



# L1:

## Overview of AI and its Application

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Lecturer: Runhe Huang, 黄 潤和

TA: 金子 昌平 mail: [shohei.kaneko.3a@stu.hosei.ac.jp](mailto:shohei.kaneko.3a@stu.hosei.ac.jp) (Room: A1)



# AI?

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## Our Attempt to Build Models of Ourselves

From when? 1000 years ago? 2000 years ago?

A.I. is the study of how to make computers do things at which, at the moment, people are better.

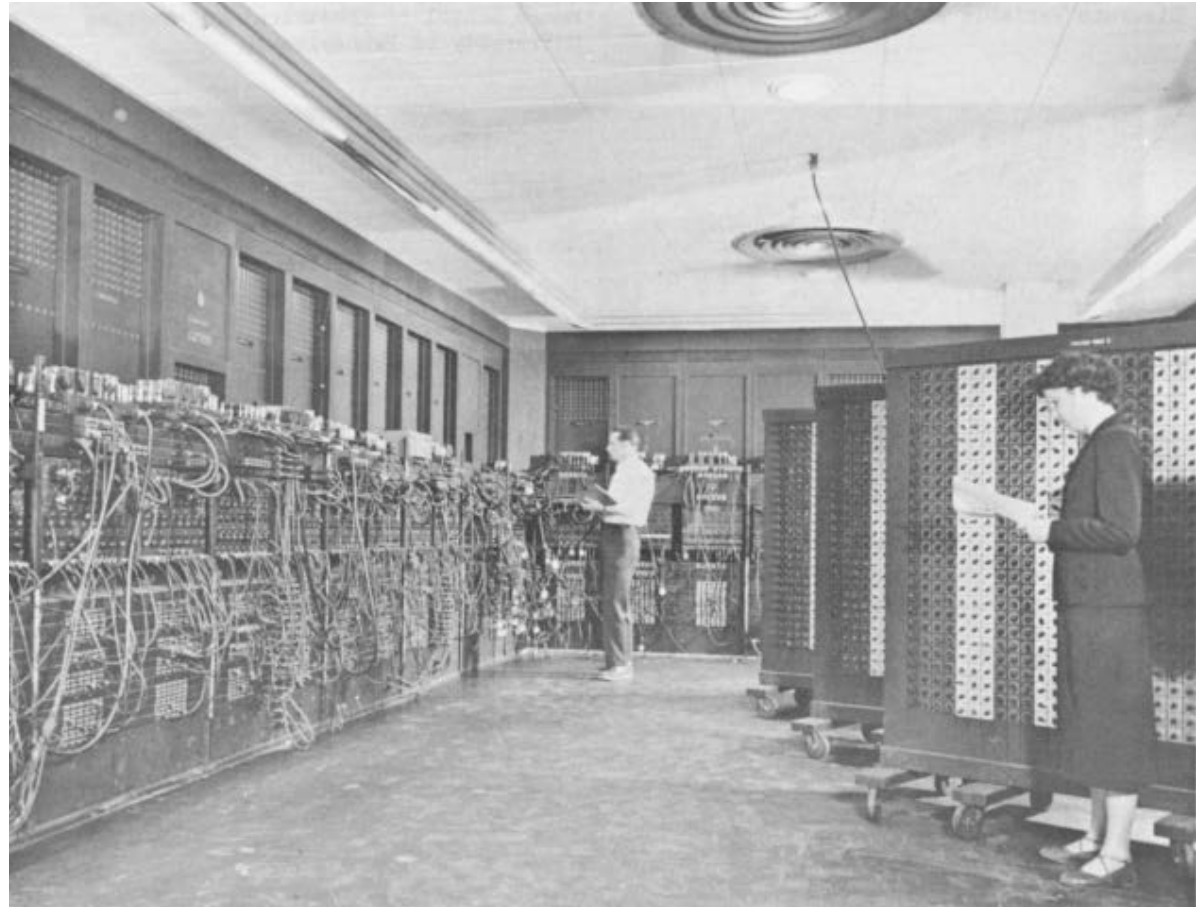
From when? since having computer? in 30's?

AI history – after we have computers

Q? what is the first computer?

