Overview of Artificial Intelligence

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Objectives

Upon completion of this lecture, you will be able to:

- Understand basic concepts of artificial intelligence (AI).
- Understand AI technologies and their development history.

AI in the Eyes of Society

People get to know AI through news, movies, and actual applications in daily life. What is AI in the eyes **of the public**?

AI in the Eyes of Society

China's first AI theme park opens in Beijing
http://www.xinhuanet.com/english/2018-11/05/c_137583314.htm

Artificial Intelligence Generated Artwork Sells for $432,500
https://scitechdaily.com/artificial-intelligence-generated-artwork-sells-for-432500-is-ai-a-simple-tool-or-creative-genius/

The AI That Has Nothing to Learn From Humans
https://www.theatlantic.com/technology/archive/2017/10/alphago-zero-the-ai-that-taught-itself-go/543450/

Will artificial intelligence take over the world?
https://www.irishtimes.com/special-reports/artificial-intelligence/will-artificial-intelligence-take-over-the-world-1.4095345

AI in the Eyes of Society

The Terminator

The Matrix

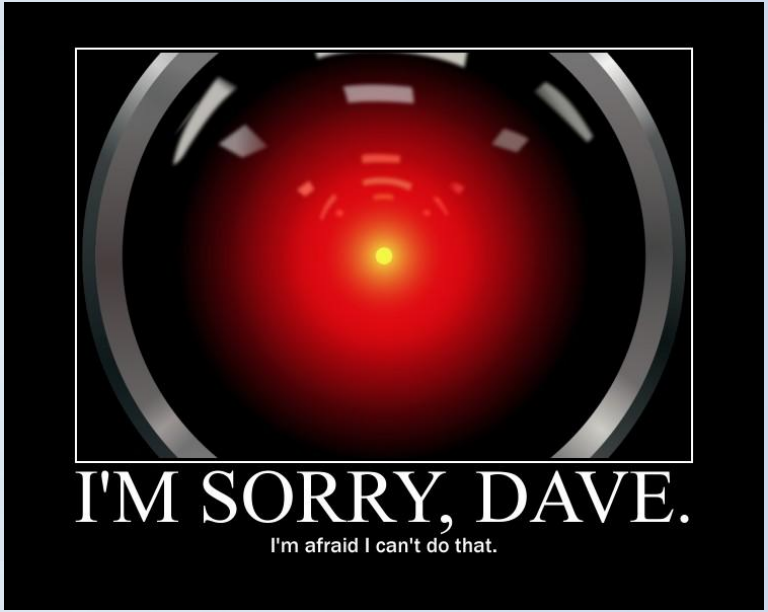
2001: A Space Odyssey

A.I. Artificial Intelligence

I, Robot

Bicentennial Man

Ex Machina



AI in the Eyes of Society

Music/Movie recommendation

Smart speaker

Vacuum cleaning robot

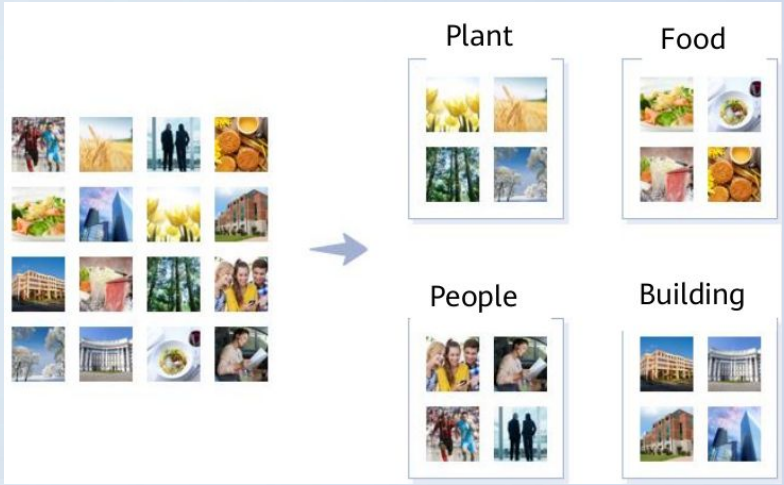
Machine translation

Face recognition

Optical character recognition

Smart album

Question answering bot



AI in the Eyes of Researchers

I propose to consider the question, 'Can machines think?'

— Alan Turing, 1950

The branch of computer science concerned with making computers behave like humans.

