



The Introduction To Artificial Intelligence

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The Introduction to Artificial Intelligence

□ Curriculum Aims & Objectives

- Master the basic concepts, methods of AI
- Be familiar with applications of AI
- Use computer to solve some actual problem of intelligence.

The Introduction to Artificial Intelligence

□ Class Administration

- What are we going to learn in this term?
 - *Part 1 Brief Introduction to AI*
 - *Part 2 Model selection*
 - *Part 3 Machine Learning*
 - *Part 4 Neural Networks* ★
 - *Part 5 Applications*

The Introduction to Artificial Intelligence

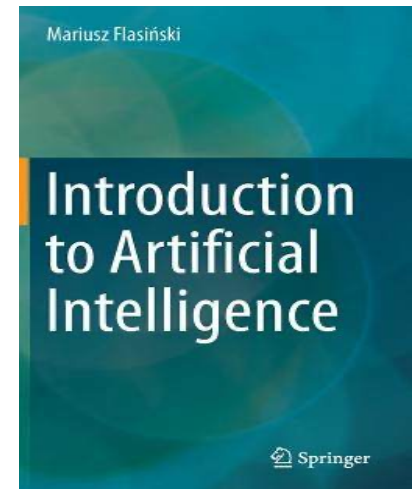
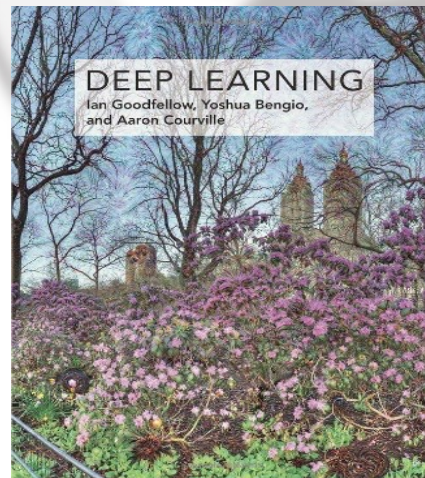
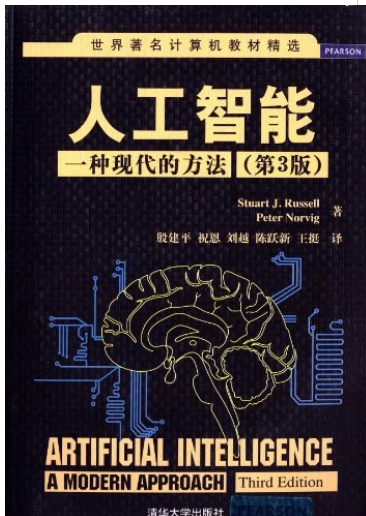
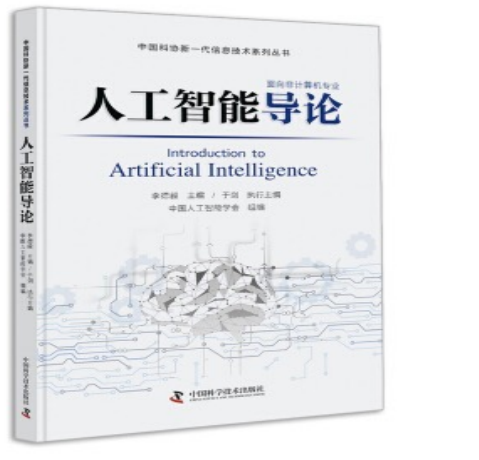
- Teaching hours: 32 hours
- Assessment:

| Assessment Methods | Assessment Requirements | Assessment Weighting |
|-----------------------|-----------------------------------|----------------------|
| Homework | 3-4 times | 40% of grade |
| Literature review | About Applications in AI | |
| Classroom performance | Attendances, test and interaction | 20% of grade |
| Final exam | Open-book examination | 40% of grade |

- No Copy! No Plagiarize!

The Introduction to Artificial Intelligence

- References:



The Introduction to Artificial Intelligence

Literature Search

- Top Researcher, Conference, Journal in AI area.....
- CCF recommended list for AI
 - Journal: AI, TPAMI, IJCV, *et al.*
 - Conference: AAAI, NIPS, CVPR, ICCV, ICML, IJCAI *et al.*

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The Introduction to Artificial Intelligence

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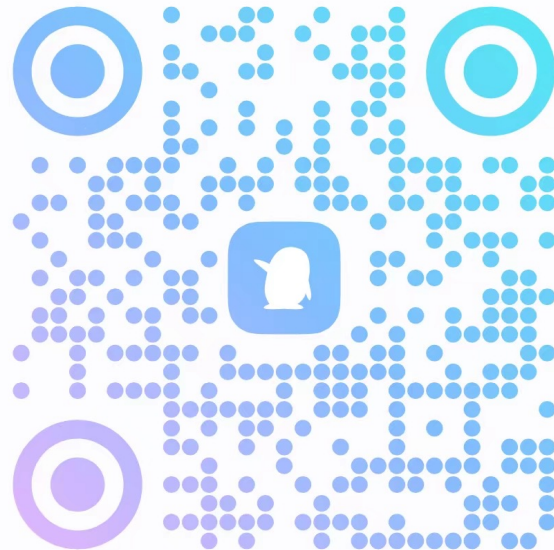
班级管理

QQ GROUP



2024-2025-1人...

群号: 877679440



回答: 曾煜妮

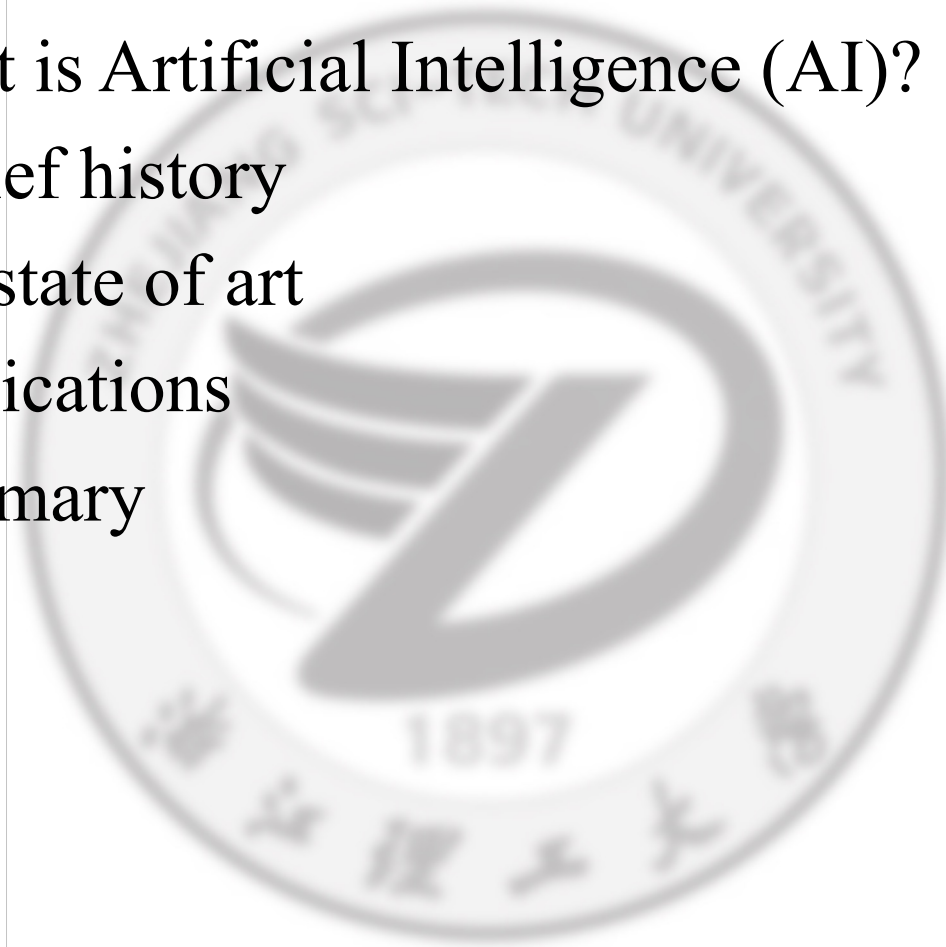
The Introduction to Artificial Intelligence

✚ Part I Brief Introduction to AI



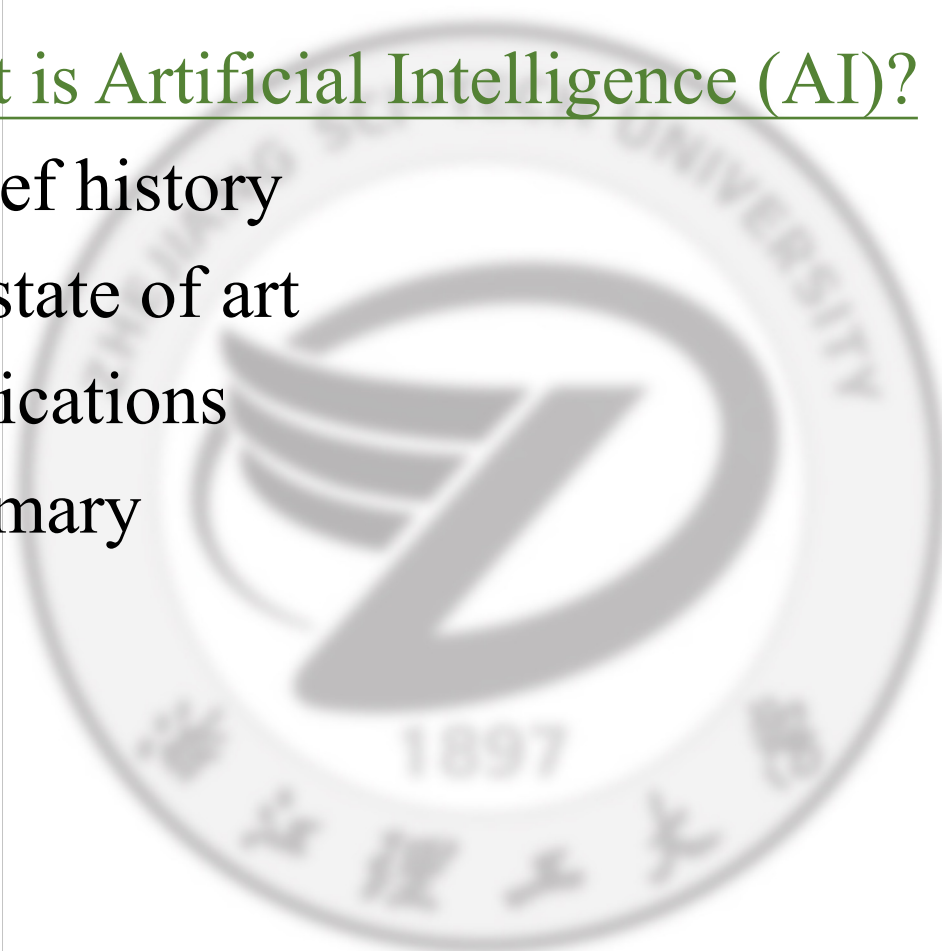
Brief Introduction to AI

- 1.1 What is Artificial Intelligence (AI)?
- 1.2 A brief history
- 1.3 The state of art
- 1.4 Applications
- 1.5 Summary



Brief Introduction to AI

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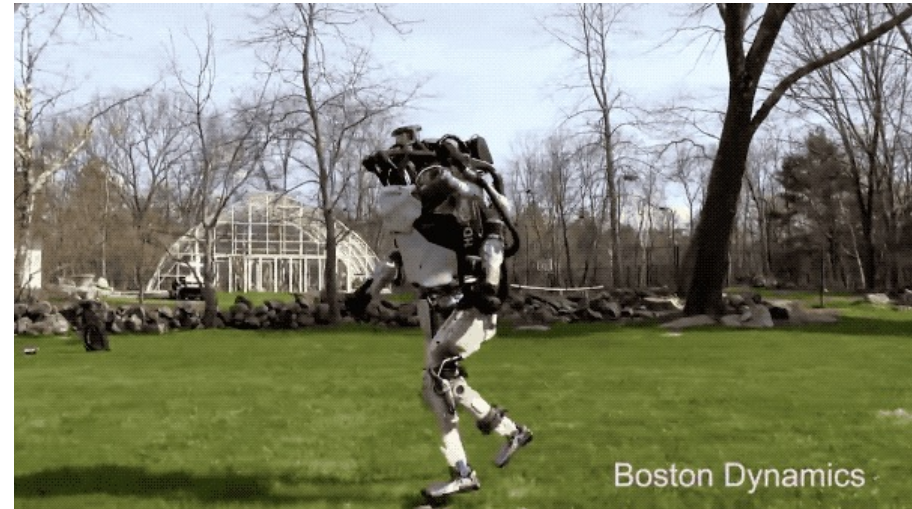
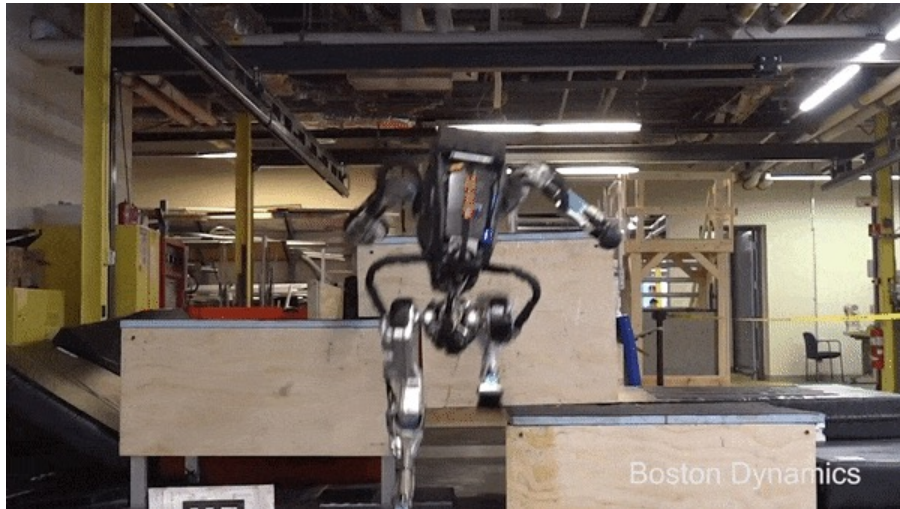
1.1 What is Artificial Intelligence (AI)?



When it comes to artificial intelligence,
what comes to your mind first?

1.1 What is Artificial Intelligence (AI)?

HUMAN-LIKE ROBOTS?



1.1 What is Artificial Intelligence (AI)?

AUTO-DRIVING SYSTEMS



1.1 What is Artificial Intelligence (AI)?



What Is Artificial Intelligence?

1.1 What is Artificial Intelligence (AI)?

□ Definitions

- “the exciting new effort to make computers think in a full and literal sense.” (Haugeland, 1985) “计算机思考的令人激动的新成就...”
- “[The area of]... such as decision making, problem solving, learning ...” (Benjamin, 1970) “与人类思维先关的活动，注入决策、问题求解、学习等活动的【自动化】”
- “The study of mental faculties through the use of computer models.” (Charniak and McDermott, 1985) “通过使用计算机模型来研究智力”
- “The study of the computations that can be performed to make a computer act.” (Winston, 1992) “使用感知、推理和行动成为可能的计算研究”
- “The art of creating machines that perform functions that would require intelligence if performed by people.” (Kurzweil, 1990) “创造能执行一些功能的机器的技艺，当有人来执行这些功能是需要智能”
- “The study of how to make computers do what humans do better.” (Rich and Knight, 1991) “研究如何使计算机能做哪些目前人比计算机更擅长的事情”
- “Computational Intelligence is the study of the design of intelligent agents.” (Poole et al., 1998) “计算智能研究智能Agent的设计”
- “AI ... is concerned with intelligent behavior.” “AI ...是与人工制品中的智能行为有关”

1.1 What is Artificial Intelligence (AI)?

- We see eight definitions of AI, in four categories.

| Systems that think like humans | Systems that think rationally |
|---|--|
| <p>“the exciting new effort to make computers think ... machines with minds, in 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> |
| Systems that act like humans | Systems that act rationally |
| <p>“The art of creating machines that perform functions that require intelligence when preformed by people.”(Kurzweil, 1990)</p> <p>“The study of how to make computers do things at which, at moment, people are better.”(Rich and knight, 1992)</p> | <p>“Computational Intelligence is the study of the design of intelligent agents.”(Poole et al., 1998)</p> <p>“AI ... is concerned with intelligent behavior in artifacts.”(Nilsson, 1998)</p> |

1.1 What is Artificial Intelligence (AI)?



□ Definitions

| | |
|--------------------------------|-------------------------------|
| Systems that think like humans | Systems that think rationally |
| Systems that act like humans | Systems that act rationally |

- We see eight definitions of AI, laid out along two dimensions.
- The definitions on the top concerned with *thought processes and reasoning*, whereas the ones on the bottom address *behavior*.