# The Advent of the Computer

1945 ENIAC *The first electronic digital computer*



# 1949 EDVAC

*The first stored program computer*



# AI milestones

Can not distinguish machine or human

General problem solver

Name AI

Game AI

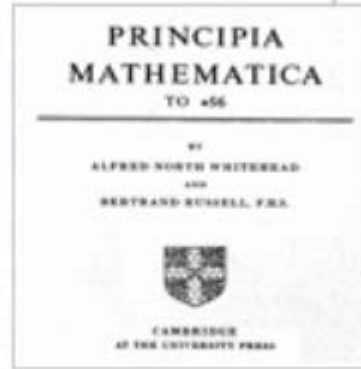
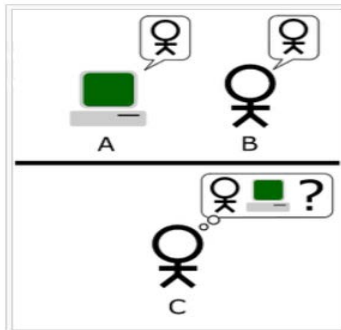


The Manchester Small-Scale Experimental Machine is the first computer to execute a program stored in electronic memory.



Alan Turing's paper "Computing Machinery and Intelligence" introduces the concept of the Turing test.

**The Annual Turing Award**



Work begins on the "Logic Theorist," which many consider the first AI program. It proves 38 of the first 52 theorems in *Principia Mathematica*, an early-20th-century attempt to devise a set of rules for all mathematical truths.



John McCarthy organizes a conference at Dartmouth College with prominent minds in the field and coins the term "artificial intelligence."

August 31, 1955 → **The birth of AI**  
 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

1<sup>st</sup> AI program (having problem solving skills) written in 1955 and 1956

by **Allen Newell, Herbert A. Simon and Cliff Shaw**

# The Birth of AI

August 31, 1955

DARTMOUTH SUMMER RESEARCH PROJECT ON  
ARTIFICIAL INTELLIGENCE (AI)

**J. McCarthy**, Dartmouth College

**M. L. Minsky**, Harvard University

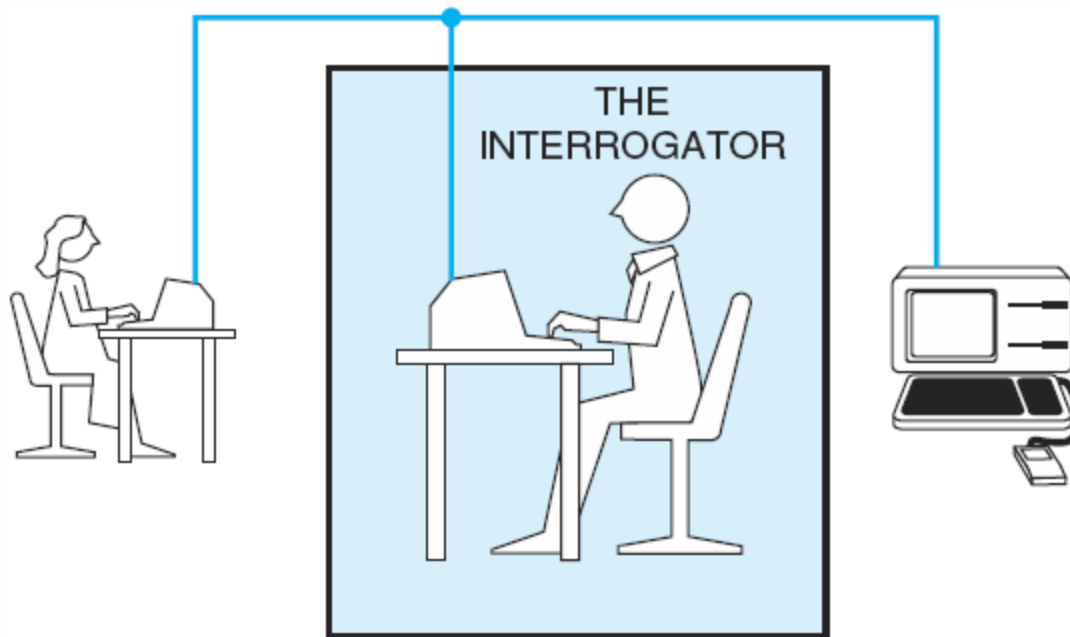
**N. Rochester**, I.B.M. Corporation

**C.E. Shannon**, Bell Telephone Laboratories

"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."