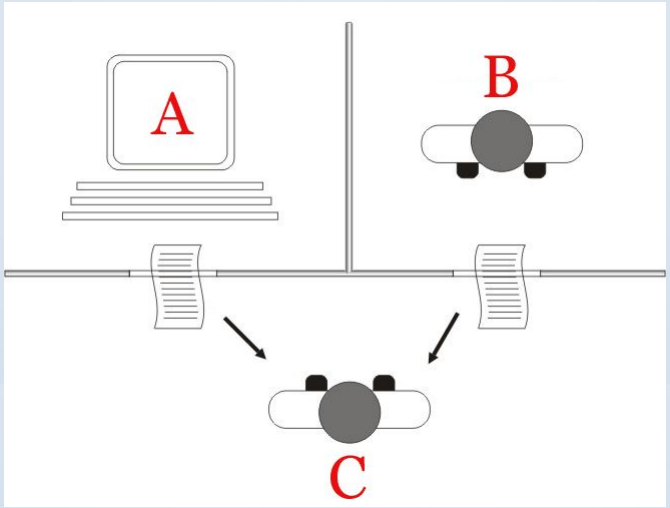
— John McCarthy, 1956

The science of making machines do things that would require intelligence if done by men.

— Marvin Minsky, 1968

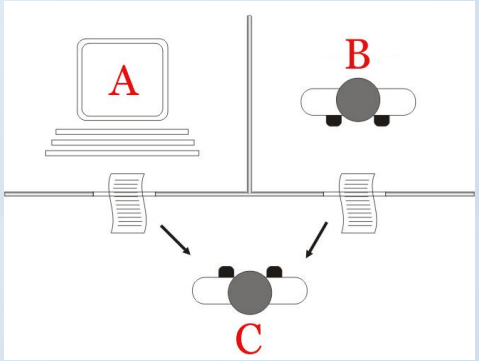
Turing Test

It is a test proposed by **Alan Turing in 1950** for determining whether or not a machine is capable of **exhibit intelligent behaviour** indistinguishable from that of a human.



Turing Test

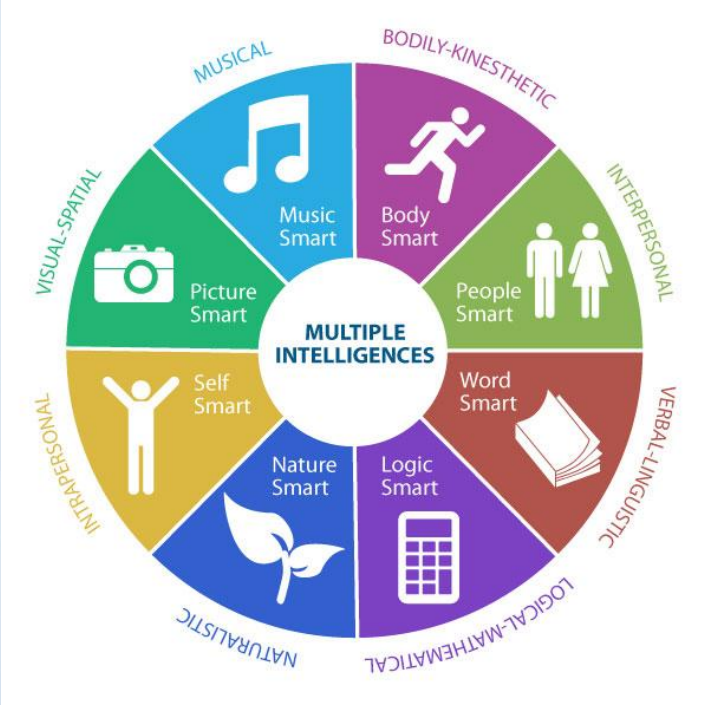
- A human evaluator would judge natural language conversations between a human and a machine.
- All participants would be separated from one another and the conversation would be limited to a text-only channel.
- If the evaluator cannot reliably tell the machine from the human, the machine is said to have passed the test.



What are Intelligences?