1.1 What is Artificial Intelligence (AI)?



□ Definitions

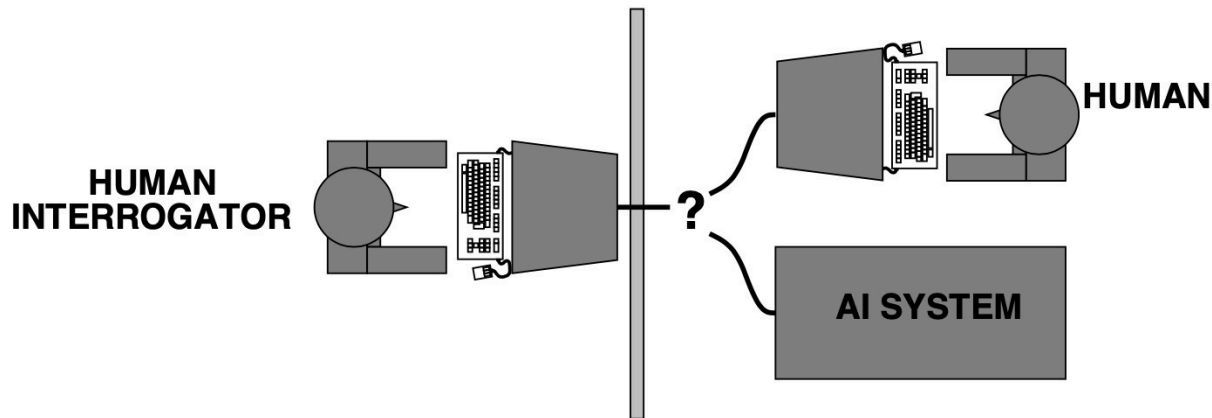
| | |
|--------------------------------|-------------------------------|
| Systems that think like humans | Systems that think rationally |
| Systems that act like humans | Systems that act rationally |

- The definitions on the left measure success in terms of fidelity to *human* performance, whereas the ones on the right measure against an ideal performance measure, called *rationality*.
- Let us look at the four approaches in more detail.

1.1 What is Artificial Intelligence (AI)?

❑ Systems that act like humans: **The Turing test (1950)**

- A computer passes the test if a human interrogator, after posing some written questions, *cannot tell* whether the written responses come *from a person or from a computer*.
- “Can machine think?” → “Can machine behave intelligently?”
- Turing test is not *reproducible, constructive*, or amenable to *mathematical analysis*.



The Turing test

1.1 What is Artificial Intelligence (AI)?



❑ Systems that think like humans: Cognitive Science (1960)

- way of determining how humans think;
- to get *inside* the actual workings of human minds;
- The interdisciplinary field of *cognitive science* brings together *computer models* from AI and *experimental techniques* from psychology to construct precise and testable theories of the human mind.

1.1 What is Artificial Intelligence (AI)?



□ Systems that think rationally: **Laws of Thought**

- Several Greek schools developed various forms of *logic*: *notation* and *rules of derivation* for thoughts;
- Aristotle, one of the first to attempt to codify “right thinking” : what are correct arguments/thought processes?
- Direct line through *mathematics* and *philosophy* to modern AI;

1.1 What is Artificial Intelligence (AI)?

□ Systems that act rationally: Rational agents

- An *agent* is an entity that perceives and acts.
- This course is about *designing rational agents*.
- Abstractly, an *agent* is a function from percept histories to actions:

$$f: \mathcal{P}^* \rightarrow \mathcal{A}$$

- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance.
→ *design best program for given machine resources*

1.1 What is Artificial Intelligence (AI)?

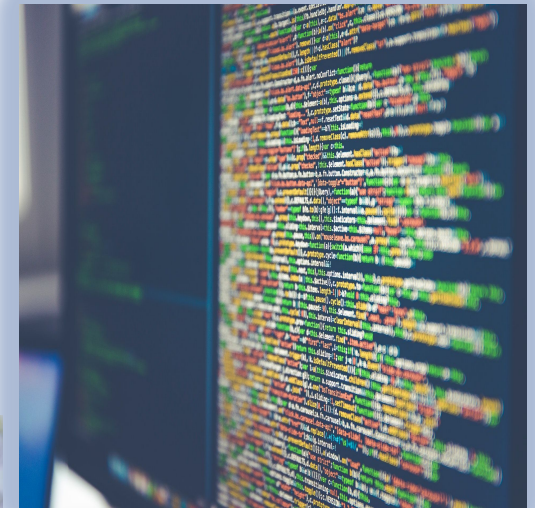
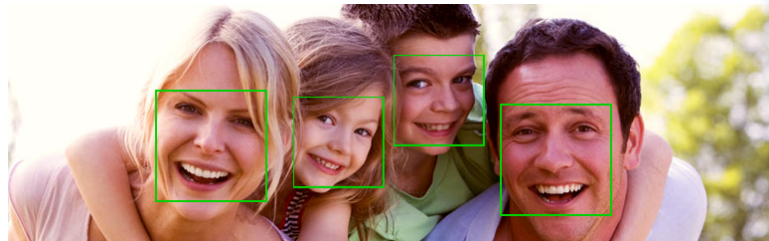
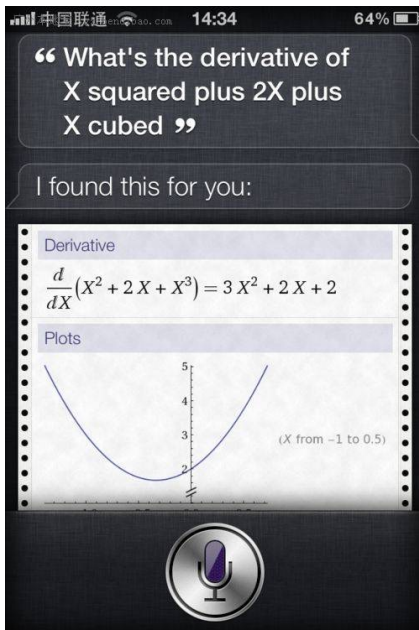


What Is Artificial Intelligence?

1.1 What is Artificial Intelligence (AI)?

□ What Is Artificial Intelligence?

Actually,
artificial intelligence is **intelligence** exhibited by machines.



1.1 What is Artificial Intelligence (AI)?



What Is Intelligence?

1.1 What is Artificial Intelligence (AI)?

□ In dictionaries...

“运用记忆、知识、经验、理解、推理、想象和判断来解决问题和适应新情况的能力。”

“学习、理解和做出判断或有基于理性的意见的能力”

“The general mental ability involved in calculating, reasoning, perceiving

“一般智力包括计算、推理、感知关系和类比、快速学习、存储和检索信息、流利地使用语言、分类、概括和适应新情况。”

Situations.

Columbia Encyclopedia, sixth edition, 2006

“学习、理解和思考的能力。”

“学习、推理和理解的能力。”

A Collection of Definitions of Intelligence

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October 4, 2006

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- “The **ability** to use memory, knowledge, experience, understanding, reasoning, imagination and judgement in order to solve problems and adapt to new situations.”
Cambridge Advance Learner’ s Dictionary, 2006
- “The **ability** to learn, understand and make judgments or have opinions that are based on reason”
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- “The **ability** to learn, understand, and think about things.”
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- “The **capacity** to learn, reason, and understand.”
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Intelligence is the ability to **learn** or **understand** or to **deal with** new or trying situations;
the ability to apply knowledge to manipulate one's **environment** or to **think** abstractly.

1.1 What is Artificial Intelligence (AI)?

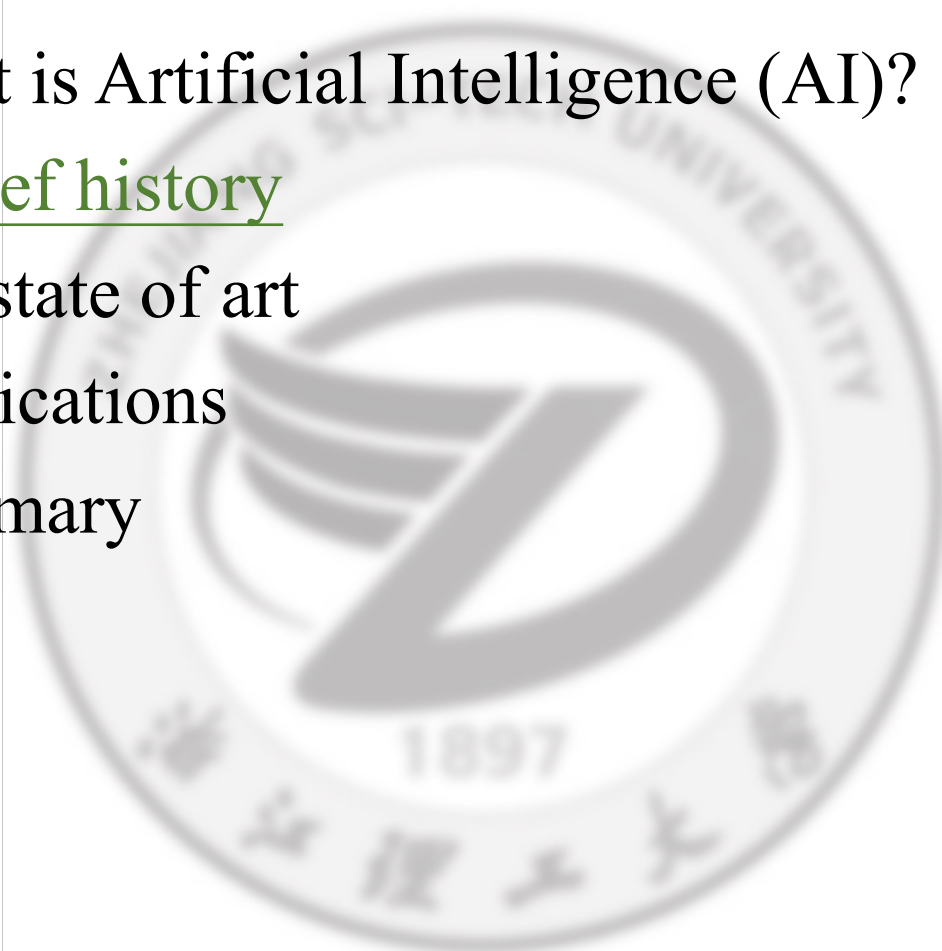
□ What Is Artificial Intelligence?



- Artificial intelligence (AI) is an area of **COMPUTER SCIENCE** that enables machines to learn from experience, adjust to new inputs and perform human-like tasks.

Chapter 1 Introduction

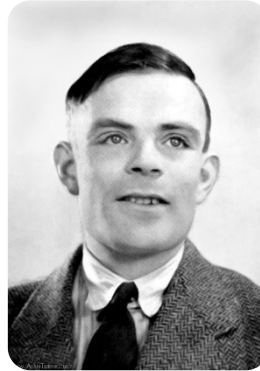
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1.2 A brief history

□ The History of AI

Father of modern computer



Alan Turing

1942,
Turing Test



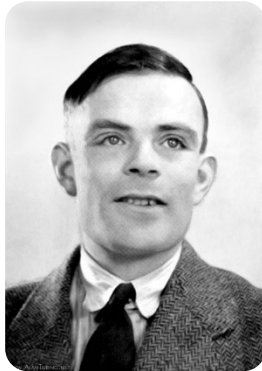
1.2 A brief history

□ The History of AI

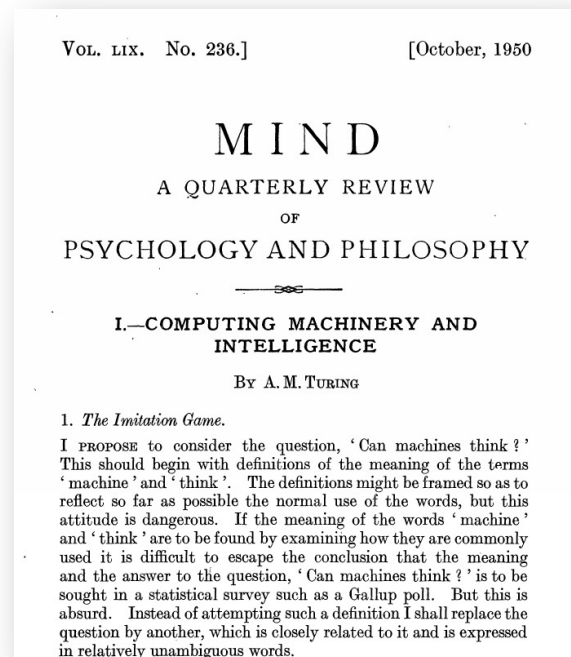
➤ 1943-1955: The gestation of AI (孕育期)

- In the 1940s, “Connectionism” was developed to study the process of **thinking**.
- In 1950, Alan Turing wrote “**Computing Machinery and Intelligence**”.

Father of modern computer



Alan Turing



1.2 A brief history

□ The History of AI

Dartmouth Artificial Intelligence (AI) Conference

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.

- [Dartmouth AI Project Proposal](#); J. McCarthy et al.; Aug. 31, 1955.

1956,
The birth of “AI”

1942,
Turing Test



1.2 A brief history

□ The History of AI

➤ 1956: The birth of AI (诞生)

- *Artificial Intelligence was formally born in a workshop conducted by IBM at Dartmouth College in 1956.*

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我们提议1956年现在在DARTMOUTH大学开展一次有10人为期两个月的人工智能研究。

这项研究是基于这样一个假设进行的，即学习的每一个方面或智能的任何其他特征原则上都可以如此精确地描述，以至于可以制造一台机器来模拟它。试图找到如何使用语言，形成抽象和概念，解决目前为人类保留的各种问题，提高自己。

1.2 A brief history

□ The History of AI

The father of AI



John McCarthy

Won the Turing Award



Marvin Minsky

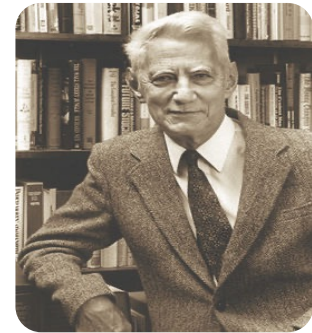
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- [Dartmouth AI Project Proposal](#); J. McCarthy et al.; Aug. 31, 1955.

The father of information theory



Claude Shannon

Designed the IBM 701



Nathaniel Rochester

1.2 A brief history

□ The History of AI

1956, at Dartmouth



2006, at Dartmouth



Five of the attendees of the 1956 Dartmouth Summer Research Project on Artificial Intelligence reunited at the July AI@50 conference. From left: **Trenchard More, John McCarthy, Marvin Minsky, Oliver Selfridge, and Ray Solomonoff.**

1.2 A brief history

□ The History of AI

1956,
The birth of “AI”

1959,
General problem solver

1942,
Turing Test

In 1959, the **General problem solver** was demonstrated by Newell, Shaw & Simon. It was the first useful AI program.



