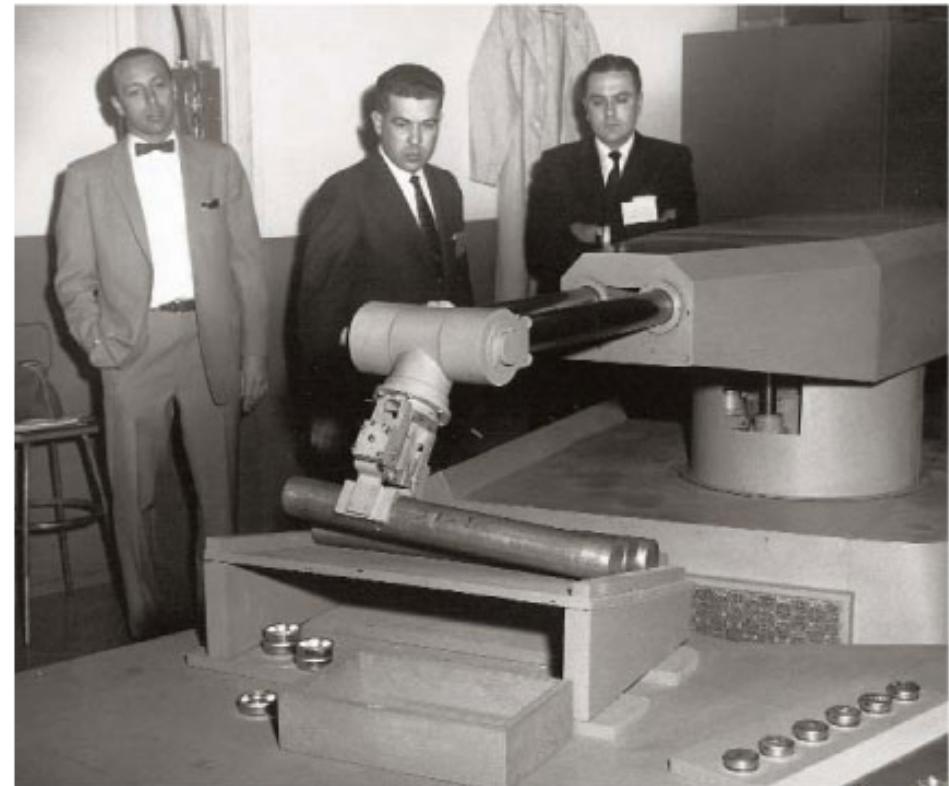
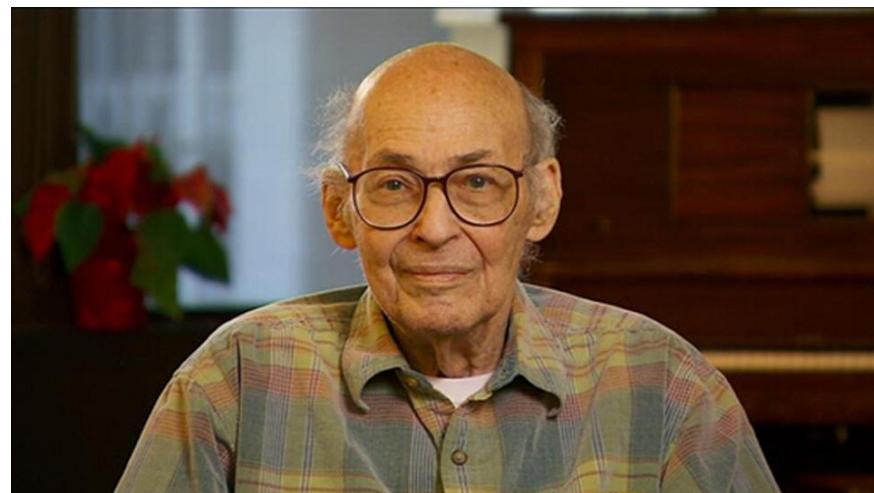
- **1940 – 1950 Early days**
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's “Computing Machinery and Intelligence”