Howard Gardner's Multiple Intelligences can be divided into seven categories:

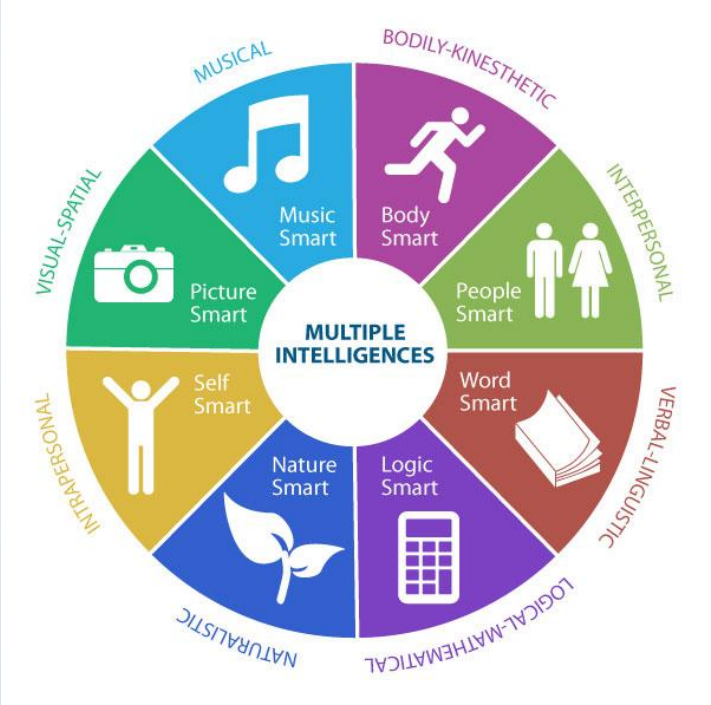
- Verbal/Linguistic
- Logical/Mathematical
- Visual/Spatial
- Bodily/Kinesthetic



What are Intelligences?

Howard Gardner's Multiple Intelligences can be divided into seven categories:

- Musical/Rhythmic
- Interpersonal/Social
- Intra-personal/Introspective

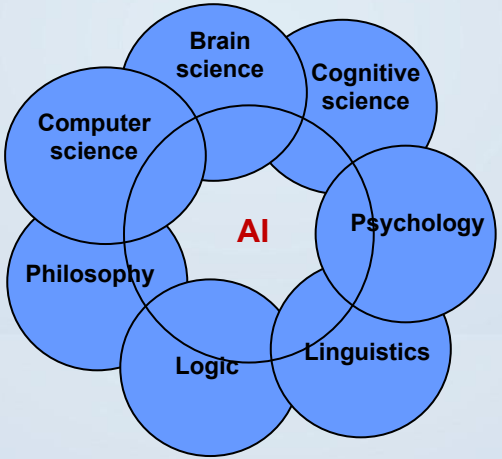


What is Artificial Intelligence?

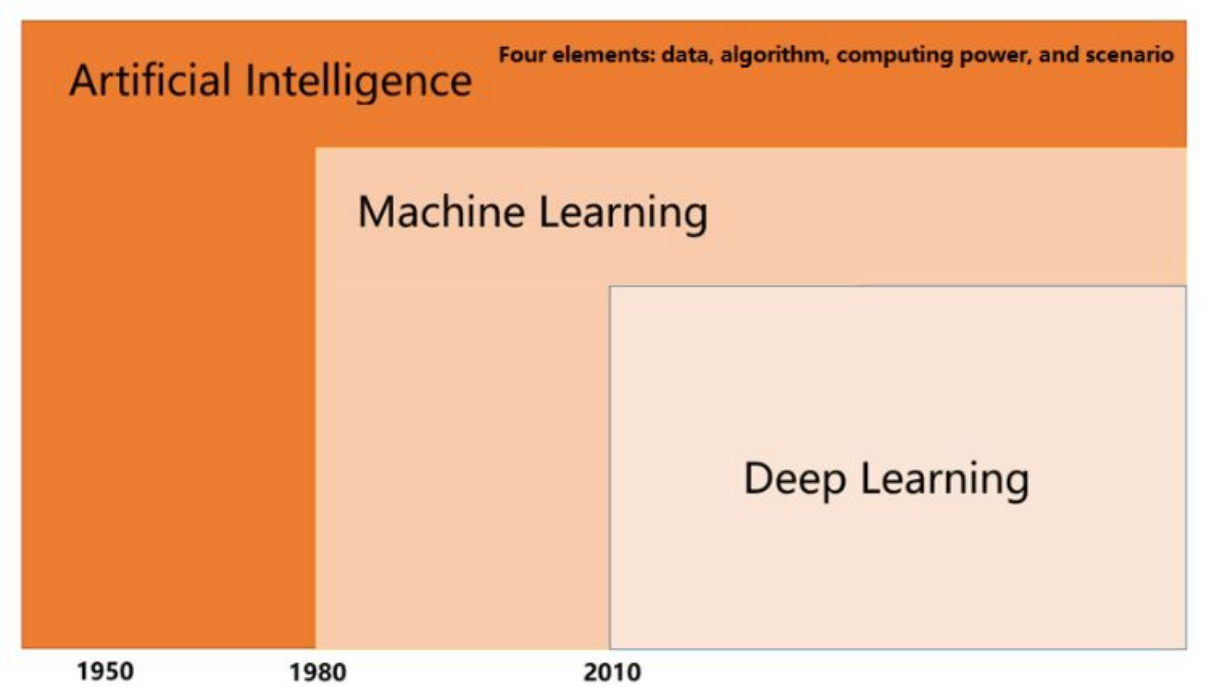
- AI is a new technical science that studies and develops theories, methods, techniques, and application systems for **simulating and extending human intelligence**.
- In 1956, the concept of AI was first proposed by John McCarthy, who defined the subject as "science and engineering of making intelligent machines, especially intelligent computer program".