1.2 A brief history

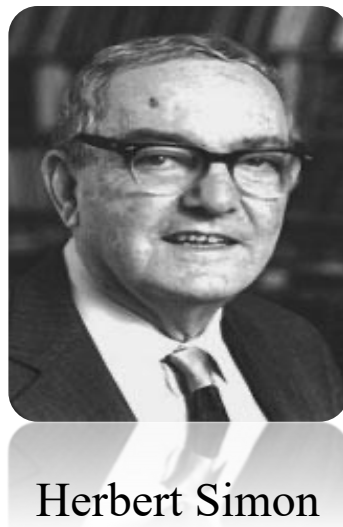
□ The History of AI

➤ General Problem solver

- Computer program that solves any problem to be expressed with well-formed formulas (Horn. Clauses).
- Towers of Hanoi
- Euclidean Geometry



Allen Newell

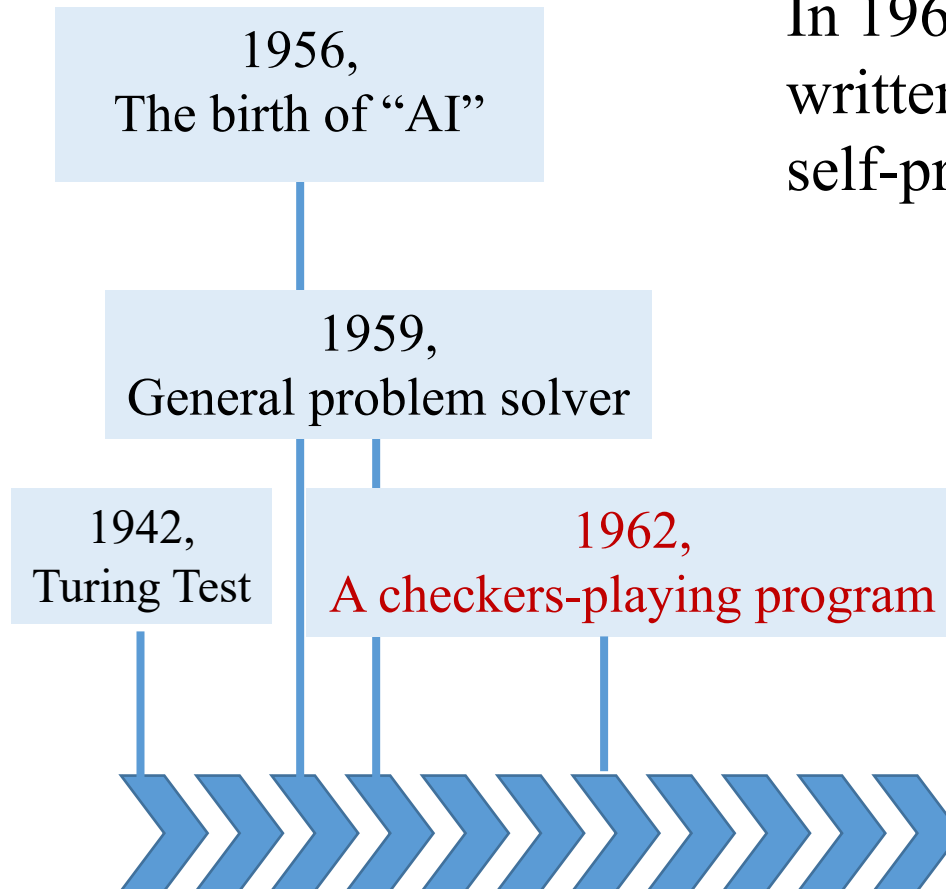


Herbert Simon

John Clifford Shaw

1.2 A brief history

□ The History of AI

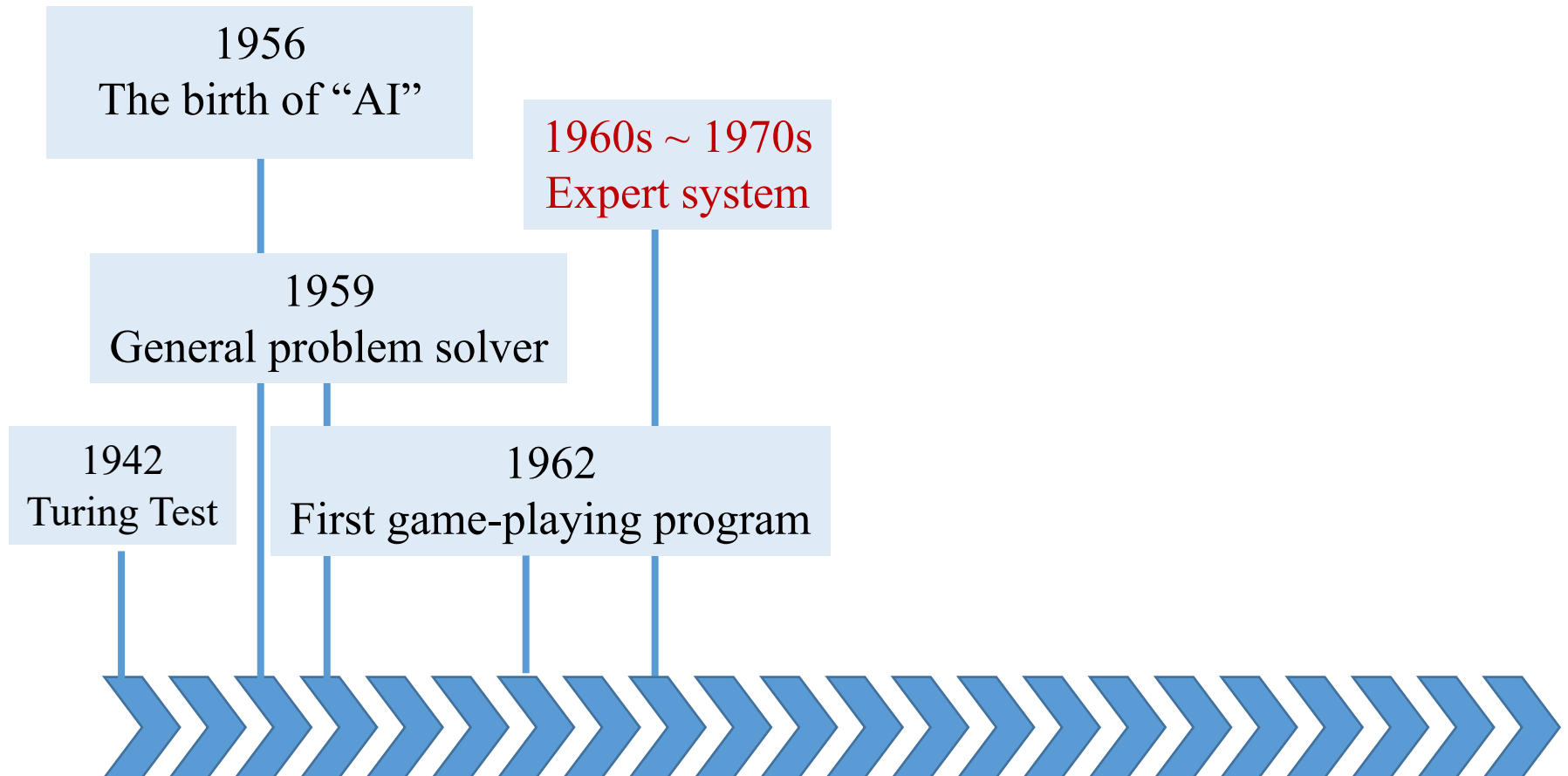


In 1962, a **checkers-playing program** written by Arthur Samuel defeated a self-proclaimed master player.



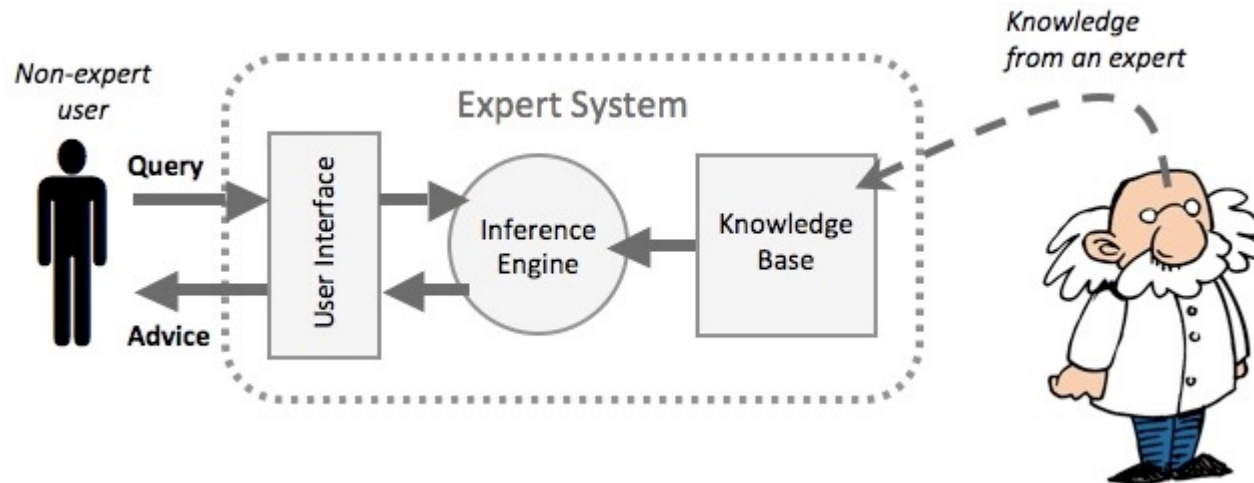
1.2 A brief history

□ The History of AI



1.2 A brief history

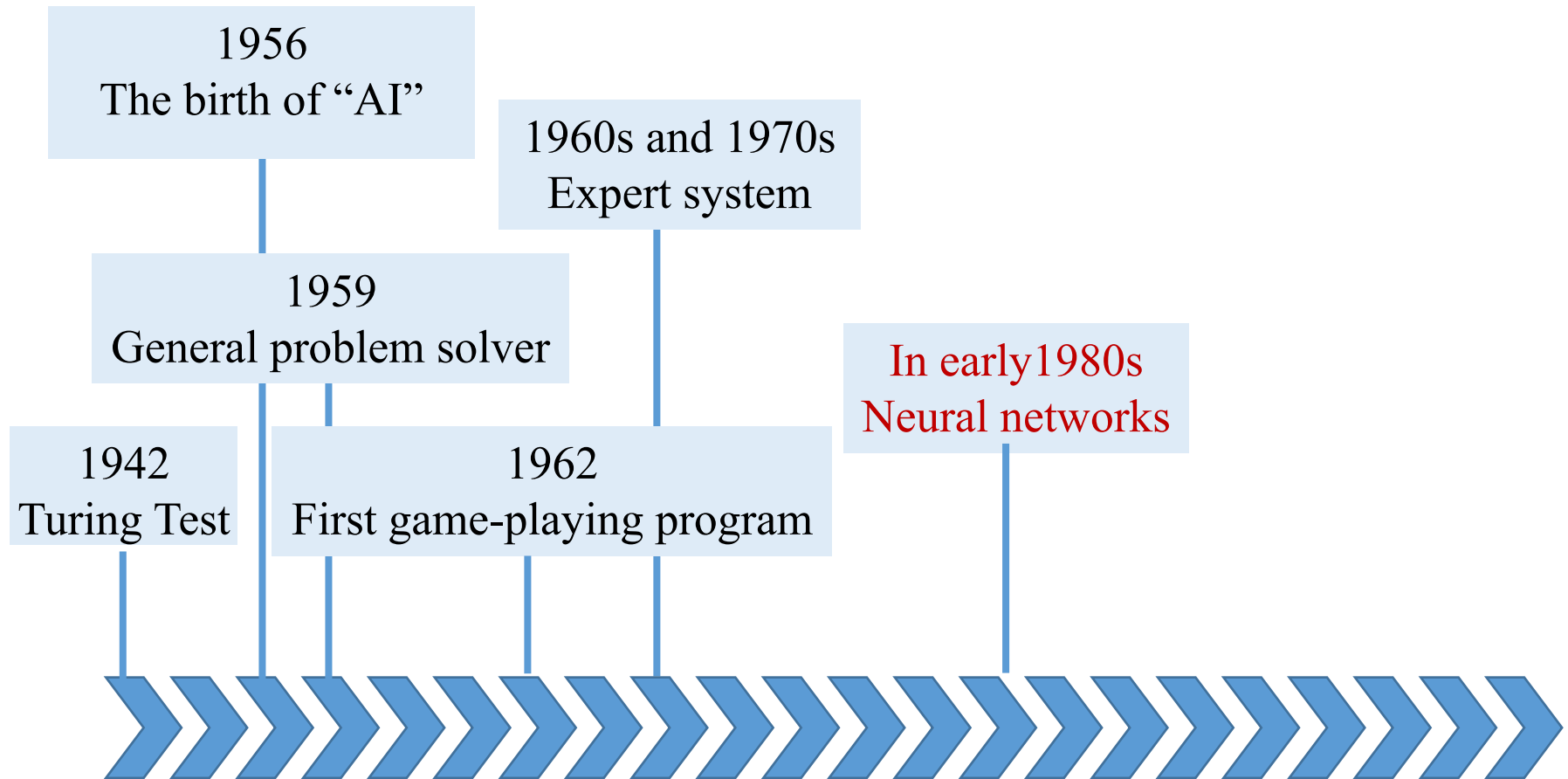
□ Expert System



Expert system is an artificial intelligence program that has **expert-level knowledge** about a particular domain and knows how to use its knowledge to respond properly.

1.2 A brief history

□ The History of AI

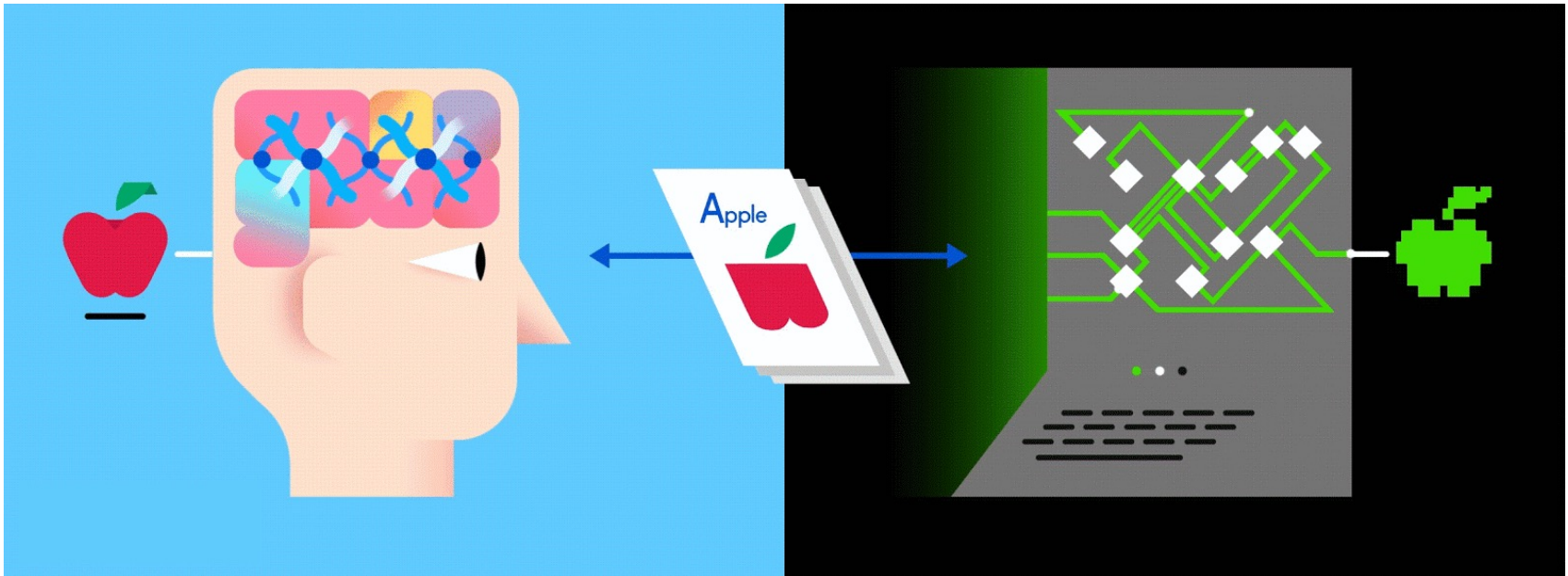


1.2 A brief history

□ Neural Networks

Human neural network

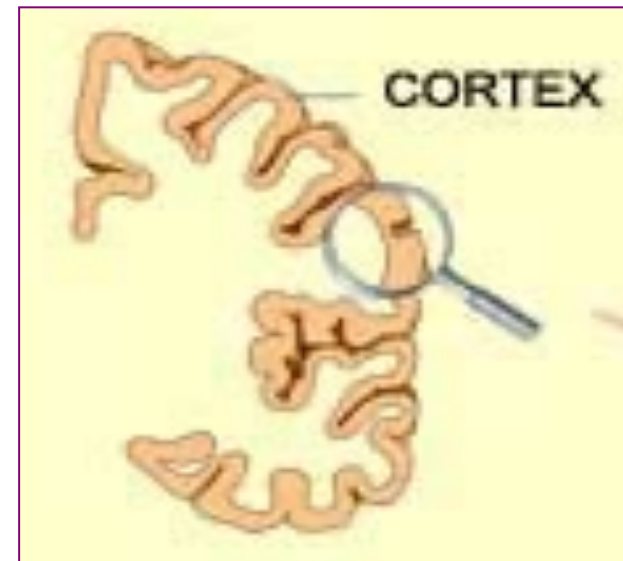
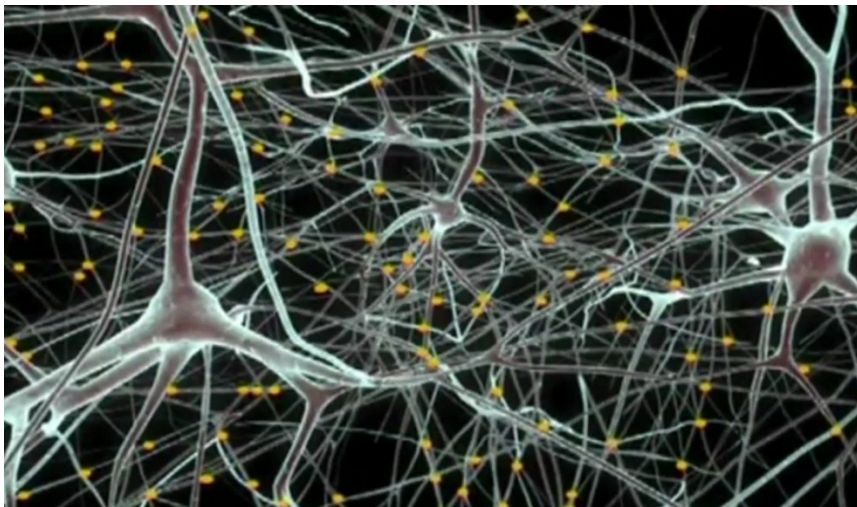
Artificial neural network



