

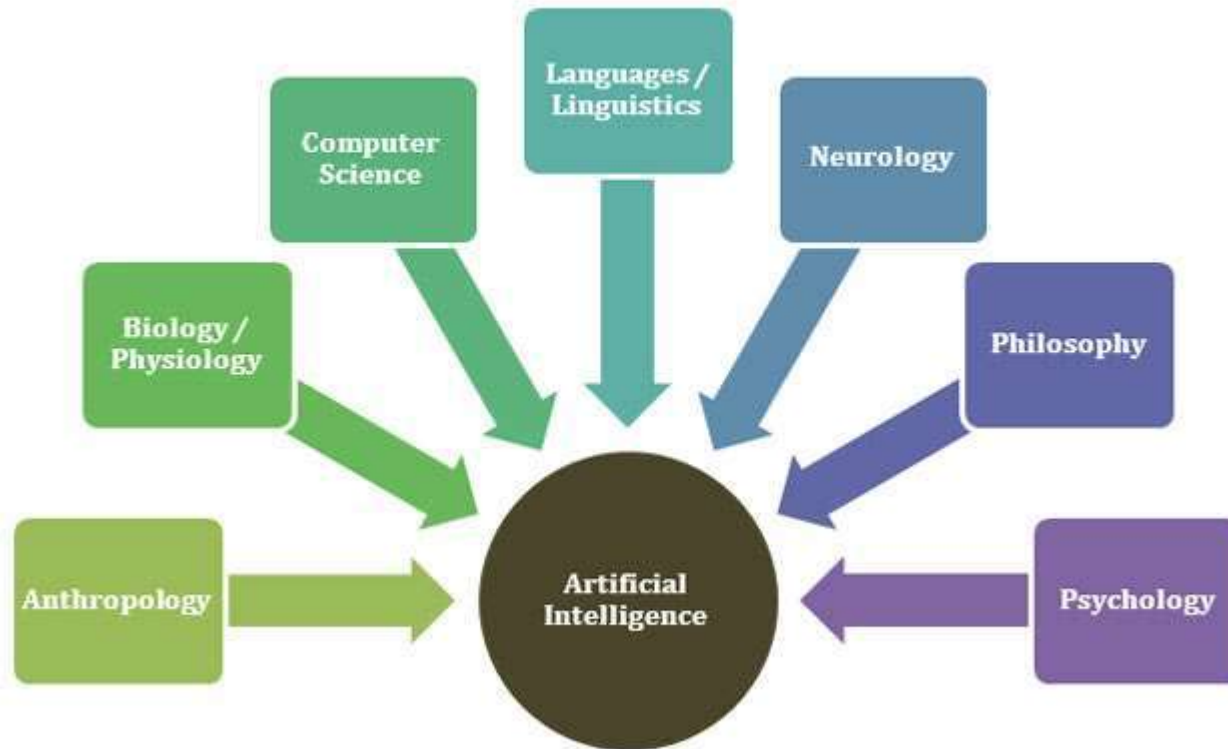
Artificial Intelligence

Lecture-2

- **Introduction to AI**
 - ▶ Foundations of Artificial Intelligence
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The Foundations of AI...

The Multiple Disciplines that contribute to A. I.



The Foundations of AI...