# History: the Turing Test

- The imitation game (1950)



<https://www.youtube.com/watch?v=sXx-PpEBR7k>

# How Will We Recognize AI?

1950 Alan Turing's paper, *Computing Machinery and Intelligence*, described what is now called "The Turing Test".

<http://www.loebner.net/Prizef/loebner-prize.html>

1990 Loebner Prize established. Grand Prize of \$100,000 and a Gold Medal for the first computer whose responses are indistinguishable from a human.





Logic reasoning

Neuron Network (connectionist)

GA

Swarm intelligence

Natural inspired alg/sys

Collective intelligence

crowd of wisdom

In 1980's 5<sup>th</sup> generation computer (funded by Japan Government and Industry)

with \$850 million in year 1981



## AI Better Than You At Games

<http://www.ibtimes.com/pulse/ai-better-you-games-deep-q-deep-blue-everything-between-1829530>

Deep Blue was a chess-playing computer developed by IBM that beat world champion Garry Kasparov in a controversial six-game rematch in 1997

The supercomputer Watson was developed to answer "Jeopardy" questions against the past "Jeopardy" champions Ken Jennings and Brad Rutter. It used machine learning and automated reasoning to improve its accuracy.



# AI present

## Top 10 Emerging Technologies of 2015

1. Fuel cell vehicles
2. **Next-generation robotics**
3. Recyclable thermoset plastics
4. Precise genetic engineering techniques
5. Additive manufacturing
6. **Emergent artificial intelligence**
7. Distributed manufacturing
8. 'Sense and avoid' drones
9. Neuromorphic technology
10. Digital genome

## Top 10 Breakthrough Technologies 2013

1. **AI Breakthrough – deep learning**
2. Ultra-Efficient Solar
3. **Big Data Goldmine (machine learning)**
4. Snapchat's Disappearing Act
5. Pebble Power
6. Prosthetic Memory Implants
7. Blue-Collar Bot
8. Additive Manufacturing
9. Fetal DNA Sequencing
10. Supergrids

## Top 10 Breakthrough Technologies 2014

- Agricultural Drones
- Ultraprivate Smartphones
- Brain Mapping**
- Neuromorphic Chips
- Genome Editing
- Microscale 3-D Printing
- Mobile Collaboration
- Oculus Rift
- Agile Robots**
- Smart** Wind and Solar Power

# Robots: ビッグドッグ (BigDog)

ビッグドッグは起伏の多い地形で歩兵に随伴出来る輸送用ロボットとして用いる為、米国防高等研究計画局による資金提供で開発された。

歩行の様子は幾つかの動画共有サイトに掲載されている。横から胴体部分を蹴られても倒れる事無く即座に姿勢を復元出来、氷上で足を滑らせても素早く体制を立て直す事で転倒にはいたらないという姿勢制御技術の高さを見る事が出来る。また、通常は左右の脚を互い違いに進ませて歩行するが、馬のギャロップの様に疾走させ、ジャンプして障害物を飛び越えさせる実験も行われている。

2012年からアメリカ海兵隊で運用試験が始まっており、音声指示が可能となっている。2014年にアメリカ海兵隊での実運用開始を目指していると発表した。

<https://www.youtube.com/watch?v=ahSbguu6VHk>

# Human Brain Model Projects:

## USA: The BRAIN Initiative (2013/4~)

is the White House Brain Research through Advancing Innovative Neurotechnologies, a collaborative, public-private research initiative announced by the Obama administration on April 2, 2013, with the goal of supporting the development and application of innovative technologies that can create a dynamic understanding of brain function for fiscal year 2014 of approximately \$110 million

## EU: The Human Brain Project (2013/4~)

is a large 10-year scientific research project, established in 2013, largely funded by the EU which aims to provide a collaborative informatics infrastructure and first draft rodent and human whole brain models within its 10 year funding period \$1.6 billion

## JP: 「革新的技術による脳機能ネットワークの全容解明プロジェクト」

[http://www.lifescience.mext.go.jp/files/pdf/n1332\\_06.pdf](http://www.lifescience.mext.go.jp/files/pdf/n1332_06.pdf)

year 2014, \$34 million (2014/4~)

## CN: China Brain Project

The China government also places great importance on brain study, and China Brain Project will be started, a report on People's Daily said. 2014-6-29.