1.2 A brief history

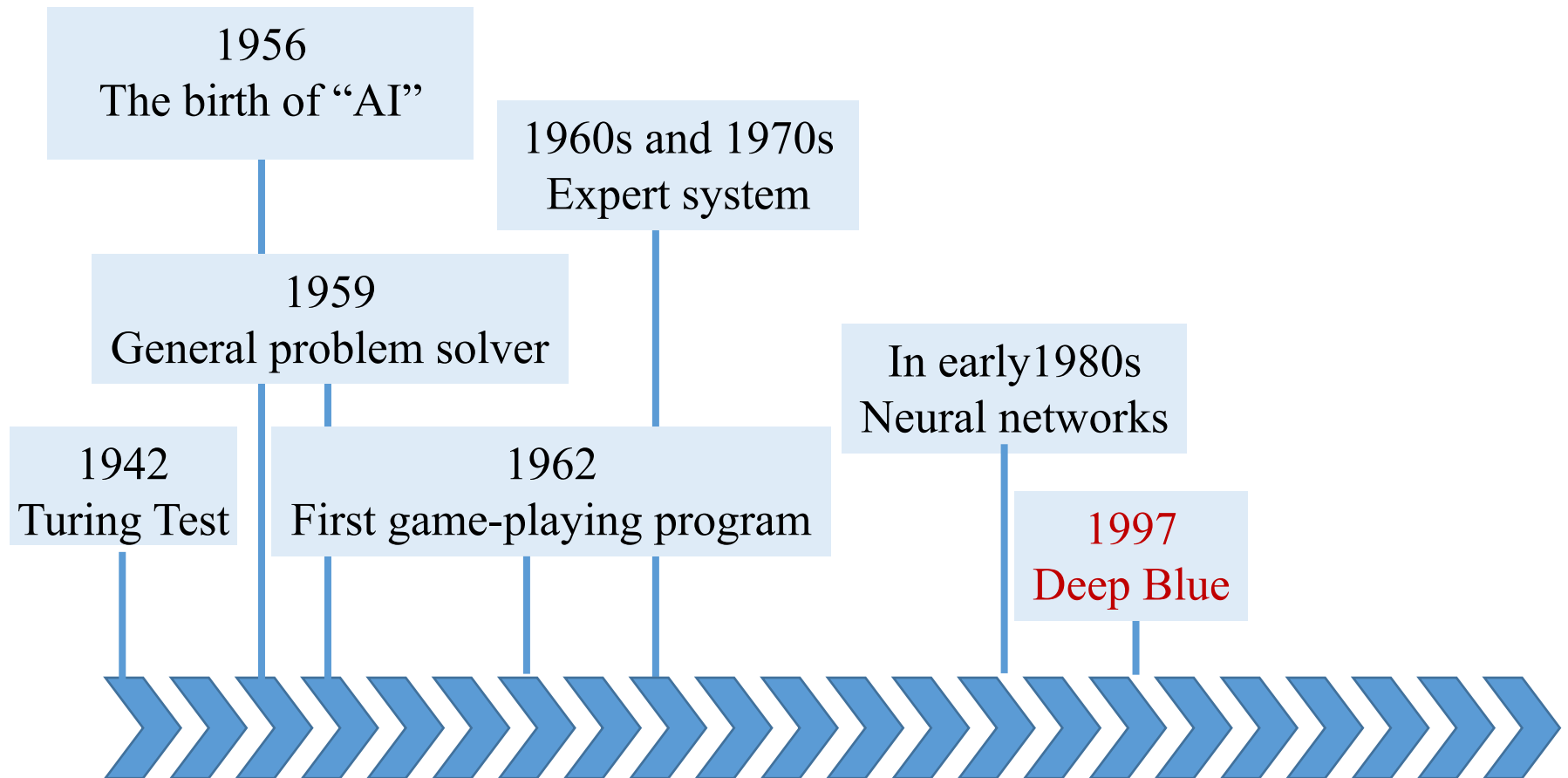
□ Neural Networks

The typical human neocortex contains around **thirty billion** neurons. A tiny square millimeter contains an estimated 100,000 neurons.



1.2 A brief history

□ The History of AI



1.2 A brief history

□ Deep Blue

FRIDAY, FEBRUARY 17, 1978
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The New York Times

Computer Gains on Chess Master

By MALCOLM W. BROWNE

In 1968, David Levy, a British international chess master, bet a group of computer experts 1,250 pounds that in the decade that followed no chess-playing computer could beat him. This year, Mr. Levy expects to collect his wager, but it is turning out to be a much closer race than many had imagined possible.

Chess-playing skill is widely regarded as a legitimate gauge of at least one aspect of human intelligence. Most human chess masters had long believed that although computers could rapidly sift through an enormous number of possibilities, machines lacked certain qualities vital to real mastery of the game.

But new computer programs are proving to be such formidable opponents in tournaments that, experts say, that old idea about the limitations of computer intelligence must be revised.

Levy vs. Chess 4.6

The man-versus-machine controversy this year will center on two conspicuous antagonists.

One is Mr. Levy, a 32-year-old Londoner who writes chess books and is classified as a "weak" international master—one of the few hundred best chess players in the world.

Opposing him will be a computer program called "Chess 4.6" devised by David J. Slate, a 23-year-old computer expert at Northwestern University, in Evanston, Ill. Mr. Slate's program, as used on a powerful Control Data Corporation Cyber 176 computer, is also among the several hundred best chess players in the world.

In separate interviews, Mr. Slate and Mr. Levy agreed that Mr. Levy would probably beat the computer in a final match, which may be played in August at the Canadian National Exposition in Toronto.

If so, Mr. Levy will win 1,250 pounds (about \$2,600) from four preferences in computer technology—Donald Michie of Edinburgh University, Seymour Papert of Massachusetts Institute of Technology, John McCarthy of Stanford University, and Edward Knuthmowski of Princeton University. He also hopes to receive large royalties from television coverage.

Referring to the Northwestern computer group Mr. Levy said: "Unless they make some major improvements in their Chess 4.6 program, my chances are good. They don't have to get much better to beat me, and they've already beaten me in speed matches, five seconds a move. But they're running out of time."

Mr. Slate said: "Using our present Chess 4.6 program, I'll be very happy if we take one and a half or two guests out of eight from Levy. If our new Chess 5.0 program proves to work and be as adaptable as we hope, we could really put a dent in Levy."

The Chess 4.6 program has already shaken the chess community to some extent.

In 1976, the Paul Masson Chess Tournament in California attracted some 100 contestants, including Mr. Slate's program, which was entered in the Class B level against 128 good amateur players. The computer easily won all its games to take a \$150 prize, which Northwestern had agreed in advance to relinquish.

In February 1977, Chess 4.6 entered the Minnesota Open Tournament, playing against some highly ranked opponents.

Chess 4.6 won the tournament 5 to 1, emerging with an official rating of 2,271—a chess master.

Defeated Soviet Program

The Chess 4.6 program is probably the best in the world. Last year it easily defeated the Soviet "Kaissa" program in Toronto, 4 to 0.

Mr. Levy and Mr. Slate agree that eventually computer programs will successfully challenge even grand masters. Pronouncing friendly pieces and attacking opposing pieces are the main objects of the computer programs, he said, and the program is now in planning long-range strategy and subtle positional advantages.

Defeating champion computer chess programs, difficult as it is, is vastly simpler than other problems facing experts in artificial intelligence, Mr. Slate and other experts said.

The single biggest problem now is in giving computers natural language ability—the ability to converse with untrained humans in human language.

Storing Information

Grouping computer memory data in terms of "frames"—associative scenarios such as "ordering a meal at a restaurant" or "participating in a fertility rite"—is one of the new techniques computer experts are particularly enthusiastic about.

Trained information will be vastly easier to retrieve, they say, and will be available in forms much closer to human associative recall.

While computer scientists are deeply divided over the question of whether there can be real artificial intelligence, most of those interviewed agreed that the so-called Turing test could eventually settle the argument.

The test is named for the late English mathematician Alan Turing, who proposed it in the late 1940's. In this test, a human is seated at a table, communications keyboard, which he uses to converse for a half hour with a computer. He may ask any question, except such purely anthropomorphic questions as "what color are your eyes?"

If after the session the human is unable to decide whether his interlocutor is human or machine, the machine may be said to have human intelligence, according to the test.

One leading computer expert, Dr. Hans Berliner of Carnegie-Mellon University, asserts that such a machine already partly exists in the form of the "Chess 4.6" program.

"Most chess players are defeated by the machine and very, very few players would risk money betting whether they had been beaten by a human or a machine in this case," he said.



Herbert Biensack, regional coordinator of the Bureau of Labor Statistics

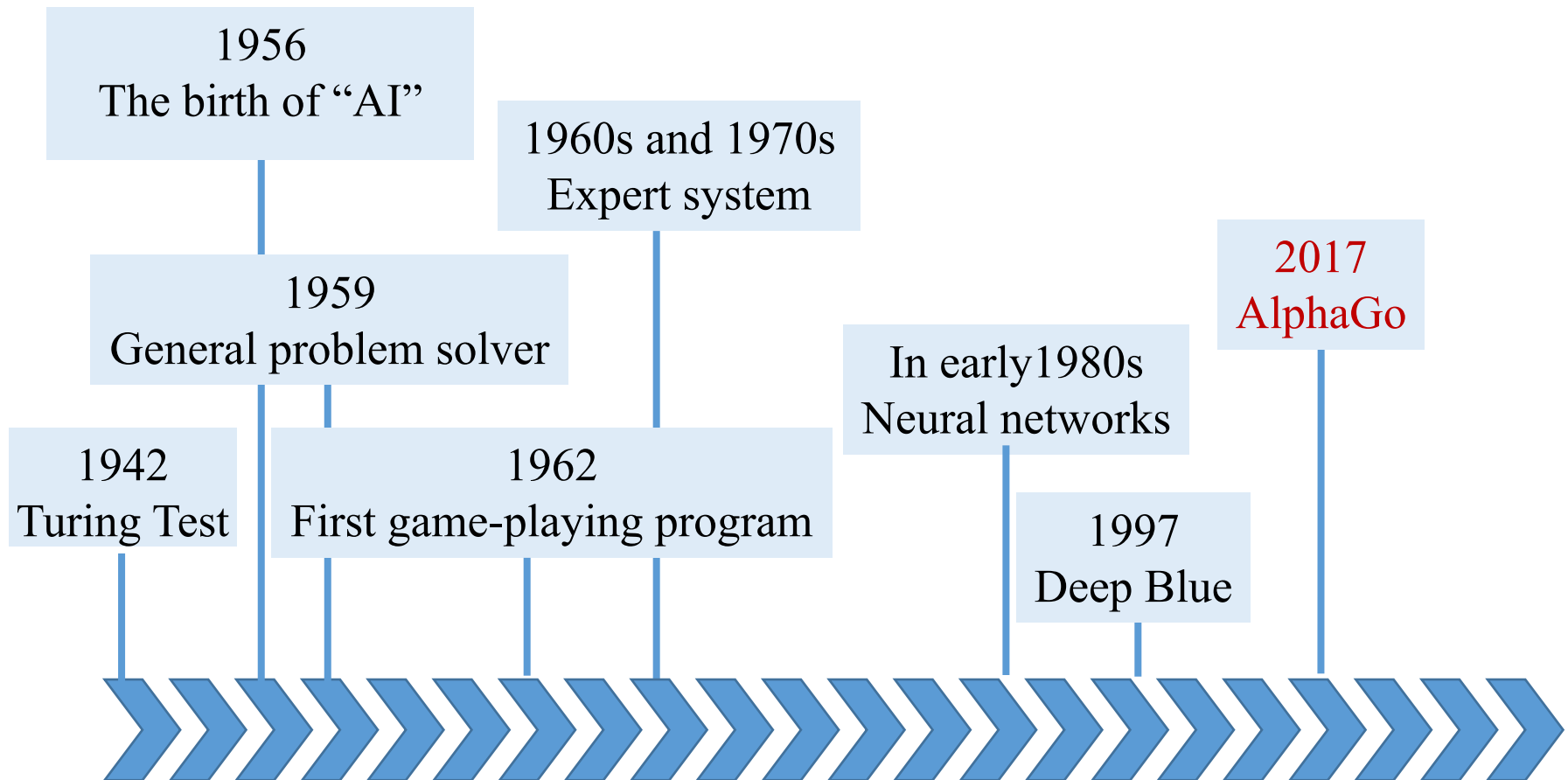
Busy Biensack Notes Big Bygone

© 2016 The New York Times

In 1997, Deep Blue[®] beat the world chess champion after a six-game match

1.2 A brief history

□ The History of AI



1.2 A brief history

□ The History of AI

Google AlphaGo Beats World Champions!