What is Artificial Intelligence?

- AI is concerned with making machines work **in an intelligent way**, similar to the way that the human mind works.
- At present, AI has become an interdisciplinary course that involves **various fields**.



Relationship of AI, ML and DL



Relationship of AI, ML and DL

Artificial Intelligence focuses on the research and development of theories, methods, techniques, and application systems for **simulating and extending human intelligence**.

Relationship of AI, ML and DL

Machine learning is a core research field of AI.

It focuses on the study of how computers can obtain new knowledge or skills by **simulating or performing learning behavior** of human beings, and reorganize existing knowledge architecture to improve its performance.

Relationship of AI, ML and DL

Deep learning is a new field of machine learning.

- The concept of deep learning originates from the research on artificial neural networks.
- The multi-layer perceptron (MLP) is a type of deep learning architecture.
- Deep learning aims to simulate the human brain to interpret data such as images, sounds, and texts.

Three Major Schools of Thought

Symbolism

- The cognitive process of human beings is the **process of inference and operation of various symbols**.
- A human being is a physical symbol system, and so is a computer. Computers, therefore, can be used to simulate intelligent behavior of human beings.
- The core of AI lies in **knowledge representation and knowledge inference**. Knowledge and concepts **can be represented with symbols**.

Three Major Schools of Thought

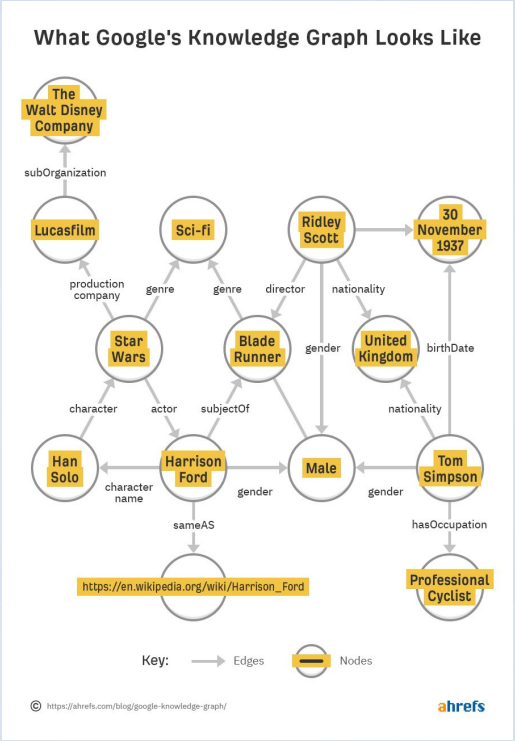
Symbolism

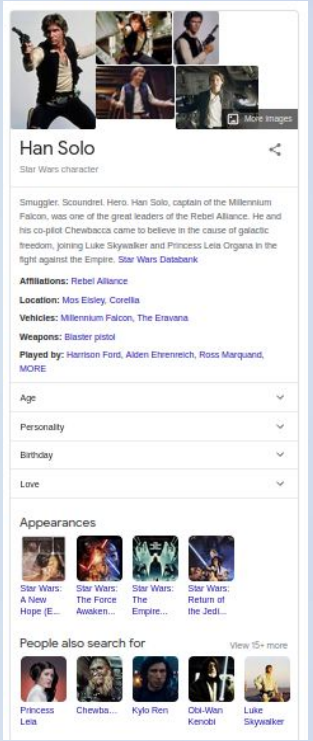
if the infection is meningitis **and** the type of infection is bacterial **and** the patient has undergone surgery **and** the surgery-time was < 2 months ago **and** the patient got a ventricular-urethral-shunt **then** infection = e.coli **or** klebsiella(.85)