■ 1950 - 70: Excitement

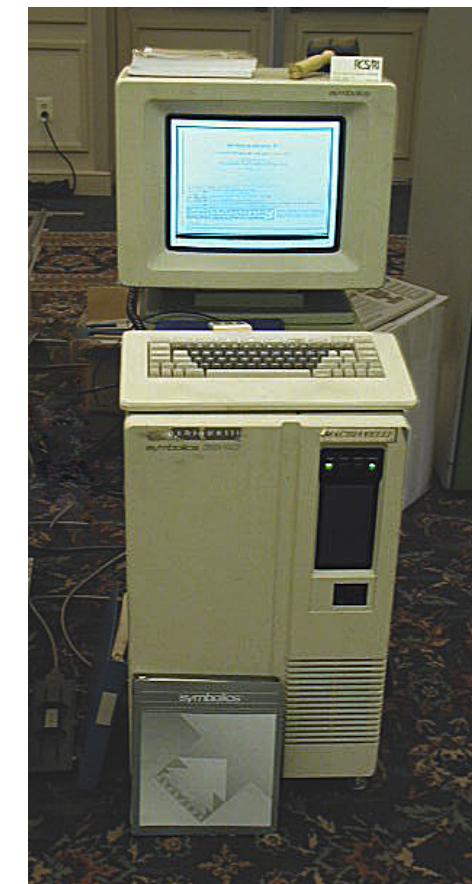
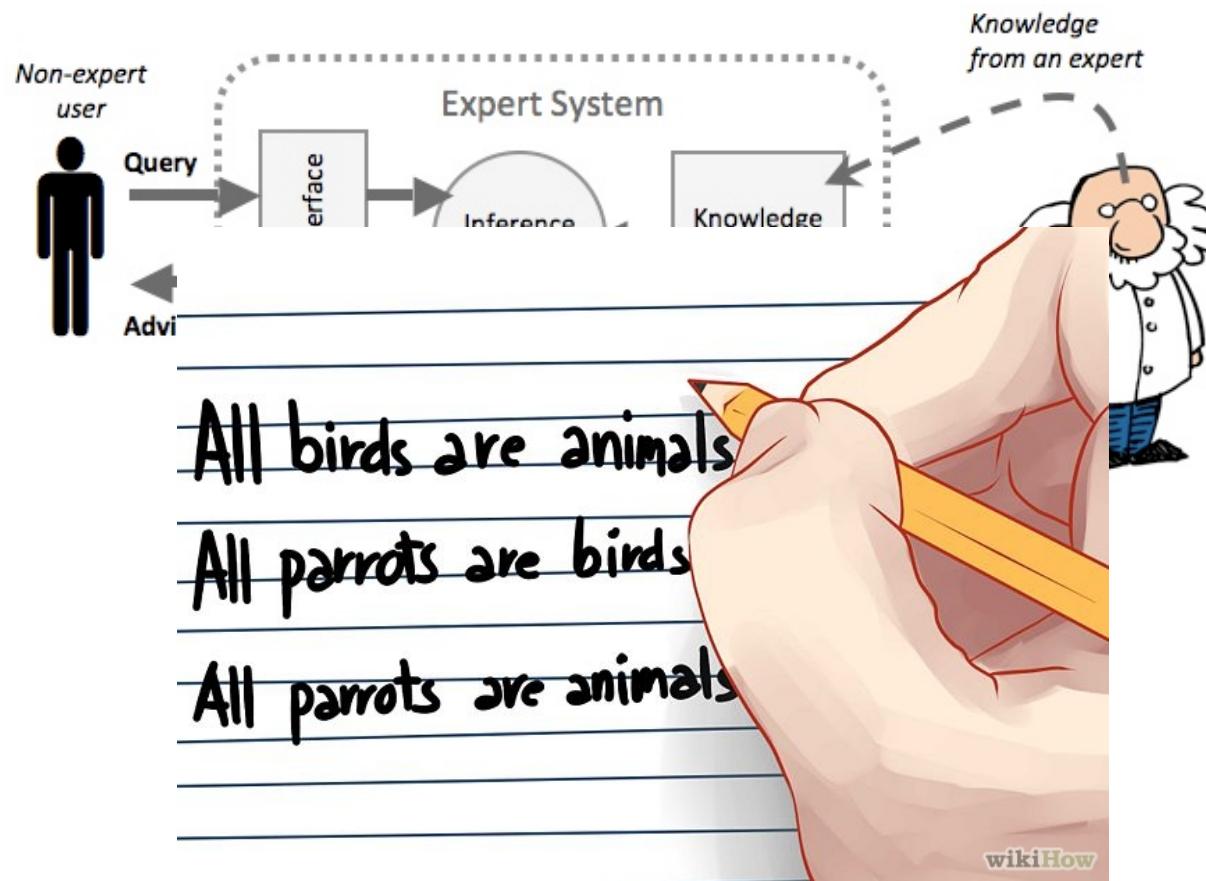
- 1956: Dartmouth meeting: “Artificial Intelligence” adopt by John McCarthy, Marvin Minsky
- 1961: The first industrial robot “Unimation” in GM





■ 1970—90: Knowledge-based approaches

- 1979: Medical diagnosis program by Jack Myers Harry Pople
- 1980: Expert systems industry booms