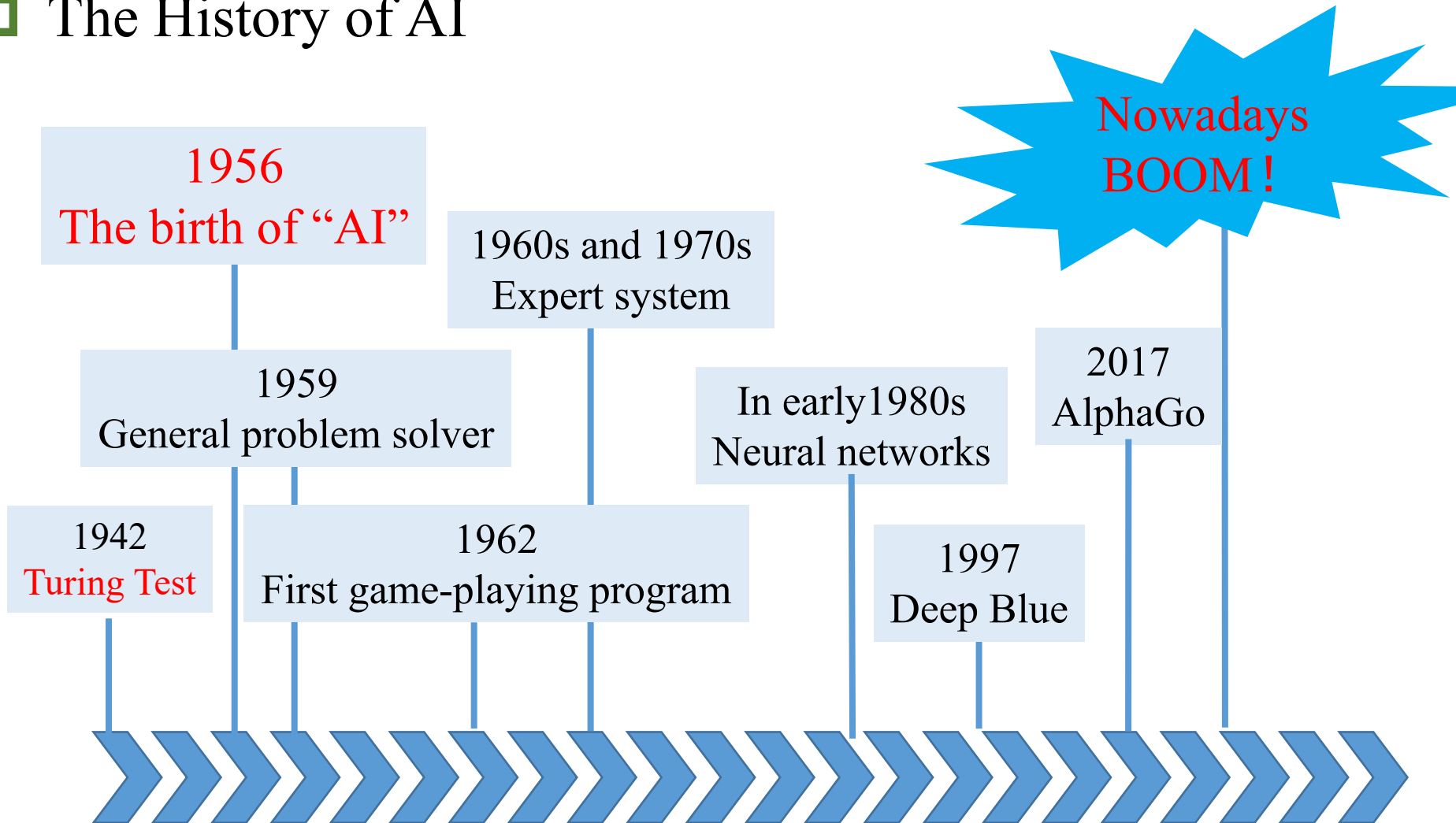
A year ago, Li Shishi was defeated by AlphaGo - www.bestchinanews.com/Science-Technology/8794.html ▼
Mar 16, 2017 - March 2016 **AlphaGo** challenge world champion, **Li Shishi** represents the highest level of mankind. Before ...

Li Shishi explained the man-machine war Bureau: thechinesenews.net/Today-News/65702.html
May 28, 2017 - **Li Shishi** explained the man-machine war Bureau: **AlphaGo** times **Li Shishi** nine paragraph explanation ...

Google's AlphaGo AI beats Lee Se-dol again to win **Google DeepMind** Challenge Match
<https://www.theverge.com/2016/3/15/.../alphago-deepmind-go-match>
Mar 15, 2016 - After suffering its first defeat in the Google DeepMind Challenge Match, Google's AI **AlphaGo** has beaten world-class player ...

1.2 A brief history

□ The History of AI



1.2 A brief history

□ Nowadays

➤ Foundation Model!



Chapter 1 Introduction

- 1.1 What is Artificial Intelligence (AI)?
- 1.2 A brief history
- 1.3 The state of art
- 1.4 Applications
- 1.5 Summary



1.3 Nowadays

□ The foundations of AI

- *Philosophy* (哲学): logic, methods of reasoning, foundations of learning, language, rationality
- *Mathematics* (数学): formal representation and proof, algorithms, computation, (un)decidability, (in)tractability, probability
- *Psychology* (心理学): adaptation, phenomena of perception and motor control, experimental techniques
- *Economics* (经济学): formal theory of rational decisions
- *Linguistics* (语言学): knowledge representation
- *Neuroscience* (神经科学) : plastic physical substrate for mental activity
- *Control theory* (控制理论) : homeostatic systems, stability; simple optimal agent designs

1.3 Nowadays



Geoffrey Hinton
University of Toronto
Google



Andrew Ng
Stanford University



Feifei Li
Stanford University
Google



Yann LeCun
New York University
Facebook



Kaifu Li
Beijing frontier international Artificial
Intelligence Research Institute

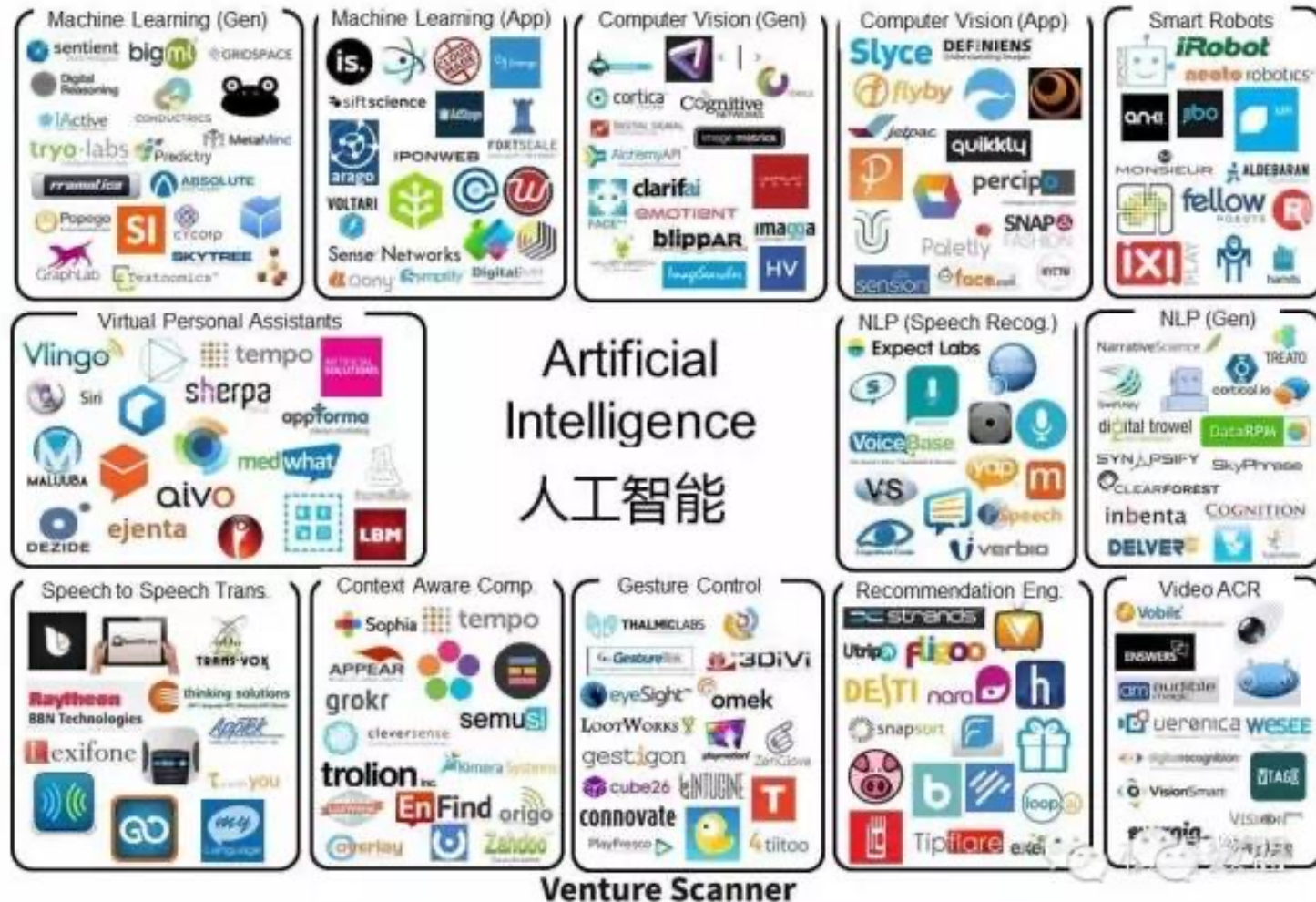


Microsoft



1.3 Nowadays

Many AI products in different fields



1.3 Nowadays



- **Image recognition:** CNN achieve over 97% recognition rate on Imagenet2017 dataset, which is comparable to human performance.
- **Speech recognition:** RBM network reduce the error rate by 30%, which is the most significant breakthrough in the past decade.
- **Nature language processing:** recurrent neural networks show superior performance than baseline methods in NLP problems..
- **AI Games:** AlphaGO defeated Lee Sedol and Jie Ke, two of the best Go players in the world.
- **Disease diagnosis:** artificial intelligence can help doctors avoid mistakes.
- **GAN:** Training a network to understand and generate data.
-

Introduction



- 1.1 What is Artificial Intelligence (AI)?
- 1.2 A brief history
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- 1.4 Applications
- 1.5 Summary



1.3 The State of Art

□ A few tasks of artificial intelligence systems

- Robotic vehicles
- Speech recognition
- Image Understanding
- Robot
- Protein Prediction
- Machine Translation
-



Computer Vision

Nature Language Processing

Speech Signal Processing

AI Game

Bioinformatics

AI- CDSS

.....

1.4 Applications



- 1. Computer Vision
- 2. Nature Language Processing
- 3. Speech Signal Processing
- 4. AI Game
- 5. Bioinformatics
- 6. AI- CDSS (Artificial Intelligence for clinical decision support)
-

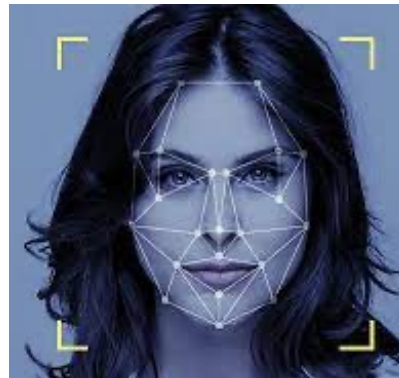
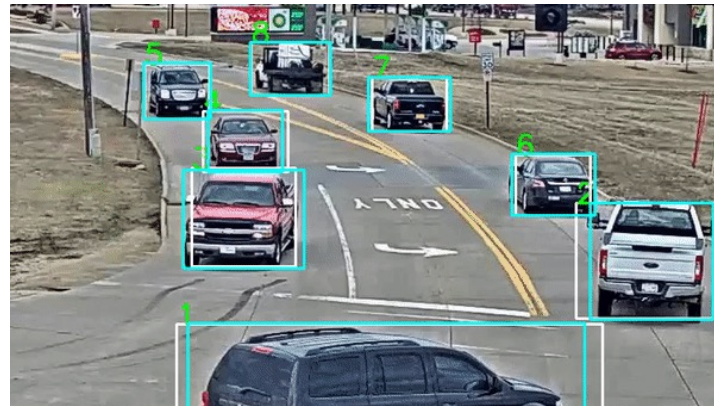
1.4 Applications

- 1. **Computer Vision**
- 2. Nature Language Processing
- 3. Speech Signal Processing
- 4. AI Game
- 5. Bioinformatics
- 6. AI- CDSS (Artificial Intelligence for clinical decision support)
-

1.4 Applications - Computer Vision

AI is used to give human recognition intelligence to machine which is required in Computer Vision field.

- Image Classification
- Image Understanding
- Semantic Segmentation
- Tracking
- Object Detection
- Image Style Transfer
- OCR (optical character recognition);
- Face Recognition
-

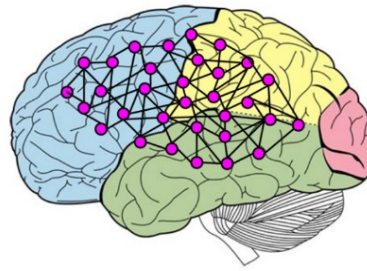
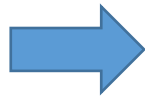


1.4 Applications - Computer Vision

➤ The simplest model in CV.



Image Input



AI Model



Image Classification
Image Understanding
Semantic Segmentation
Tracking
.....

Output for different tasks

➤ Object Detection

R-CNN: *Regions with CNN features*

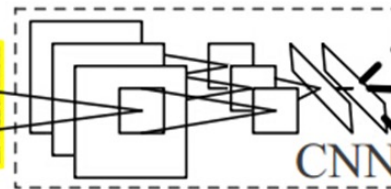


1. Input image

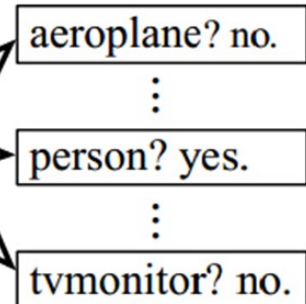


2. Extract region proposals (~2k)

warped region



3. Compute CNN features



4. Classify regions

1.4 Applications - Computer Vision



□ Object Detection

- My real project: flying UAVs detection
- With the rapid development of UAV technology, UAV not only plays an increasingly important role in war, but also brings convenience to people's life.
- Adverse effects, such as drones flying into no-fly zones causing **safety problems**.

Flying UAVs detection is necessary.

1.4 Applications - Computer Vision

□ Object Detection

- My real project: flying UAVs detection



STEP 1: UAVs Recognition, like uav_1, uav_2..

STEP 2: Location by bounding box



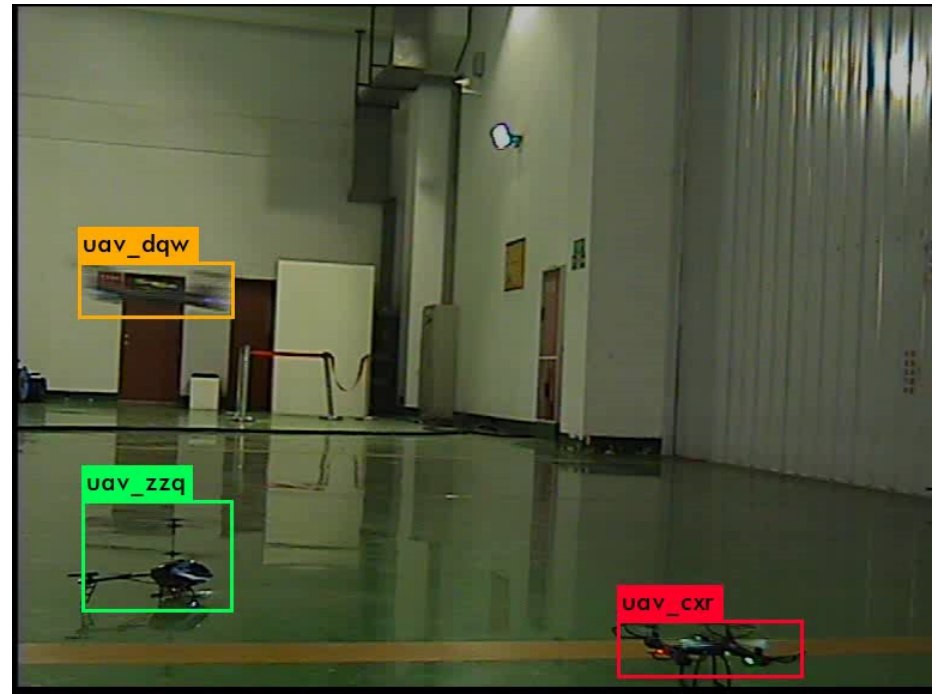
1.4 Applications - Computer Vision

❑ Object Detection

➤ My real project: flying UAVs detection



Input



Detection Output

1.4 Applications

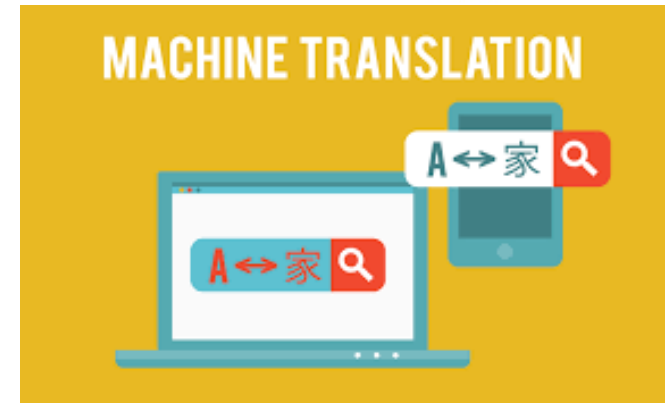


- 1. Computer Vision
- 2. Nature Language Processing
- 3. Speech Signal Processing
- 4. AI Game
- 5. Bioinformatics
- 6. AI- CDSS (Artificial Intelligence for clinical decision support)
-