# What AI successes so far

- Logic problem solving 38 math problems
- AI in games
- AI in Quiz show
  
- Driverless car
- Driverless airplane
- Pattern/Feature recognition – deep learning
  
- Humanoid robots → Human-like robots?
- IBM Cognitive-X
  
- Smart phone/smart device → smart city/ smart planet?
- Can machine think?
  
- Internet of things (IoT)
  - Internet of smart/intelligence things (human, non-human but human-like) (IoIT)

# AI Future

## What does AI pursue?

From Turing Test, to Logic Theorist, to IBM Deep Blue, to IBM Watson  
IBM cognitive computing, video

The Dartmouth Summer Research Conference on Artificial Intelligence, organized by computer scientist John McCarthy

- The first use of the term 'artificial intelligence'.
- 'every aspect of learning or any other feature of intelligence can be so precisely described that a machine can be made to simulate it'.

In 1967, Herman Khan and Anthony J Wiener'

"by the year 2000, computers are likely to match, simulate or surpass some of man's most 'human-like' intellectual abilities."

Brain projects

→ Super-intelligence:

human-like intelligence

+  $\alpha$  surpass human abilities enhanced by taking advantages of

computers (fast processing, unlimited memory, do not lost memory, easy to incorporate others' intelligence)

emerging/break through technologies

# Programming Languages

1958 Lisp – a functional programming language with a simple syntax.

*(successor SitA ActionP)*

1972 PROLOG - a logic programming language whose primary control structure is depth-first search

*ancestor(A,B) :- parent(A,B)*

*ancestor(A,B) :- parent(A,P), ancestor(P,B)*

1988 CLOS (Common Lisp Object Standard) published.  
Draws on ideas from Smalltalk and semantic nets





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# Overview of AI application areas



# AI application areas

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- Game Playing
  - Much of the early research in state space search was done using common board games such as checkers, chess, and the 15-puzzle
  - Games can generate extremely large search spaces. These are large and complex enough to require powerful techniques for determining what alternative to explore



# AI application areas

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- Automated reasoning and Theorem Proving
  - Theorem-proving is one of the most fruitful branches of the field
  - Theorem-proving research was responsible in formalizing search algorithms and developing formal representation languages such as predicate calculus and the logic programming language



# AI application areas

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- Expert System

- One major insight gained from early work in problem solving was the importance of domain-specific knowledge
- Expert knowledge is a combination of a theoretical understanding of the problem and a collection of heuristic problem-solving rules



# AI application areas

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- Expert System

- Current deficiencies:

- **Lack of flexibility**; if human cannot answer a question immediately, he can return to an examination of first principle and come up something
    - **Inability to provide deep explanations**
    - **Little learning from experience**



# AI application areas

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- Natural Language Understanding and Semantics



# AI application areas

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- Modeling Human Performance
  - Capture the human mind (knowledge representation)



# AI application areas

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- Robotics



# AI application areas

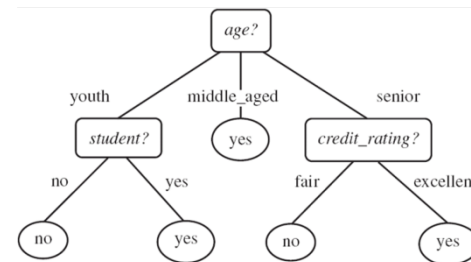
## Machine Learning

Simon's definition of “**machine learning**”

“ Learning denotes **changes** in the system that are **adaptive** in the sense that they enable the system to do the same task or tasks drawn from the same population **more effectively the next time**”

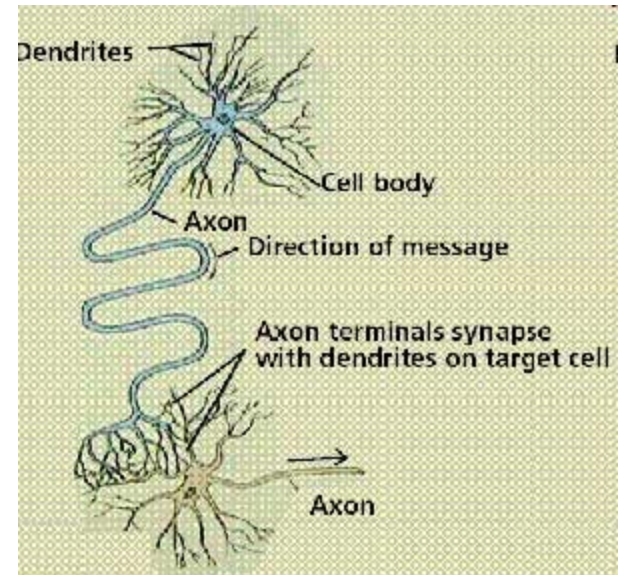
- Machine Learning I, 1993, Chapter 2.