Three Major Schools of Thought

Representative of symbolism:

- Logic;
- Symbolic inference;
- Automated reasoning;
- Expert Systems;
- Machine reasoning;
- Knowledge representation;
- Knowledge graphs.





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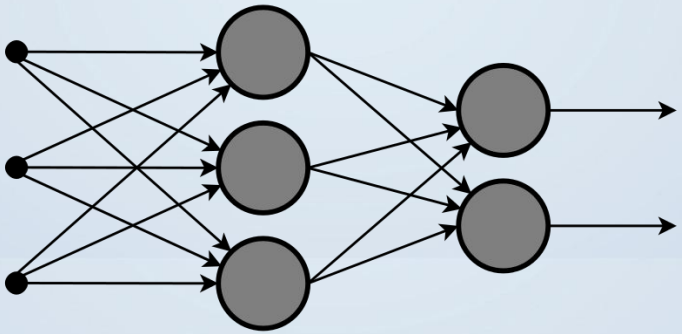
Three Major Schools of Thought

Connectionism

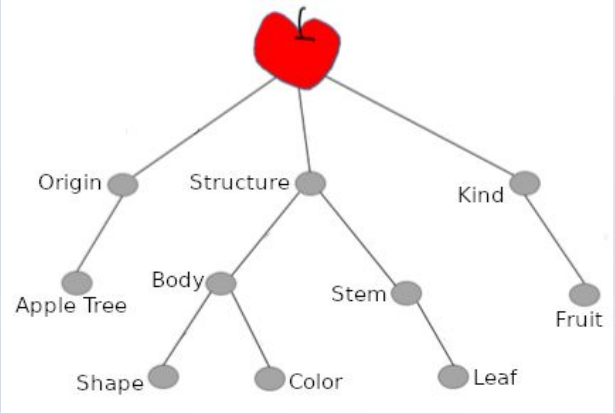
- **Neurons** rather than the process of symbol processing.
- It is derived from studies of the **human brain model**.



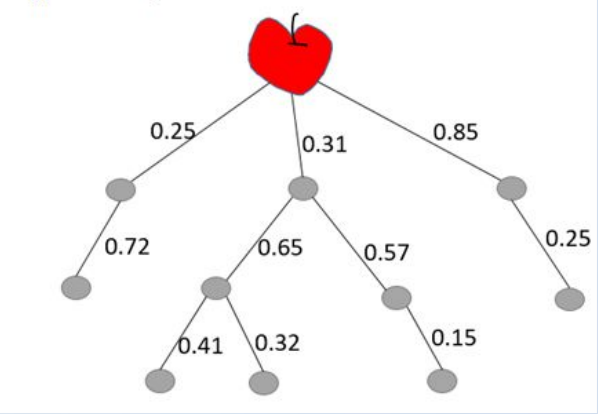
Three Major Schools of Thought

Connectionism

- A concept is represented by a set of numbers, vectors, or matrices.
- Each node, without specific meaning, plays its role in the representation of the concept.



Symbolism



Connectionism

Three Major Schools of Thought

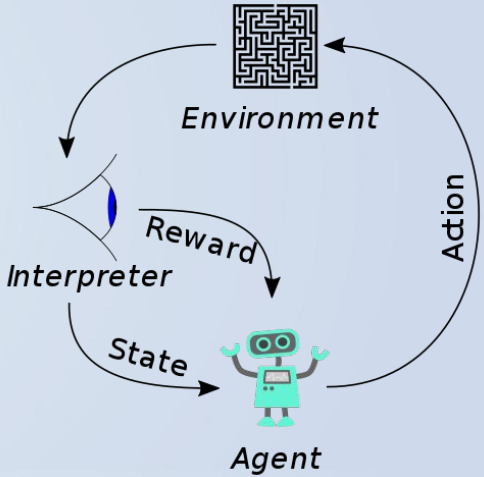
Representative of connectionism:

- Neural networks;
- Deep learning.