1.4 Applications - Nature Language Processing

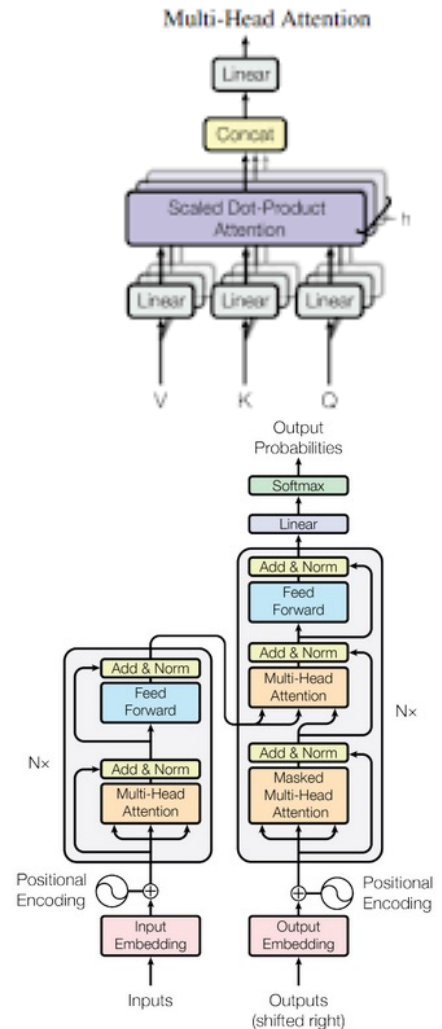
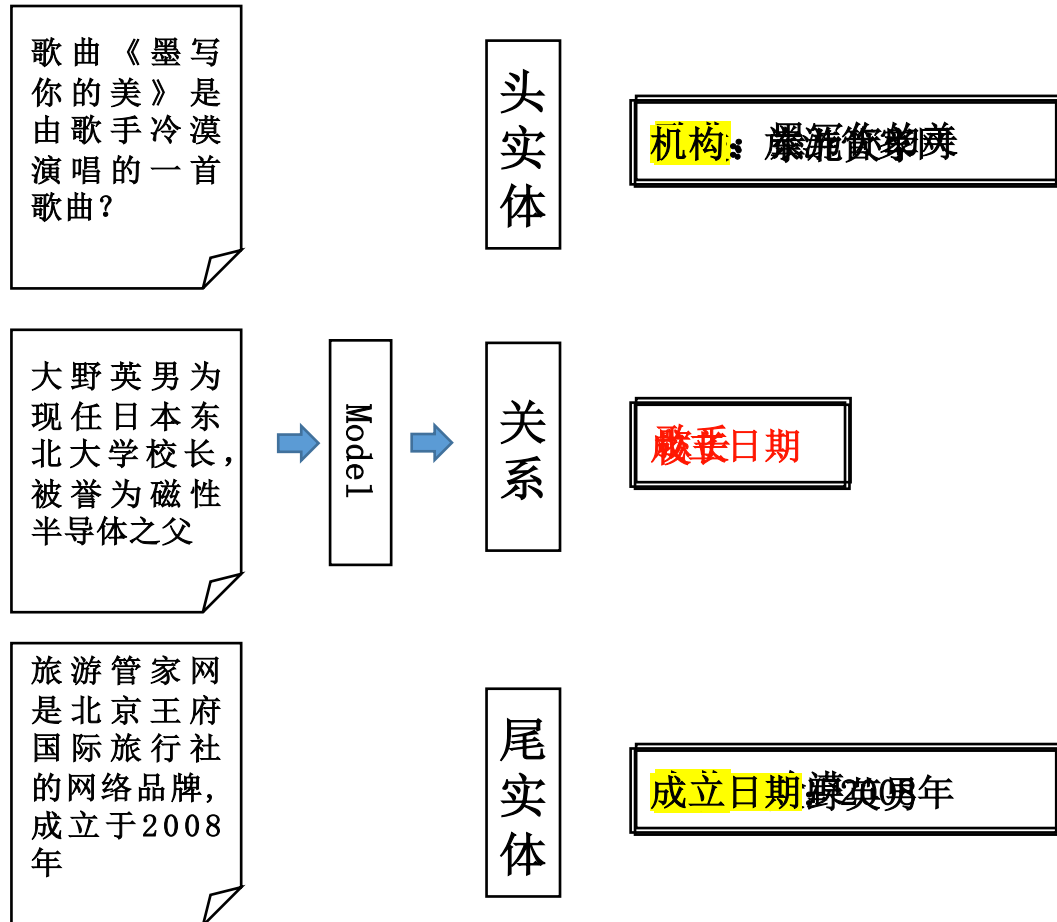
Since development of AI, Natural Language Processing (NLP) has come a long way over the recent years with the advancements in the area of language modelling and ever-increasing computational efforts put in.

- Text Classification
- Information retrieval
- Relation extraction
- Topic modelling
- Machine translation
- **Named Entity Recognition (NER)**
- Text generation
- Text style transfer
-



1.4 Applications - Nature Language Processing

➤ Named Entity Recognition (NER): real project



1.4 Applications

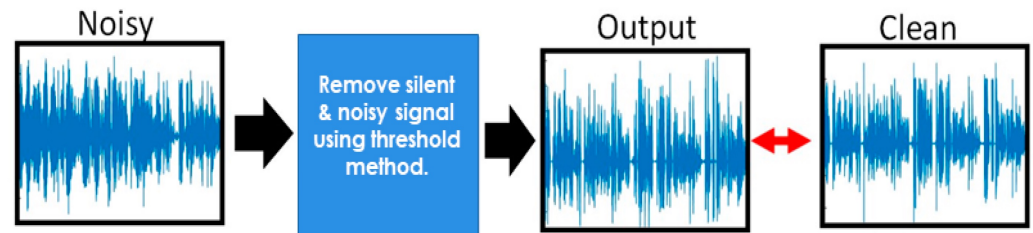
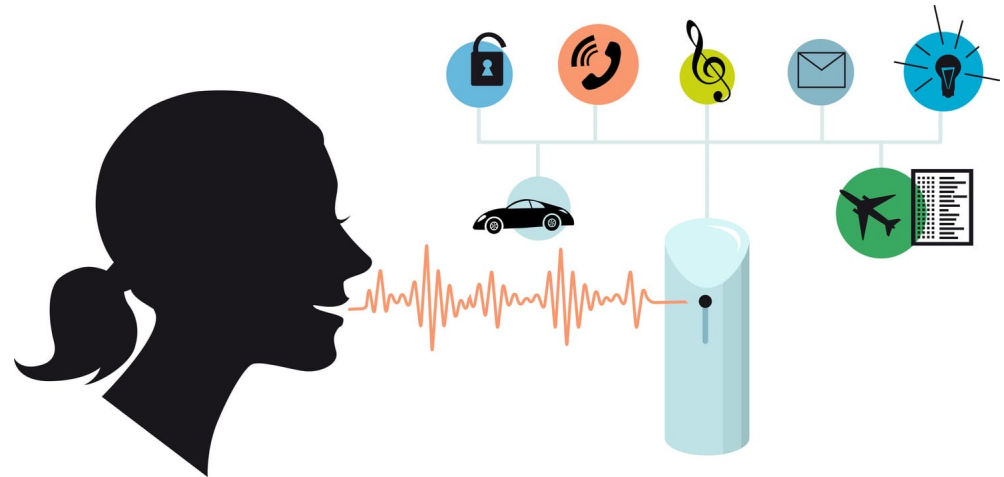


- 1. Computer Vision
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-

1.4 Applications - Speech Signal Processing

The greatest success in speech signal processing has been through AI methods.

- Accent Recognition
- Speaker Identification
- Voiceprint Recognition
- **Speech Recognition**
- Speech Event Detection
- Text-To-Speech
-



1.4 Applications - Speech Signal Processing

□ Speech Recognition



In 2012, Microsoft demonstrated AI-based simultaneous interpretation products!



By the end of 2015, the accuracy rate of simultaneous shorthand products achieve 95%, exceeding the level of human stenographer.

1.4 Applications

- 1. Computer Vision
- 2. Nature Language Processing
- 3. Speech Signal Processing
- 4. AI Game
- 5. Bioinformatics
- 6. AI- CDSS (Artificial Intelligence for clinical decision support)
-

1.4 Applications - AI Game

More and more researchers begin to apply AI methods to games.

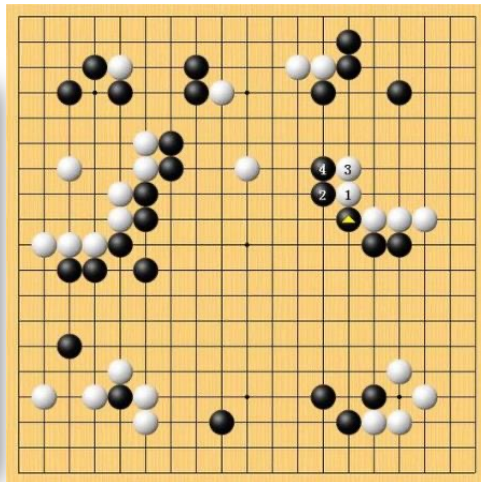
- AlphaGo
- StarCraft (星际争霸) + AI
- Arena Of Valor (王者荣耀) + AI
-



1.4 Applications - AI Game

➤ AlphaGo

In 2016, Google's AlphaGo successfully defeated world champion Lee Sedol with a score of 4 to 1, again promoting the development of AI.



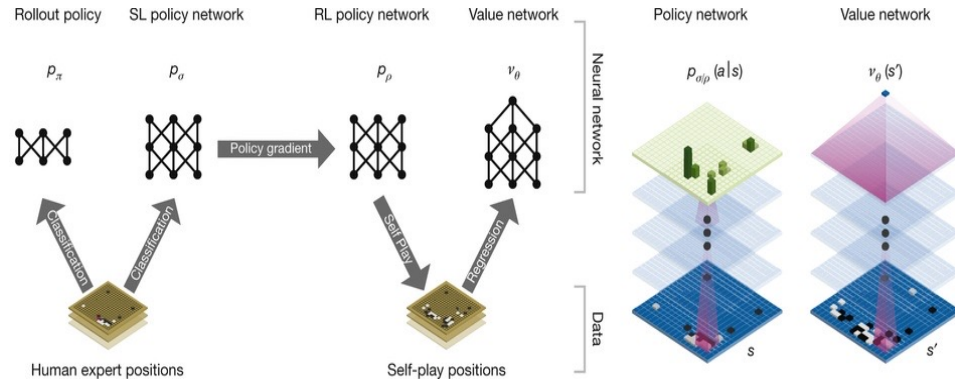
Go (围棋) is a complex board game that requires **intuition, creative and strategic thinking**. It has been long considered as a difficult challenge in the field of AI.

1.4 Applications - AI Game

➤ AlphaGo



- A 19×19 board: about 2×10^{170} legal positions .
- The observable universe: around 10^{80} atoms



| Game size | Board size N | 3^N | Percent legal | Maximum legal game positions (A094777) ^[10] |
|-----------|--------------|------------------------|---------------|--|
| 1×1 | 1 | 3 | 33% | 1 |
| 2×2 | 4 | 81 | 70% | 57 |
| 3×3 | 9 | 19,683 | 64% | 12,675 |
| 4×4 | 16 | 43,046,721 | 56% | 24,318,165 |
| 5×5 | 25 | 8.47×10^{11} | 49% | 4.1×10^{11} |
| 9×9 | 81 | 4.4×10^{38} | 23.4% | 1.039×10^{38} |
| 13×13 | 169 | 4.3×10^{80} | 8.66% | $3.72497923 \times 10^{79}$ |
| 19×19 | 361 | 1.74×10^{172} | 1.196% | $2.08168199382 \times 10^{170}$ |
| 21×21 | 441 | 2.57×10^{210} | | |



1.4 Applications

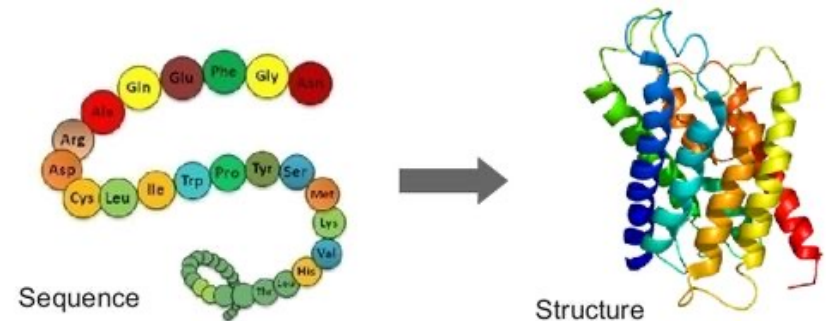
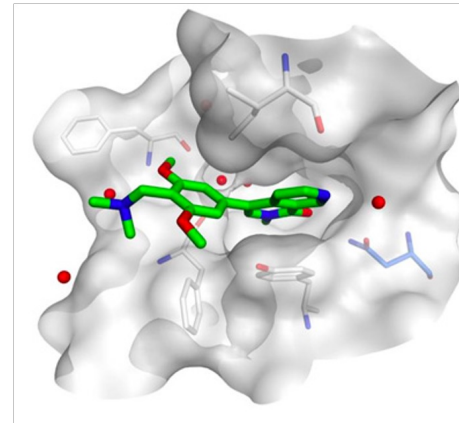


- 1. Computer Vision
- 2. Nature Language Processing
- 3. Speech Signal Processing
- 4. Game AI
- 5. Bioinformatics
- 6. AI- CDSS (Artificial Intelligence for clinical decision support)
-

1.4 Applications - Bioinformatics

“Bioinformatics + AI” is a new and important field of AI in recent years.

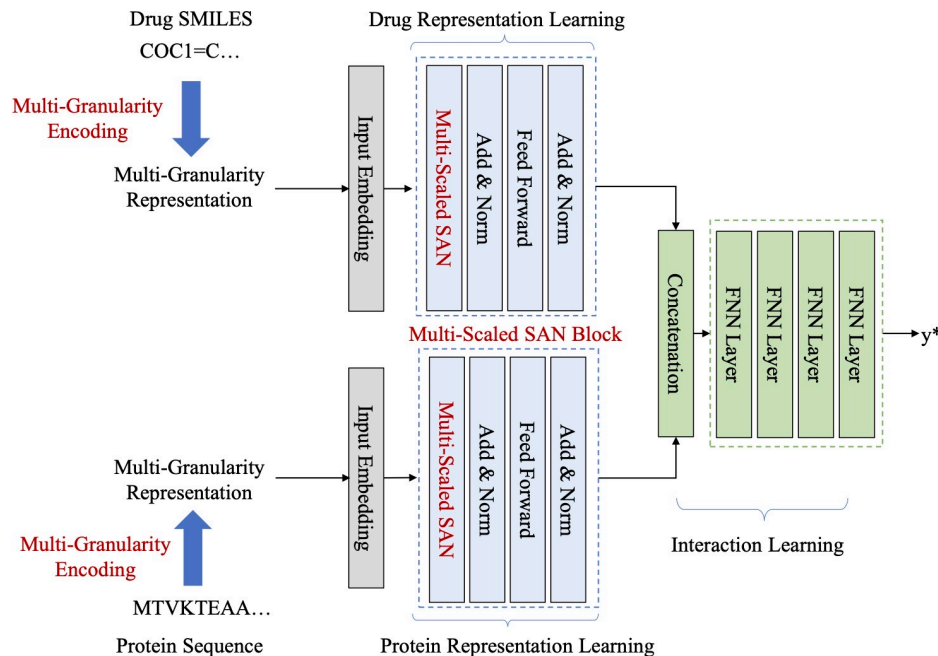
- Drug Discovery
- **Drug-Target Interaction**
- Protein-Protein Interaction
- Drug Generation
- Protein Structure Prediction
- Genome Recognition
- Quantitative Structure–Activity Relationship (QSAR)
-



1.4 Applications - Bioinformatics

➤ Drug-Target Interaction

- Drug-Target Interaction (DTI) prediction plays a crucial role in drug discovery.
- Drug–target interaction (DTI) indicates the binding of drug to their targets.
- My paper as follow: Multi-scaled self-attention for drug– target interaction prediction based on multi-granularity representation