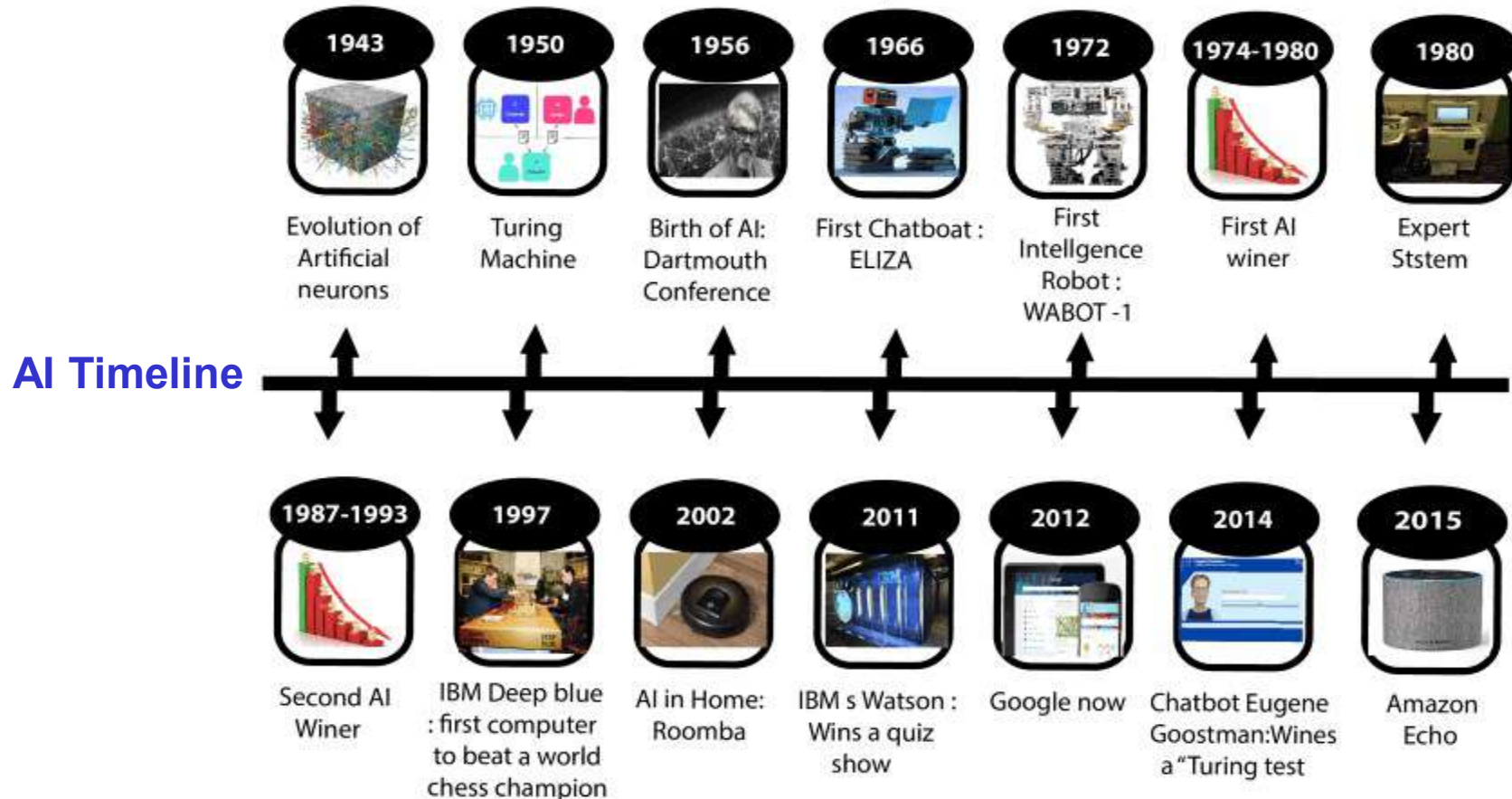
- The following is a brief history of the disciplines that contributed ideas, viewpoints, and techniques to AI:
- **Philosophy** (428 B.C - Present): Can formal rules be used to draw valid conclusions?
 - ▶ Logic, methods of reasoning, mind as physical system foundations of learning, language, rationality
- **Mathematics** (C. 800 – Present): What are the formal rules to draw valid conclusions? What can be computed?
 - ▶ Formal representation and proof algorithms, computation, (un)decidability, (in)tractability, probability
- **Economics** (1776 - Present): How should we make decisions so as to maximize payoff?
 - ▶ utility, decision theory

The Foundations of AI

- **Neuroscience (1861 - Present):** The study of the nervous system, particularly the brain. How do brains process information?
 - ▶ physical substrate for mental activity
- **Psychology (1879 - Present):** How do humans and animals think and act?
 - ▶ phenomena of perception and motor control, experimental techniques
- **Computer engineering (1940 - Present):** How can we build an efficient computer?
 - ▶ building fast computers
- **Control theory and Cybernetics (1948 – Present):** How can artifacts operate under their own control?
 - ▶ design systems that maximize an objective function over time
- **Linguistics (1957 - Present):** How does language relate to thought?
 - ▶ knowledge representation, grammar

History of AI...

Artificial Intelligence is not a new word and not a new technology for researchers. This technology is much older than you would imagine. Even there are the myths of Mechanical men in Ancient Greek and Egyptian Myths. Following are some milestones in the history of AI which defines the journey from the AI generation to till date development.



History of AI...

- **Maturation of Artificial Intelligence (1943-1952)**

- **Year 1943:** The first work which is now recognized as AI was done by Warren McCulloch and Walter Pitts in 1943. **They proposed a model of artificial neurons.**
- **Year 1949:** Donald Hebb demonstrated an updating rule for modifying the connection strength between neurons. **His rule is now called Hebbian learning.**
- **Year 1950:** The Alan Turing who was an English mathematician and pioneered Machine learning in 1950. Alan Turing publishes "Computing Machinery and Intelligence" in which he proposed a test. **The test can check the machine's ability to exhibit intelligent behavior equivalent to human intelligence, called a Turing test.**

History of AI...