- **1990 - 2000: Statistical approaches**

- Probability, uncertainty
- Statistical machine learning

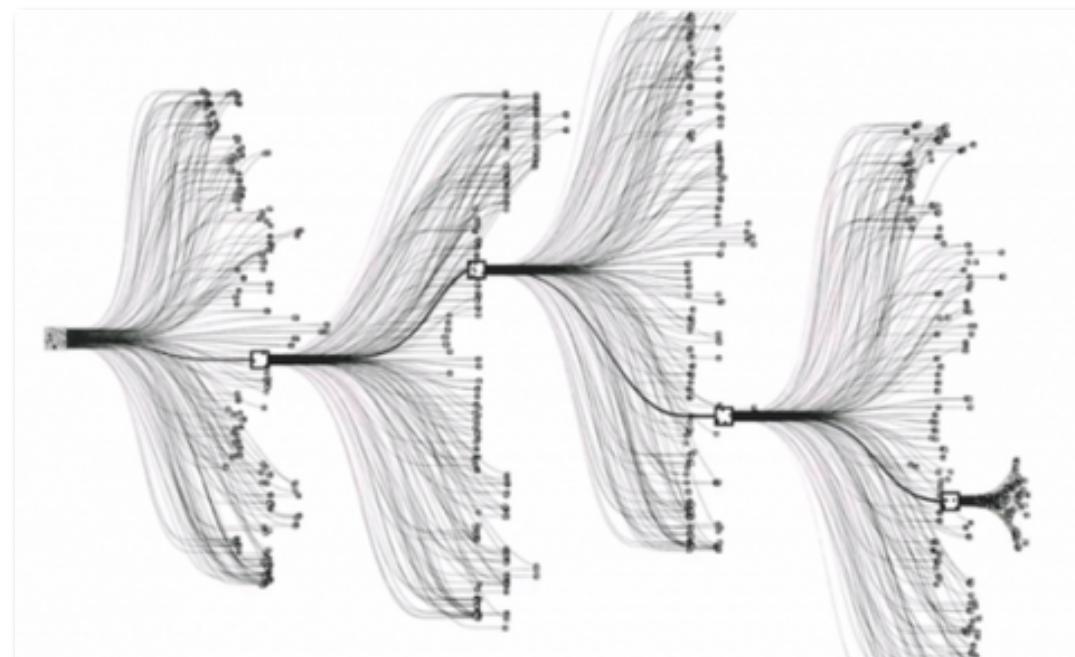
Queue for
breakfast ?

Traffic ?

How about the
weather?



Seats on the bus?





AI is born

Marvin Minsky at
Dartmouth meeting

1956

1961

First Industrial
Application



“Unimations”
The first industrial robot in
GM



Rule-based AI

Expert systems In
medical domain

1970 — 80

1990 – Now



Graphical models
Machine learning





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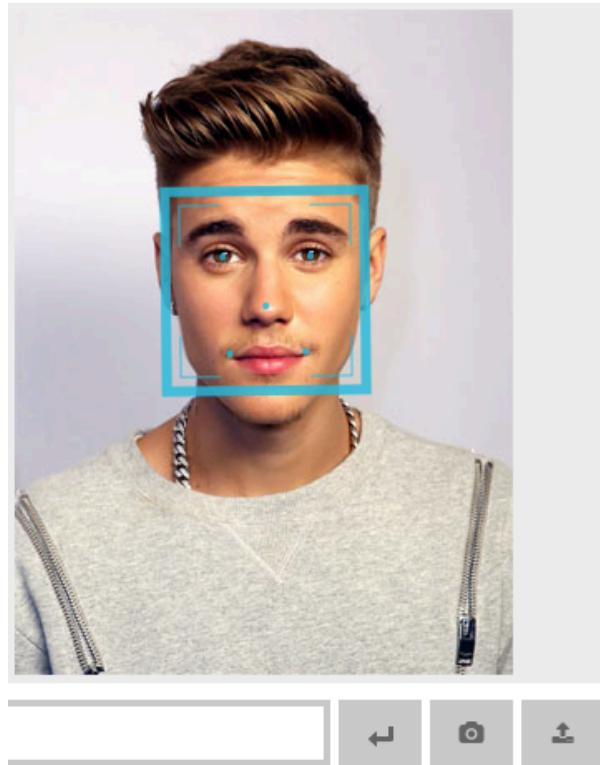


- Face Recognition
- Machine translation
- Autonomous driving
- Human vs Machines

Face Recognition



复旦大学大数据学院
School of Data Science, Fudan University



2014

Facebook produce an accuracy of **99%**

2017

Accuracy around **99.80%**
Pingan、Tencent rank top 1 in the world

On a closed test set LFW (Labeled Faces in the Wild)
<http://vis-www.cs.umass.edu/lfw/>



Google

Translate

English Spanish French Chinese - detected ▾



杨振宁表示，我是1964年3月23日加入美国国籍的，当时做这个决定曾考虑了很久，是一个很痛苦的决定。1983年在一本里我曾经说我父亲到临终时都没原谅我放弃中国国籍。

他说，2015年4月1日我放弃了美国国籍，这也不是一个简单的决定。美国是一个美丽的国家，是一个给了我做科学非常好的机会的国家。我感激美国。而且，我知道很多美国朋友不会赞同我放弃美国国籍。



182/5000

English Spanish Arabic ▾

Translate

Yang Zhenning said that I joined the United States on March 23, 1964, when the decision was made for a long time, is a very painful decision. In a book in 1983 I used to say that my father did not forgive me for dying when I gave up Chinese nationality.