Two Inputs

Regression Model

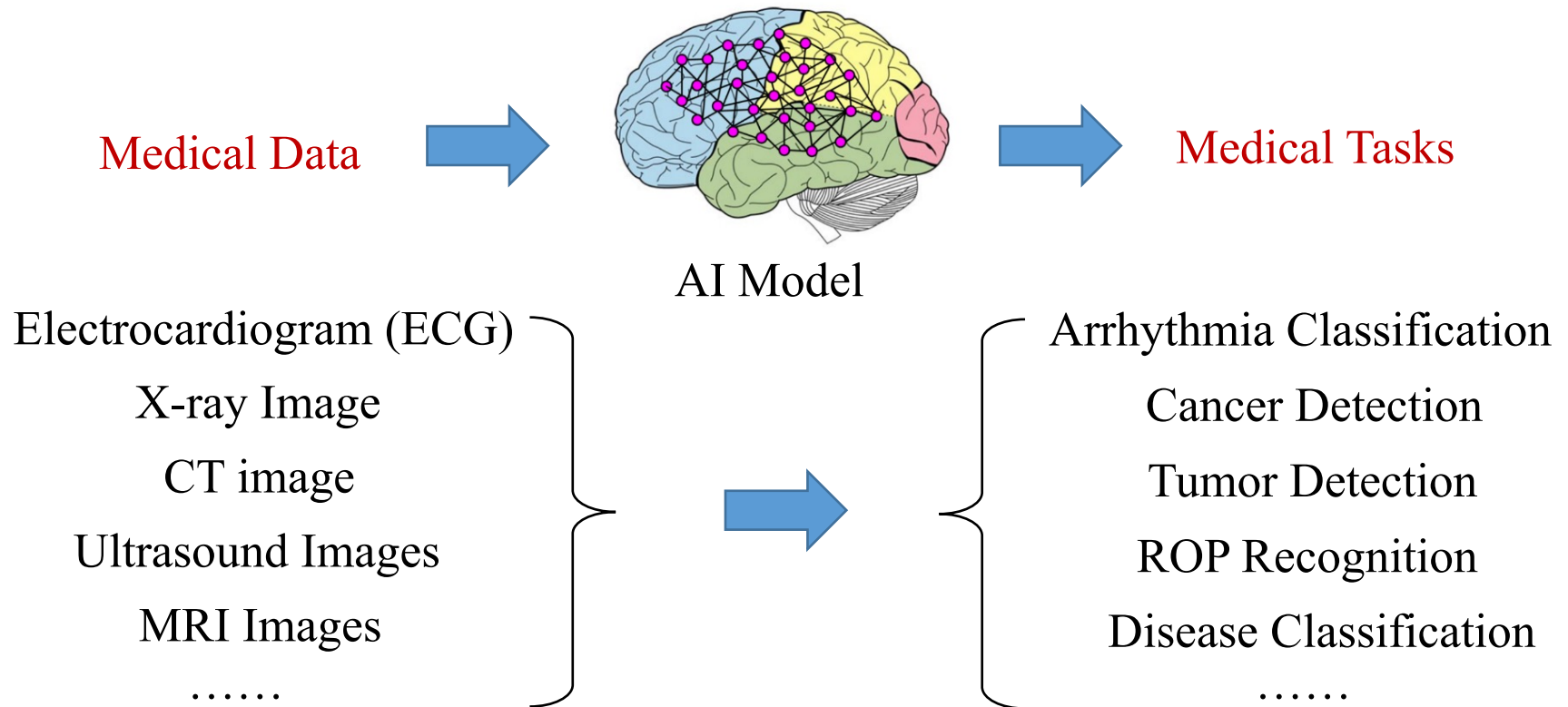
Predict the Binding Affinity Scores

1.4 Applications

- 1. Computer Vision
- 2. Nature Language Processing
- 3. Speech Signal Processing
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- 6. AI- CDSS (Artificial Intelligence for clinical decision support)
-

1.4 Applications - AI- CDSS

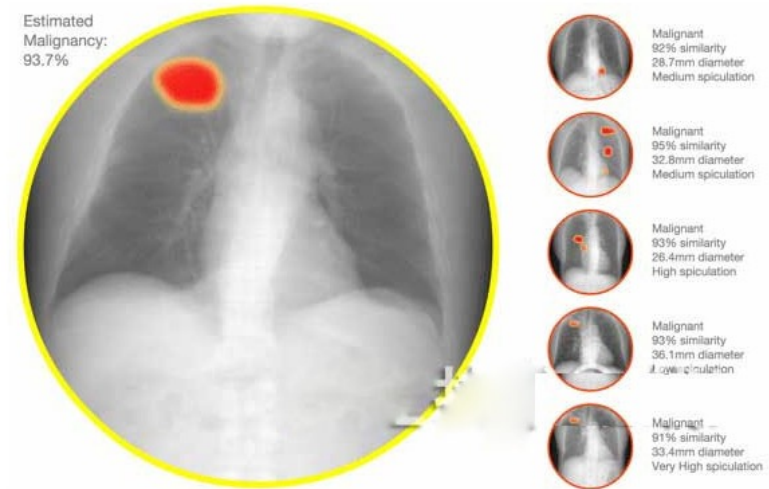
“Medical Data + AI” is another new and important field of AI in recent years.



1.4 Applications - AI- CDSS



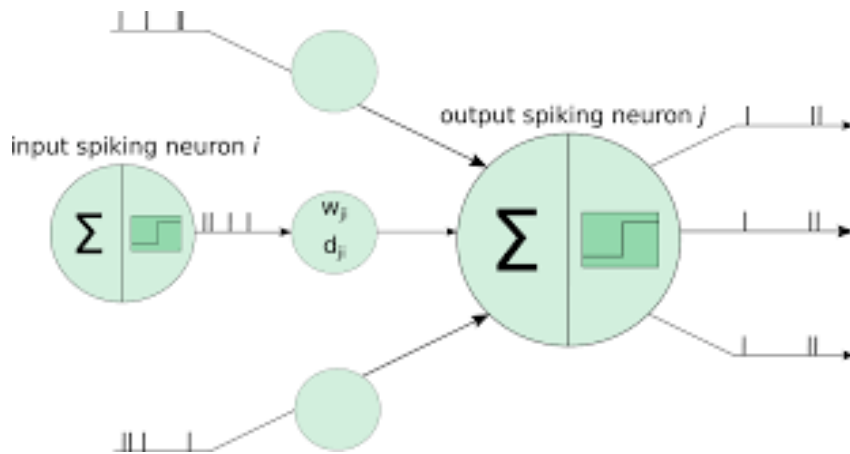
In January 2016, Enlitic developed a cancer detection system based on deep neural network, which is used to find malignant tumors from X-ray, CT scan, ultrasound examination, MRI and other images.



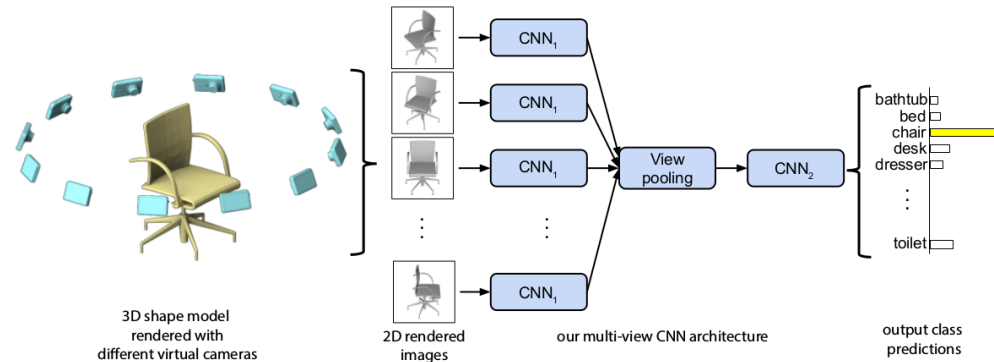
Lung cancer detection rate exceeds radiographer level!

1.4 Applications - Other

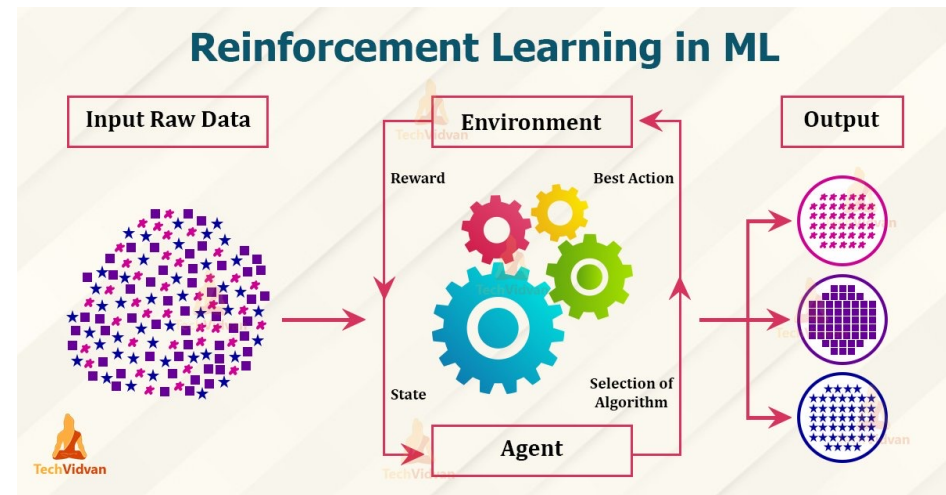
- Many tasks, learning methods, architecture in AI area.



Spiking Neural Network



Multi-view learning



Reinforcement learning

1.1 What is Artificial Intelligence (AI)?

□ What Is Artificial Intelligence?



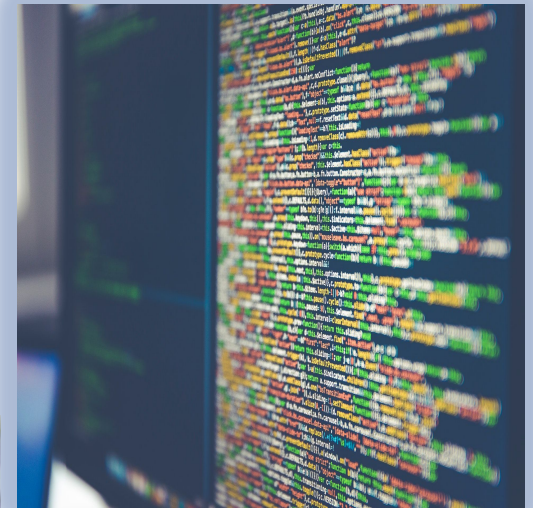
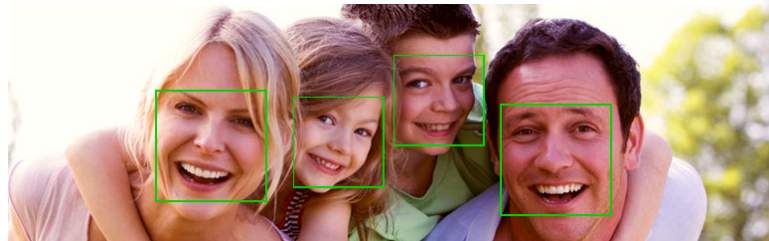
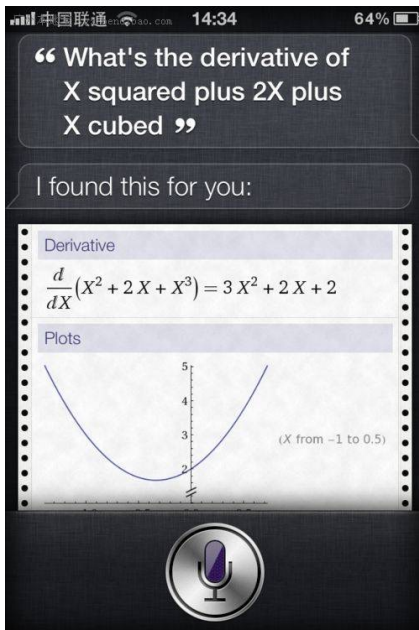
We agree with that:

Intelligence is the ability to **learn** or **understand** or to **deal with** new or trying situations;
the ability to apply knowledge to manipulate one's **environment** or to **think** abstractly.

1.1 What is Artificial Intelligence (AI)?

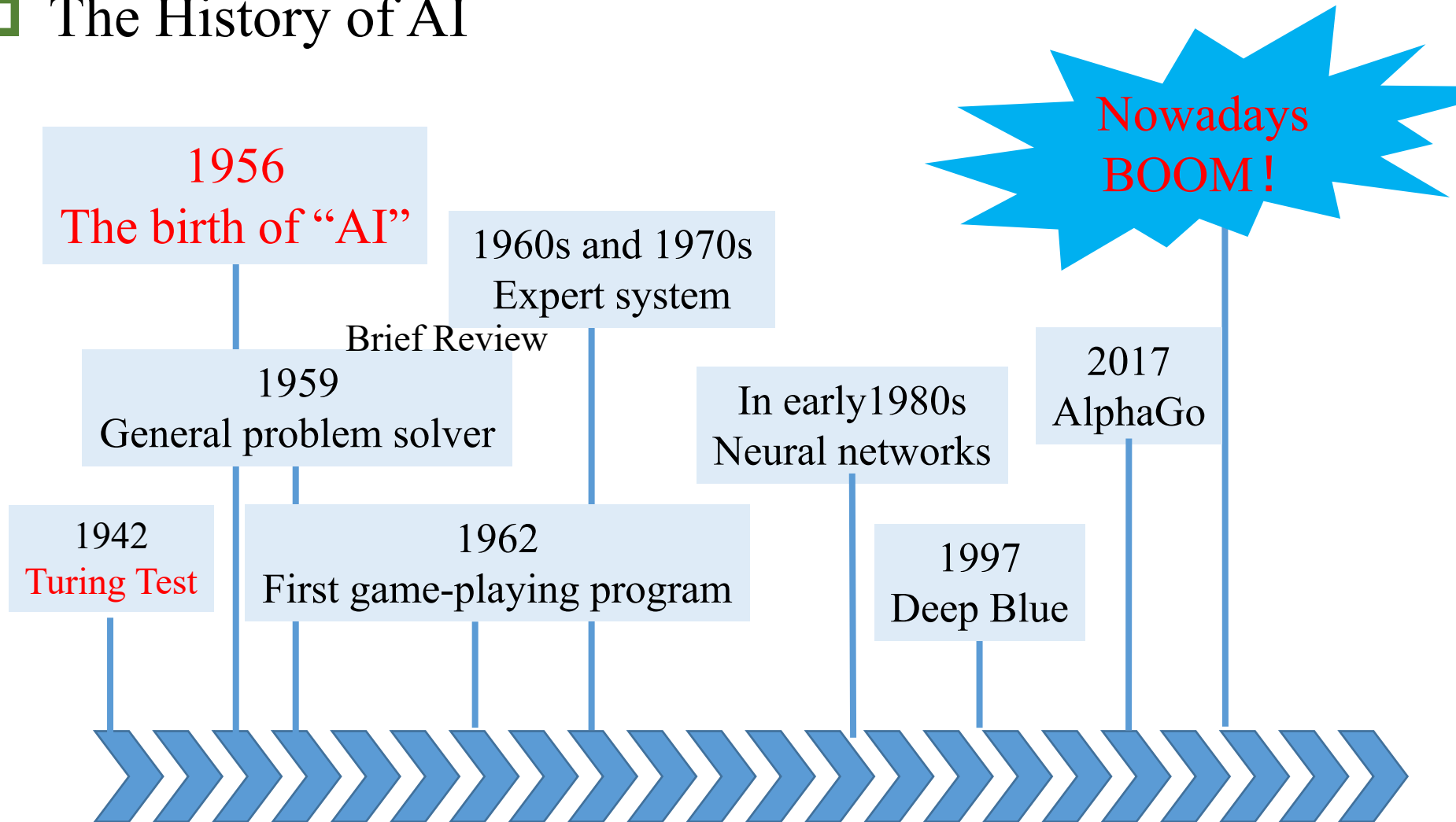
□ What Is Artificial Intelligence?

Actually,
artificial intelligence is **intelligence** exhibited by machines.