Three Major Schools of Thought

Behaviorism

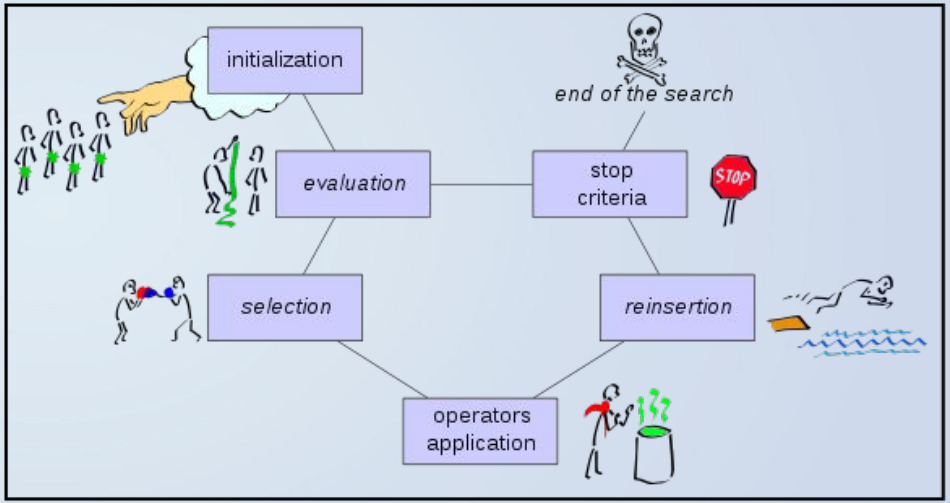
- Intelligence depends on **perception and action**.
- Intelligence requires no knowledge, representation, or inference.
- AI can **evolve** like human intelligence.
- Intelligent behavior can only be demonstrated in the real world through the constant **interaction** with the surrounding environment.
- It concerns more about how to learn from the environment **continuously** to make corrections.



Three Major Schools of Thought

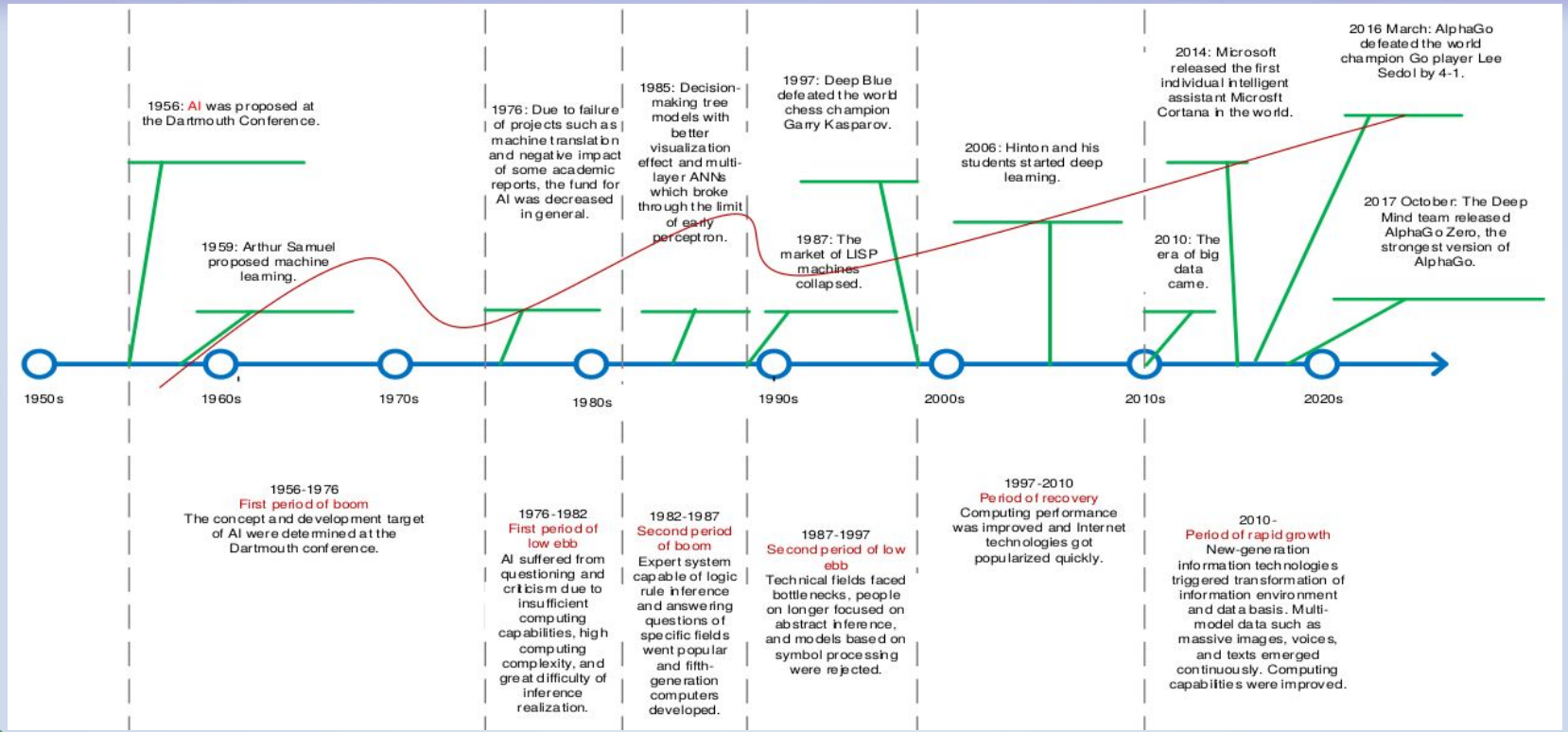
Representative of behaviorism:

- Adaptation;
- Evolutionary computing;
- Genetic algorithms;
- Reinforcement Learning.



General schema of an Evolutionary Algorithm (EA)

Brief Development History of AI



Types of AI: Strong AI

- The strong AI view holds that it is possible to create intelligent machines that can **really reason and solve problems**.
- Such machines are considered to be **conscious and self-aware**
  - can **independently** think about problems and work out optimal solutions to problems;
  - have their own **system of values** and **world views**;
  - and have all the same instincts as living things, such as **survival** and **security** needs.
- It can be regarded as a new civilization in a certain sense.

Types of AI: Weak AI

- The weak AI view holds that intelligent machines **cannot really** reason and solve problems.
- These machines **only look** intelligent, but **do not have real** intelligence or **self-awareness**.

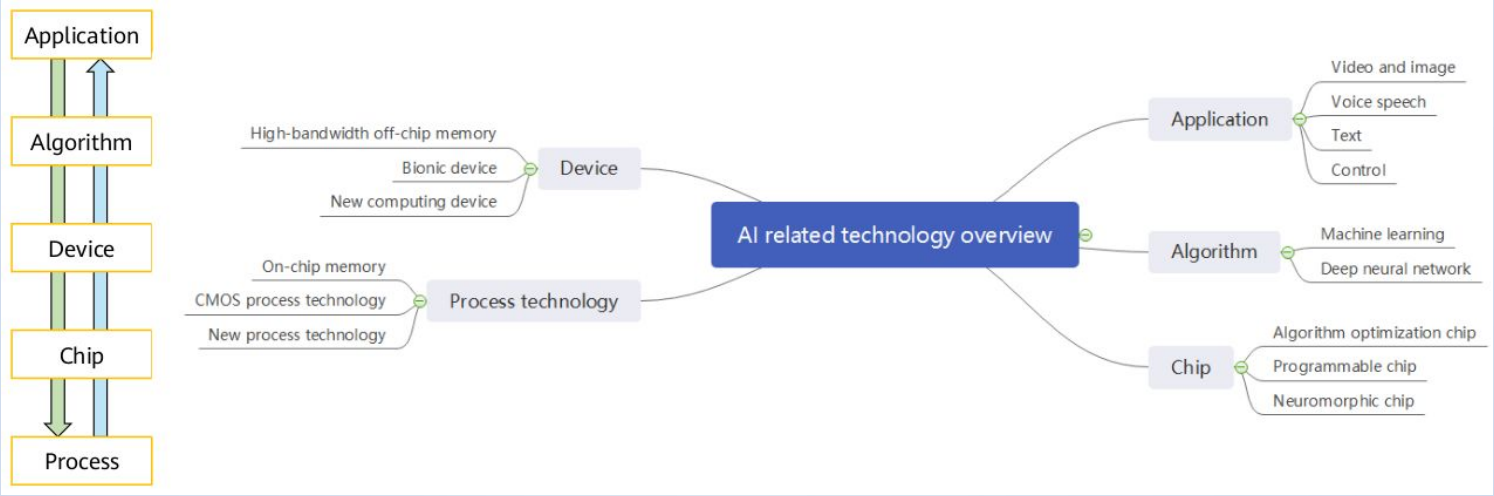
Classification of Intelligent Agents

- **Thinking like human beings**: weak AI, such as Watson and AlphaGo.
- **Acting like human beings**: weak AI, such as humanoid robot and Atlas of Boston Dynamics.
- **Thinking rationally**: strong AI.
- **Acting rationally**: strong AI.