- **The birth of Artificial Intelligence (1952-1956)**

- **Year 1955:** An Allen Newell and Herbert A. Simon created the "first artificial intelligence program", which was named as "Logic Theorist". This program had proved 38 of 52 Mathematics theorems, and find new and more elegant proofs for some theorems.
- **Year 1956:** The word "Artificial Intelligence" first adopted by American Computer scientist John McCarthy at the Dartmouth Conference. **For the first time, AI coined as an academic field.**
- At that time high-level computer languages such as FORTRAN, LISP, or COBOL were invented. And the enthusiasm for AI was very high at that time.

History of AI...

- **The golden years-Early enthusiasm (1956-1974)**
 - **Year 1966:** The researchers emphasized developing algorithms which can solve mathematical problems. **Joseph Weizenbaum created the first chatbot in 1966, which was named as ELIZA.**
 - **Year 1972:** The **first intelligent humanoid robot** was built in Japan which was named as **WABOT-1.**

History of AI...

- **The first AI winter (1974-1980)**

- The duration between years 1974 to 1980 was the first AI winter duration. **AI winter refers to the time period where computer scientist dealt with a severe shortage of funding from government for AI researches.**
- During AI winters, an interest of publicity on artificial intelligence was decreased.

History of AI...

- **A boom of AI (1980-1987)**

- **Year 1980:** After AI winter duration, **AI came back with "Expert System"**. Expert systems were programmed that emulate the decision-making ability of a human expert.
- In the Year 1980, the **first national conference of the American Association of Artificial Intelligence** was held at Stanford University.

History of AI...

- **The second AI winter (1987-1993)**
 - The duration between the years 1987 to 1993 was the second AI Winter duration.
 - Again Investors and government stopped in funding for AI research as due to high cost but not efficient result. The expert system such as XCON was very cost effective.

History of AI...

- **The emergence of intelligent agents (1993-2011)**
 - **Year 1997:** In the year 1997, **IBM Deep Blue** beats world chess champion, **Gary Kasparov**, and became the first computer to beat a world chess champion.
 - **Year 2002:** for the first time, **AI entered the home in the form of Roomba**, a vacuum cleaner.
 - **Year 2006:** AI came in the Business world till the year 2006. **Companies like Facebook, Twitter, and Netflix also started using AI.**

History of AI...

- **Deep learning, big data and artificial general intelligence**

- (2011-present)**

- **Year 2011:** In the year 2011, IBM's Watson won jeopardy, a quiz show, where it had to solve the complex questions as well as riddles. **Watson had proved that it could understand natural language and can solve tricky questions quickly.**
 - **Year 2012:** Google has launched an Android app feature "Google now", which was able to provide information to the user as a prediction.
 - **Year 2014:** In the year 2014, Chatbot "Eugene Goostman" won a competition in the infamous "Turing test."
 - **Year 2018:** The "Project Debater" from IBM debated on complex topics with two master debaters and also performed extremely well.
 - Google has demonstrated an AI program "Duplex" which was a virtual assistant and which had taken hairdresser appointment on call, and lady on other side didn't notice that she was talking with the machine.

History of AI

- **Now**
 - Now AI has developed to a remarkable level.
 - The concept of Deep learning, big data, and data science are now trending like a boom. Nowadays companies like Google, Facebook, IBM, and Amazon are working with AI and creating amazing devices.
 - The future of Artificial Intelligence is inspiring and will come with high intelligence.

The State of the Art...

- What can AI do today? There are so many activities in so many subfields.
 - ▶ **Autonomous planning and scheduling**
 - ▶ Remote agent generated plans from high-level goals specified from the ground, and it monitored the operation of the aircrafts as the plans were executed – detecting, diagnosing, and recovering from problems as they occurred.
 - ▶ **Game playing**
 - ▶ IBM's Deep blue became the first computer program to defeat the world champion in a chess match when it bested Garry Kasparov in an exhibition match (1997). Kasparov said that he felt a “new kind of intelligence” across the board from him.
 - ▶ **Autonomous control**
 - ▶ The ALVINN computer vision system was trained to steer a car to keep following a lane.

The State of the Art

- ▶ **Diagnosis**

- ▶ Medical diagnosis programs based on probabilistic analysis have been able to perform at the level of an expert physician in several areas of medicine.

- ▶ **Logistic planning**

- ▶ US forces deployed a Dynamic Analysis and Replanning Tool (DART) to do automated logistics planning and scheduling for transportation (1991). This involved up to 50,000 vehicles, cargo and people at a time, and had to account for starting points, destinations, routes, and conflict resolution among all parameters.

- ▶ **Robotics**

- ▶ Many surgeons now use robot assistants in microsurgery.