1.1 Brief Review

□ The History of AI



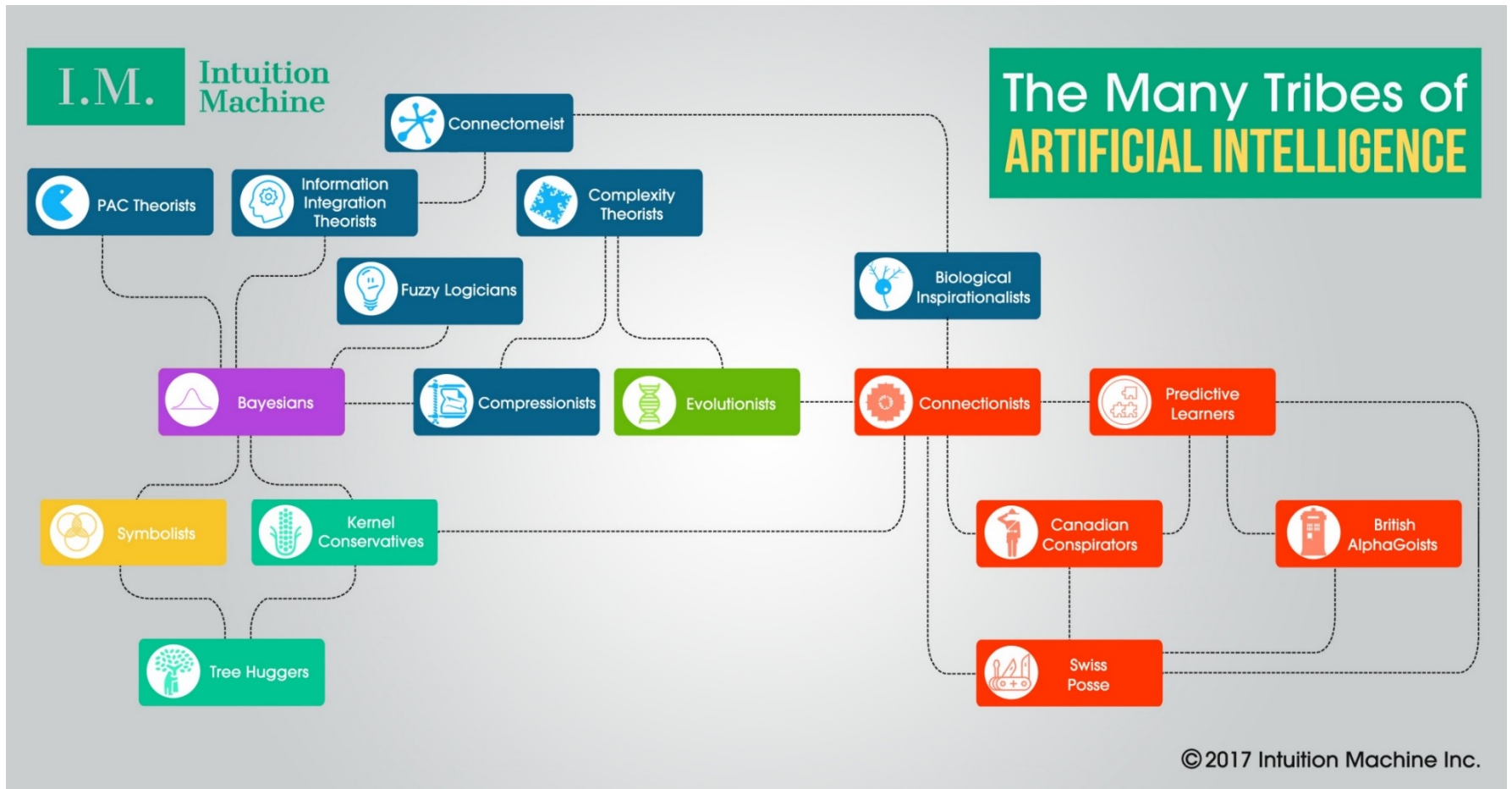
1.1 Brief Review

□ The History of AI



1.1 Brief Review

□ Different TRIBES OF AI



1.2 Different Tribes of AI



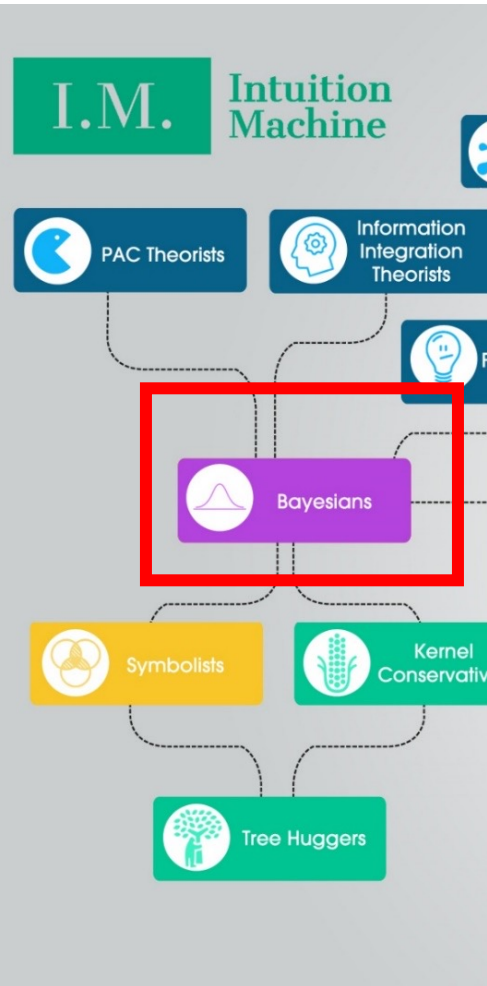
The symbols are '0', '1', ... '9',
'!', '+', '=',

Newell and Simon:

SYMBOL: an entity having a determinable meaning within a formal symbol system.

Symbolists: Folks who used symbolic rule-based systems to make inferences.

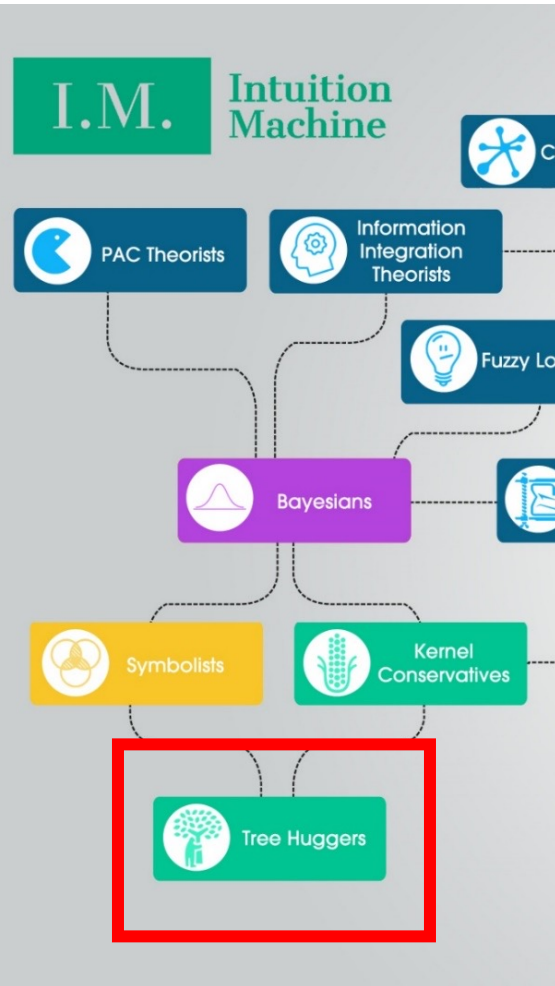
1.2 Different Tribes of AI



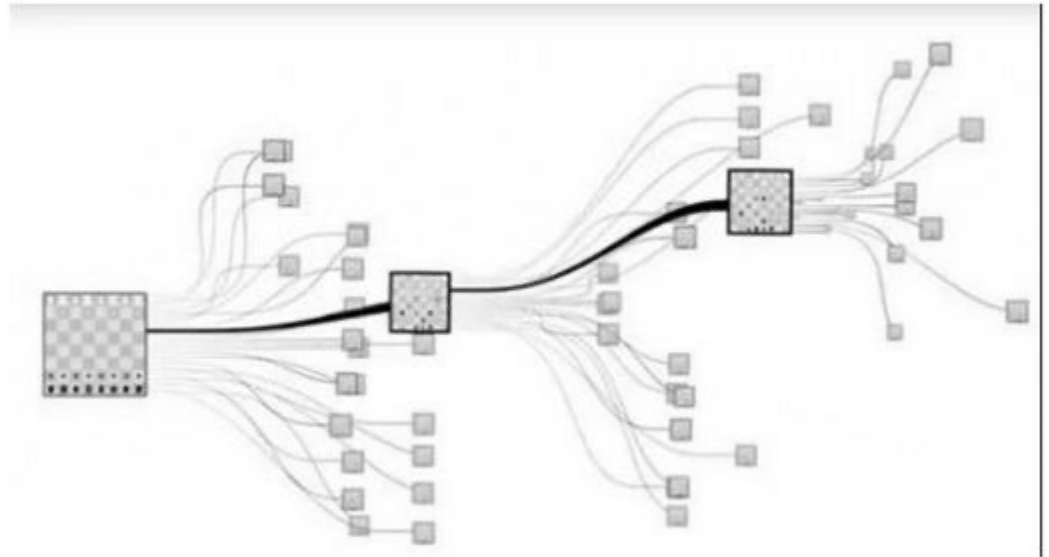
- **Bayesians**—Folks who use probabilistic rules and their dependencies to make inferences.

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

1.2 Different Tribes of AI

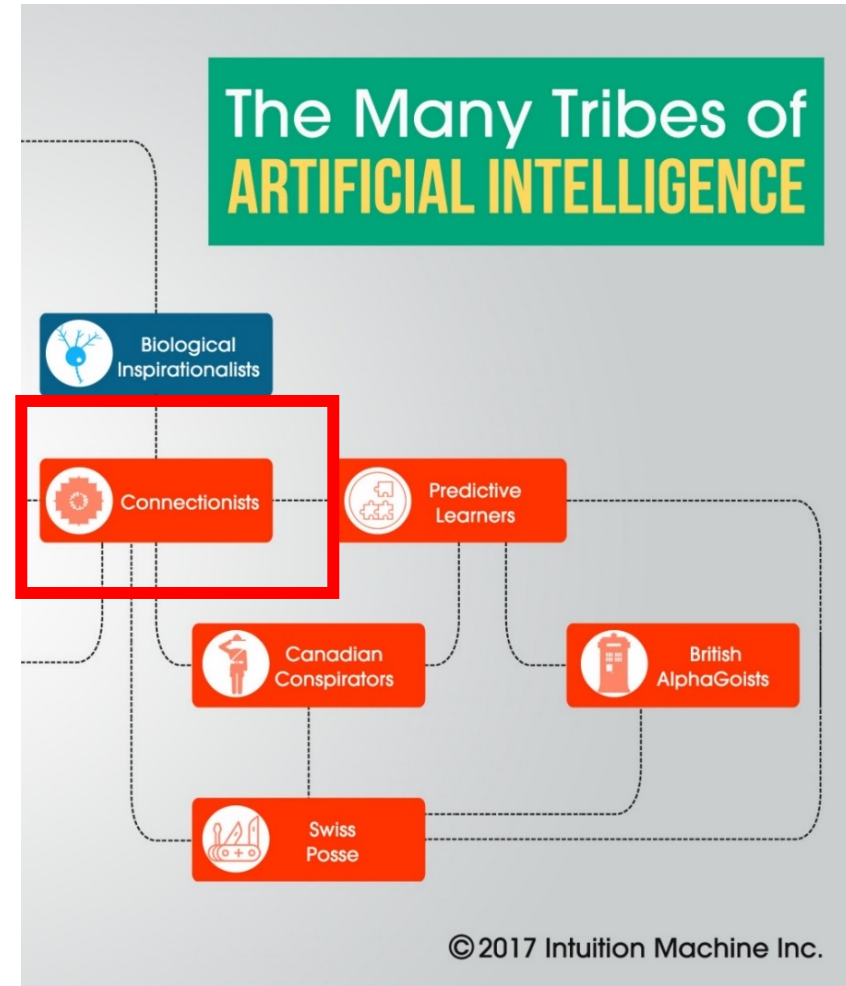
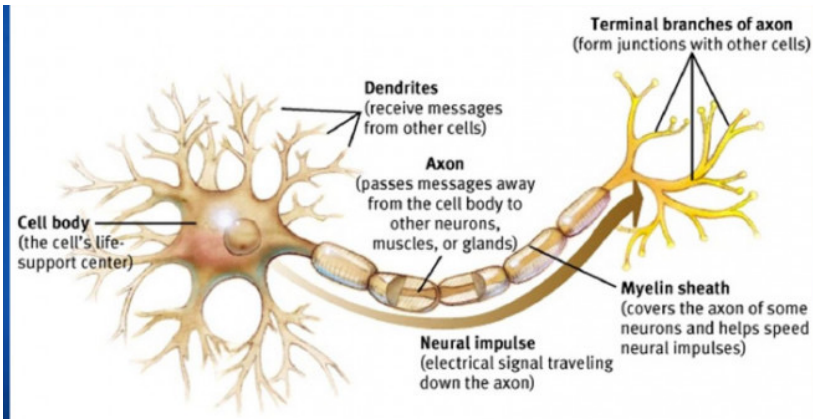


Tree Huggers: Folks who use tree-based models such as Random Forests and Gradient Boosted Decision Trees.



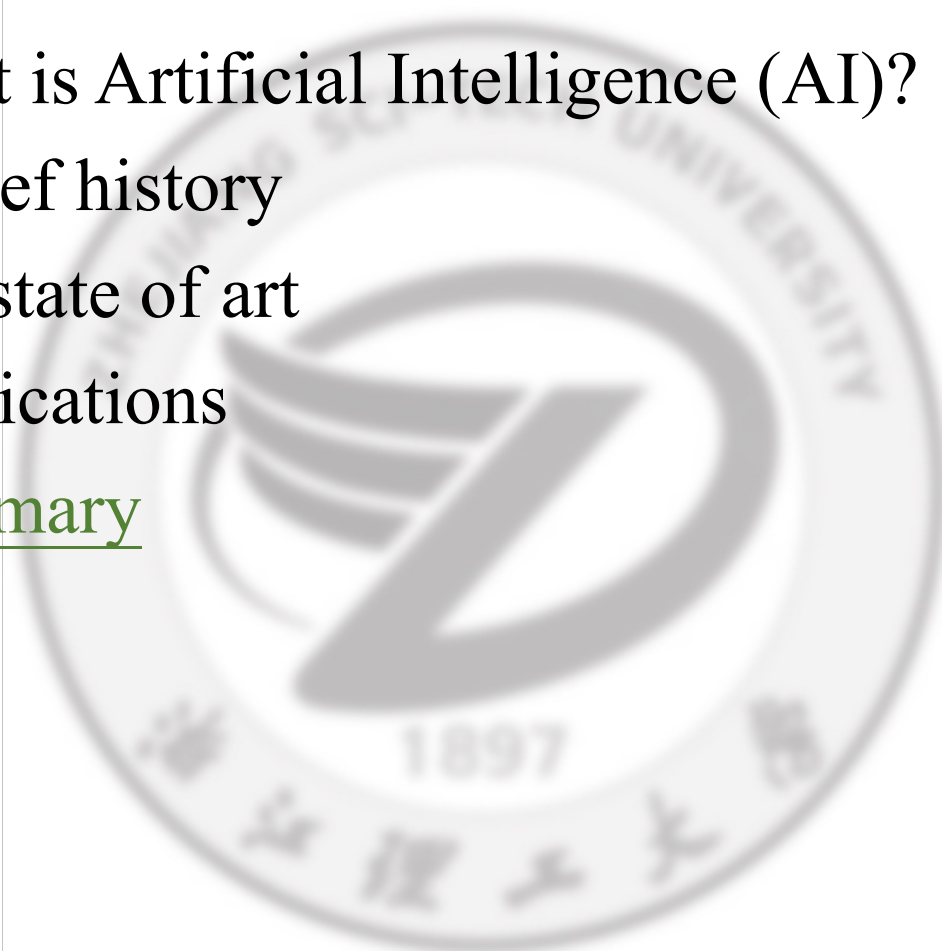
1.2 Different Tribes of AI

Connectionists—Folks who believe that intelligent behavior arises from simple mechanisms that are highly interconnected.



Chapter 1 Introduction

- 1.1 What is Artificial Intelligence (AI)?
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1.4 Summary



□ Summary

- Artificial intelligence is **intelligence** exhibited by machines.
- It is very difficult to find out a single definition for intelligence.
- **Intelligence is** the ability to learn or understand or to deal with new or trying situations; the ability to apply knowledge to manipulate one's environment or to think abstractly.
- Introduce many applications in field of AI.
- The Different Tribes of AI

Thanks!