### Decision Tree Example



# AI application areas

- Optimizations
  - ACO
  - Swarm intelligence
  - Genetic Algorithm





# Demos

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## Demos

<https://cis.k.hosei.ac.jp/~rhuang/>

1. [Searching Algorithm](#)

2. [Game Algorithm](#)

3. [Maze Robot](#)

4. [Wumpus World](#)

5. [Smart Garden](#)

6. [Automatic Chatting](#)

7. <http://lab.tomires.eu/metro/indexff.html>



# IBM: impact applications

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1. Deep Blue was a chess-playing computer developed by IBM
2. Watson is an artificially intelligent computer system capable of answering questions posed in natural language, developed in IBM's DeepQA project.
3. Deep learning is a set of algorithms in machine learning that attempt to learn layered models of inputs, commonly neural networks

IBM cognitive computing systems – Cognitive - X



# Deep Learning

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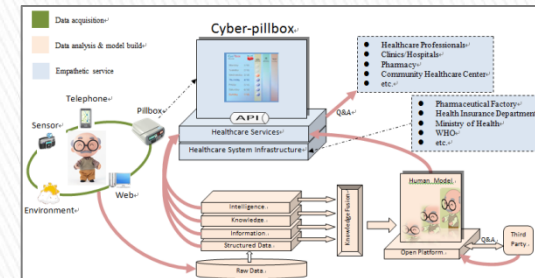
Please find out what is deep learning?

# 研究室紹介

- ▶ 教員名 : 黄 潤和
- ▶ 領域 : **人工知能**
- ▶ Goal : より快適な生活/世界

## ▶ 研究テーマ:

- スマートなモノ/デバイス  
e.g. スマートカップ, スマート杖, ...
- シティコンピューティング  
シティモデル, 空気/騒音/交通/etc.  
→ 様々な面から都市を良くする
- ヒューマンセントリックコンピューティング  
ヒューマンモデリング → 思いやりのある健康管理,  
スマートサービス, 推薦システム, ...
- コグニティブコンピューティング  
人の性格や好み、状況の**認識**に基づいた最適なサービス



# より快適な生活/世界

## ▶ データの収集

- 人のデータ
  - スマートフォン、ウェアラブルデバイス、SNS…
- 環境データ
  - カメラ、センサ、参加型センシング、iBeacon…

## ▶ 分析

- データマイニング
  - 知識の発見 : 相関関係、分類、特徴…
- 統計解析
  - 仮説検証 : 2変数の具体的な相関の測定

例：若年層の顧客はどんな商品を買う傾向があるか？

例：自宅での勉強時間と学校の成績に相関関係はあるのか？

## ▶ 応用

- 最適化、将来の予測、コンテキストウェアネス,
- **コグニティブ・コンピューティング**…

# Future with Cognitive Computing -コグニ ティブ・コンピューティングと拓く未来- (IBM JAPAN)







# Readings

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<http://www.martianherald.com/9-ways-artificial-intelligence-will-affect-our-lives>

9 ways AI will affect our lives

<http://dsc.discovery.com/tv-shows/curiosity/topics/ways-artificial-intelligence-will-affect-our-lives.htm>

10 ways AI will affect our lives



# Home work

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- (1) Please find the top 5 most impact AI applications and summarize them
- (2) When all intelligence things including humans and non-human things are inter-connected together, what will happen? What intelligence will lead to? Write your opinion.

- Internet of things (IoT)  
→ Internet of smart/intelligence things (human, non-human but human-like)  
(IoT)

## Submission:

Submit your report in summary on **9/23** before next week class.



# Evaluation

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出席 15%

演習+term project 25%

期末試験 60%