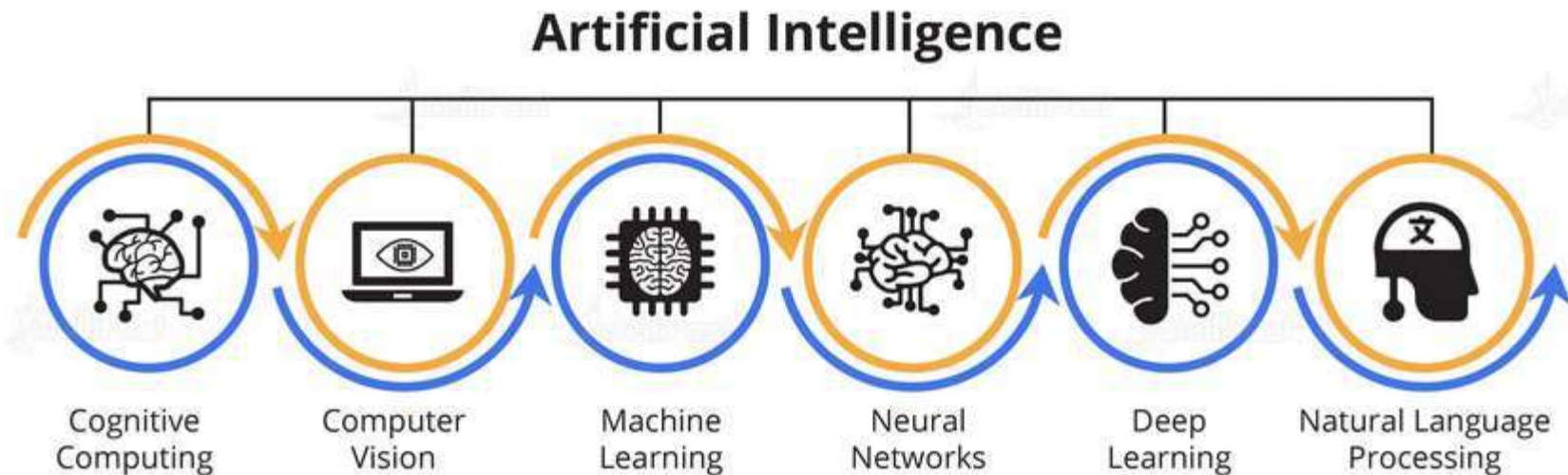
- ▶ **Language understanding and problem solving**

- ▶ PROVERB (1991) is a computer program that solves crossword puzzles better than most humans.

These are just a few examples of AI systems that exist today.

Major Sub-fields of AI...

- Artificial Intelligence works with large amounts of data which are first combined with fast, iterative processing and smart algorithms that allow the system to learn from the patterns within the data.
- This way, the system would be able to deliver accurate or close to accurate outputs. As it sounds, AI is a vast subject, which involves much-advanced and complex processes, and hence its field of study includes many theories, methods, and technologies.
- **The major subfields under AI are shown in the figure.**



Major Sub-fields of AI...

- **Machine Learning:**

- Machine Learning is the learning in which a machine can learn by its own from examples and previous experiences.
- The program developed for it need not be specific and is not static. The machine tends to change or correct its algorithm as and when required.
- Artificial Intelligence (AI) and Machine Learning (ML) are the two most commonly misinterpreted terms. Generally, people tend to understand that they are the same, which leads to confusion. ML is a subfield of AI.

- **Neural Networks:**

- Artificial Neural Networks (ANNs) were developed getting inspired by the biological neural network, i.e., the brain. ANNs are one of the most important tools in Machine Learning to find patterns within the data, which are far too complex for a human to figure out and teach the machine to recognize.

Major Sub-fields of AI...

- **Deep Learning:**
 - In Deep Learning, a large amount of data is analyzed, and here the algorithm would perform the task repeatedly, each time twisting/editing a little to improve the outcome.
- **Cognitive Computing:**
 - The ultimate goal of cognitive computing is to imitate the human thought process in a computer model.
 - How can this be achieved? Using self-learning algorithms, pattern recognition by neural networks, and natural language processing, a computer can mimic the human way of thinking.
 - Here, computerized models are deployed to simulate the human cognition process.

Major Sub-fields of AI

- **Computer Vision:**

- Computer vision works on allowing computers to see, recognize, and process images, the same way as the human vision does, and then it provides an appropriate output.
- Computer vision is closely related to Artificial Intelligence. Here, the computer must understand what it sees, and then analyze it, accordingly.

- **Natural Language Processing:**

- Natural language processing means developing methods that help us communicate with machines using natural human languages like English.

- ‘Machines and algorithms in the workplace are expected to create 133 million new roles, but cause 75 million jobs to be displaced by 2022 according to a new report from the World Economic Forum (WEF) ... This means that the growth of Artificial Intelligence could create 58 million net new jobs in the next few years.’

Foundations of Artificial Intelligence
TO BE CONTINUED...