He said that on April 1, 2015 I gave up American citizenship, and that was not a simple decision. The United States is a beautiful country, a country that gave me a very good chance of doing scientific research. I am grateful to the United States. And, I know that many American friends will not agree with me to give up American citizenship.



Suggest an edit

Machine translation
research started in the
1960s.

Statistical machine
translation

Google translate
serves 200 million
people daily

No jobs for human
translators ?

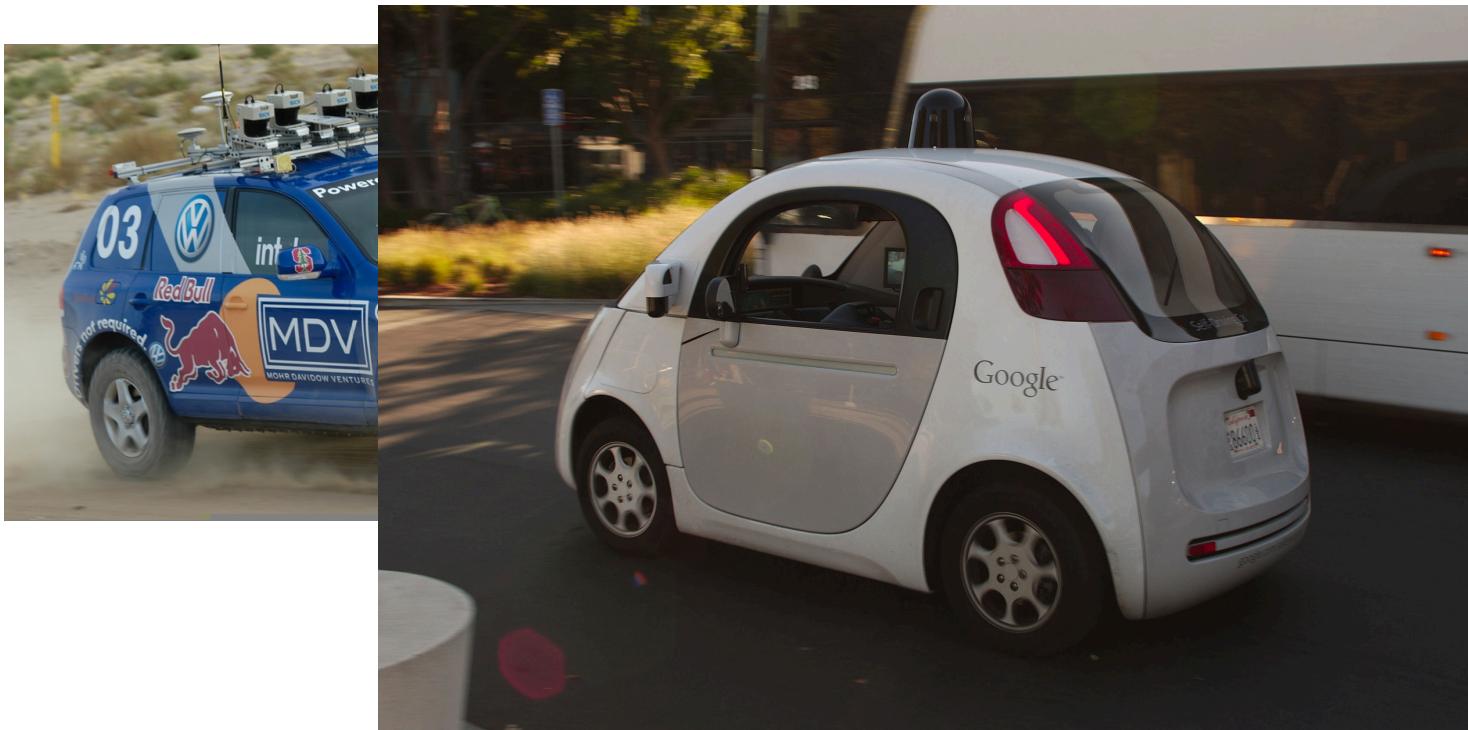
1960

1990 – 2000

2015

Future

Autonomous driving



Research started



DARPA Grand
Challenge

1980s

2005

DARPA Urban
Challenge



2007

Google started a
self-driving car
program



2009

Uber built a team for
self-driving.
Baidu and other
companies announced
similar project