	Human-like behavior	Rational behavior
Reasoning	Systems that think humanly	Systems that think rational
Acting	Systems that act humanly	Systems that act rational

Overview of AI Technologies

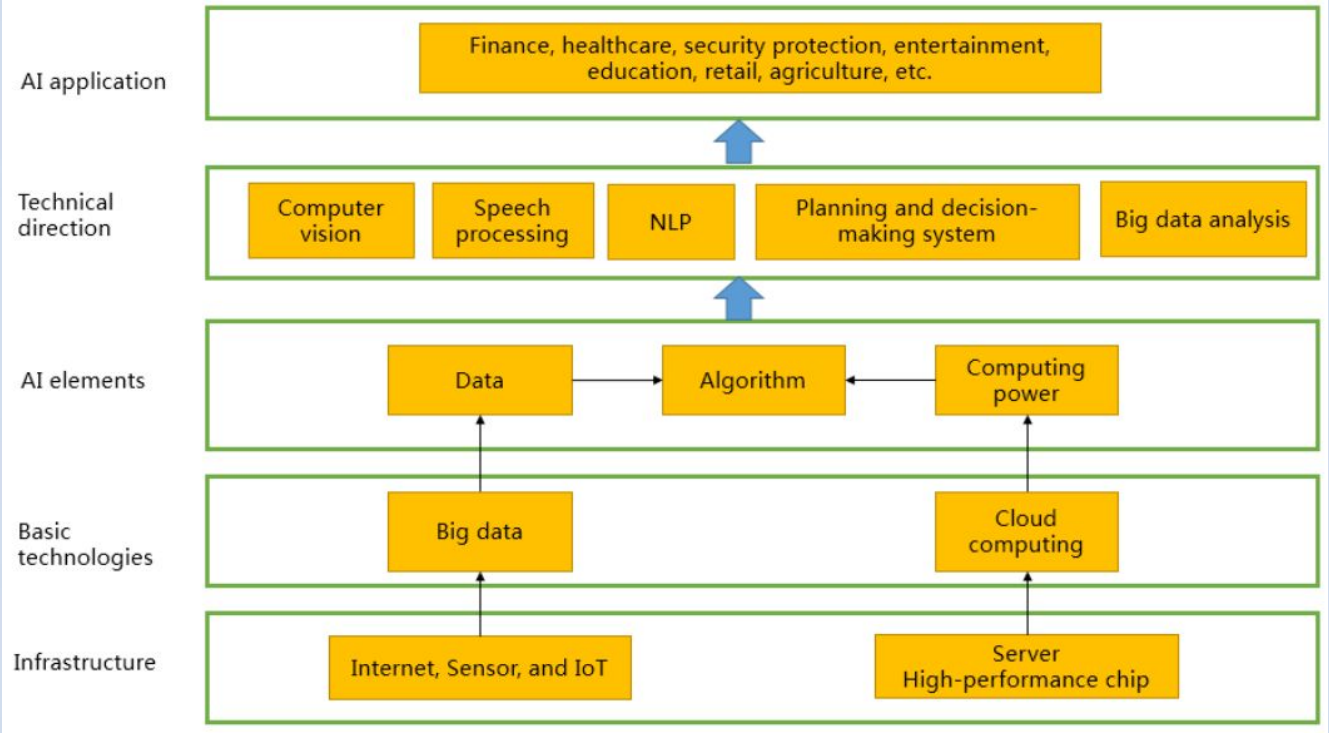
- The rapid development of applications and algorithms, especially deep learning, raises performance optimization requirements for AI chips, which has triggered the upsurge of AI chip R&D in recent years.



AI Industry Ecosystem

- The four elements of AI are **data, algorithm, computing power, and scenario**.
- To meet requirements of these four elements, we need to combine AI with cloud computing, big data, and IoT to build an intelligent society.

AI Industry Ecosystem



Subfields of AI