2015 - 2018

Human Versus Machines

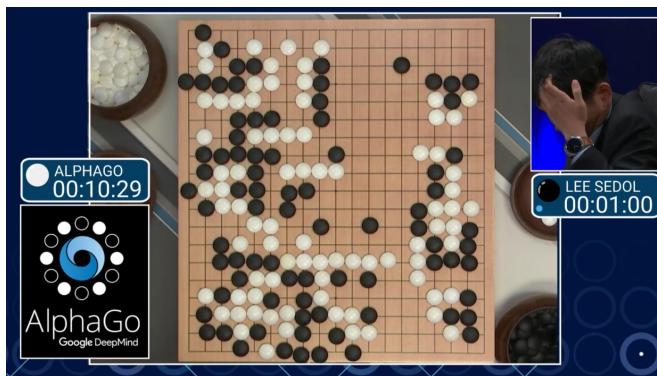


复旦大学大数据学院
School of Data Science, Fudan University



IBM

1997 Deep Blue VS Garry Kasparov



Deepmind

2016 Alpha GO VS Lee Sedol



CMU

2017 Libratus VS Human players
no limit Texas hold 'em



**2011 IBM Watson vs
Brad Rutter and Ken Jennings
on Jeopardy**



Baidu

2017 Xiaodu vs Super Human Brain
on face recognition and speech
recognition



Technology

Stephen Hawking warns artificial intelligence could end mankind

By Rory Cellan-Jones
Technology correspondent

🕒 2 December 2014 | Technology | 🗣

Share



Stephen Hawking: "Humans, who are limited by slow biological evolution, couldn't compete and would be superseded"

Limitation of Current AI Technology



Chinese (Simplified) ▾



English ▾



冬天：能穿多少穿多少。夏天：能穿多少穿多少。[Edit](#)

Dōngtiān: Néng chuān duōshǎo chuān duōshǎo. Xiàtiān: Néng chuān duōshǎo chuān duōshǎo.

Winter: how much to wear how much to wear. Summer: how much to wear how much to wear.

[Open in Google Translate](#)

[Feedback](#)



- **Closed VS Open environment**

High accuracy is produced in a closed dataset

- **Sensitive to noisy data**

e.g. speech recognition.

- **Pattern Recognition VS Real Understanding**

The way machine make progress is different from what people do

- **Heavily rely on labeled data**

Artificial intelligence is built on top of human annotator

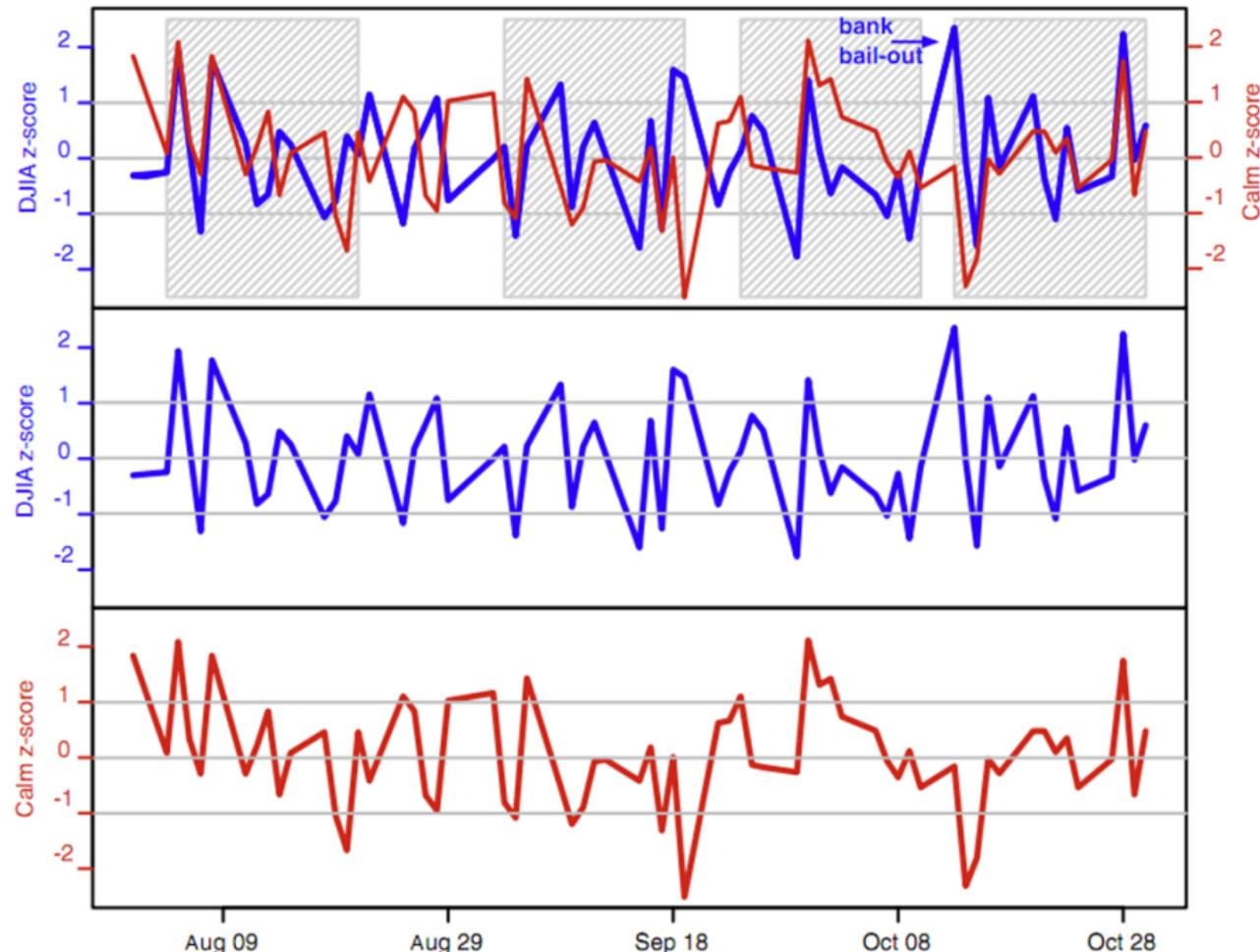


- 1966 – ALPAC report cuts off funding for translation in US
- 1974 – Lighthill report cuts off funding in UK
- 1987 – collapse of Lisp market, government funding cut in US
- When will be the next?



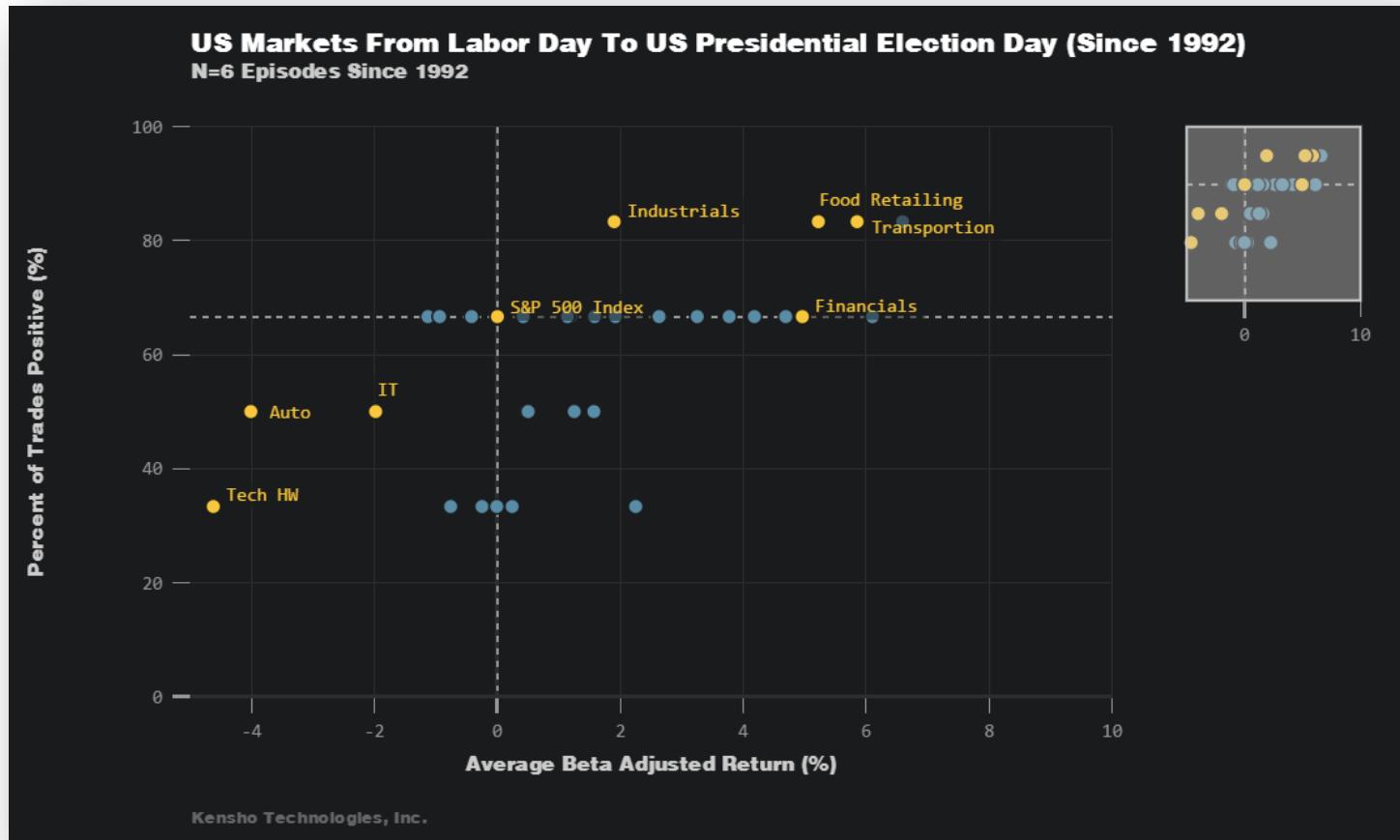
Dow Jones
Industrial
Average

Calm index
on Twitter





■ Kensho: Event driven financial support system





Enlitic uses machine learning approach to make diagnosis automatically.

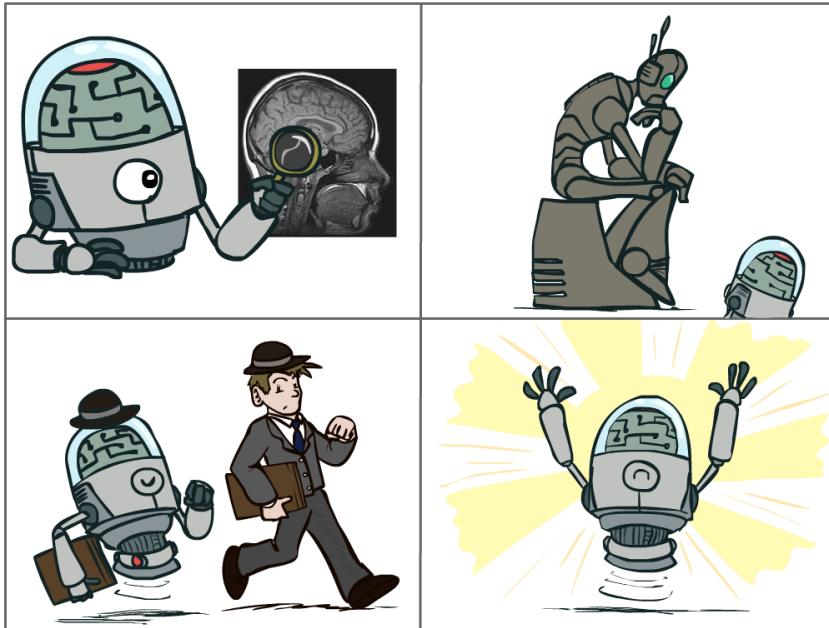
<https://www.enlitic.com/>



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Think like people



Think rationally

Act like people

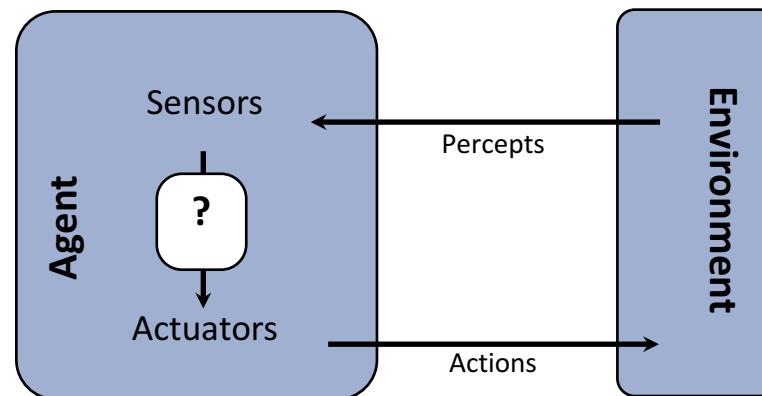
Rational Decision



- Rational: maximally achieving pre-defined goals
- Rationality only concerns what decisions are made
(not the thought process behind them)
- Goals are expressed in terms of the **utility** of outcomes
- Being rational means **maximizing your expected utility**



- An **agent** is an entity that *perceives* and *acts*.
- A **rational agent** selects actions that maximize its (expected) **utility**.
- Characteristics of the **percepts**, **environment**, and **action space** dictate techniques for selecting rational actions
- **This course is about:**
 - General AI techniques for a variety of problem types
 - Learning to recognize when and how a new problem can be solved with an existing technique





...

Web search
Speech recognition
Handwriting recognition
Machine translation
Information extraction
Document summarization
Question answering
Spelling correction
Image recognition
3D scene reconstruction
Human activity recognition
Autonomous driving
Music information retrieval
Automatic composition
Social network analysis

...

...

Product recommendation
Advertisement placement
Smart-grid energy optimization
Household robotics
Robotic surgery
Robot exploration
Spam filtering
Fraud detection
Fault diagnostics
AI for video games
Character animation
Financial trading
Protein folding
Medical diagnosis
Medical imaging

...

How to tackle these AI tasks?



Real-world task

Modeling

Formal task (model)

Algorithms

Program



- Part I: Search
 - Informed Search
 - Uninformed Search
 - Adversarial Search
 - Constraint Satisfactory Problem
- Part II: Reinforcement Learning
 - Markov Decision Process
 - Reinforcement Learning
- Part III: Graphical Model
 - Hidden Markov Model
 - Bayes Nets
- Part IV: Logic
 - First-order logic
 - Propositional logic



■ Instructor

- WEI, Zhongyu 魏忠钰
- Office: Zibin Building N202 子彬院北202
- Office Hour: Wed. 4 – 5:30pm
- Email: zywei@fudan.edu.cn

■ Tutor

- Fan, Zhihao 范智昊
- Qi, Jitong 祁季桐
- Wang, Siyuan 王思远
- Ye, Rong 叶蓉



- Course website

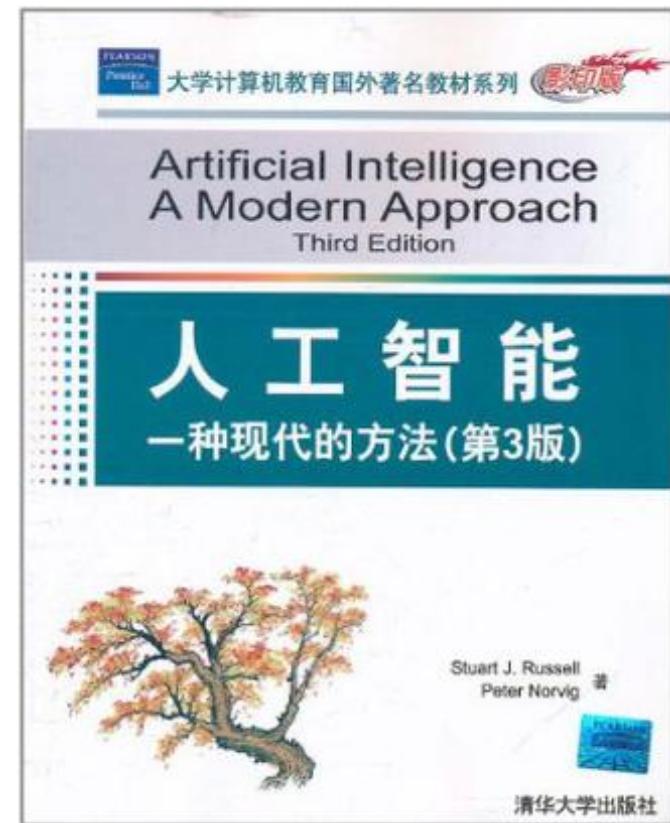
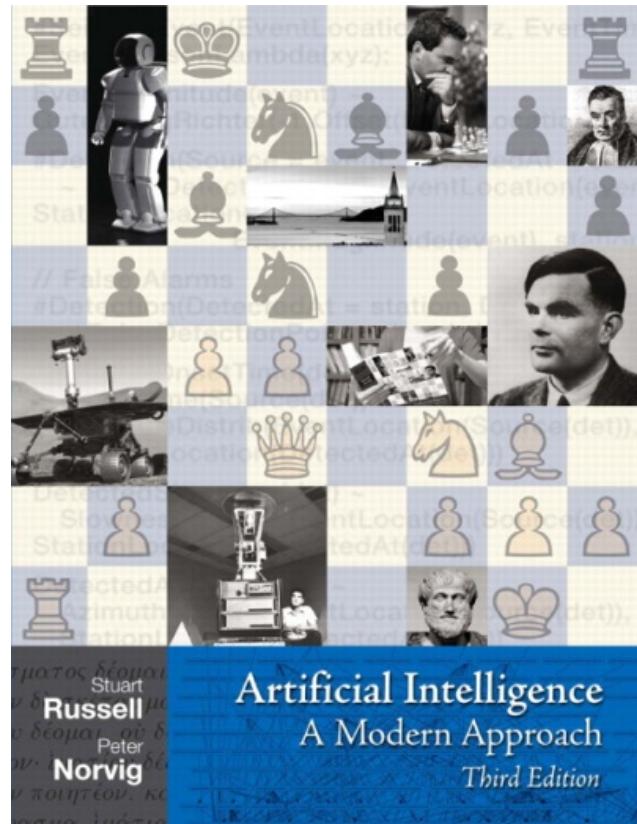
- <http://www.sdspeople.fudan.edu.cn/zywei/DATA620006/index.html>
- Please check the website regularly when it is ready.

- Work and Grading (**tentative**)

- 4 programming projects: Python (50%)
- 1 competition project: Gomoku (五子棋) (10%)
- 1 Final Exam (30%)
- Labs and Participation (10%)



- Artificial Intelligence: A Modern Approach Russell & Norvig,
3rd Ed., Prentice Hall, 2009





- We will use some materials from the following two courses.
 - Artificial Intelligence: Principles and Techniques, Stanford CS221
 - Introductory Artificial Intelligence, UC Berkeley CS 188