Artificial Intelligence

Dr. Subarna Chatterjee

subarna.cs.et@msruas.ac.in

Outline

- Introduction to AI which will help you to understand the concepts behind Artificial Intelligence.
- History of AI
- Applications of AI,
- Deep learning,
- Machine Learning,
- natural language processing, Reinforcement learning, Q-learning, Intelligent agents, Various search algorithms, etc.
- Our AI tutorial is prepared from an elementary level so you can easily understand the complete tutorial from basic concepts to the high-level concepts.

Outline

- AI Introduction
- Application of AI
- History of AI
- Types of AI

Prerequisite

- Before learning about Artificial Intelligence, you must have the fundamental knowledge of following so that you can understand the concepts easily:
  - Any computer language such as C, C++, Java, Python, etc.(knowledge of Python will be an advantage)
  - Knowledge of essential Mathematics such as derivatives, probability theory, etc.

Artificial Intelligence

- In today's world, technology is growing very fast, and we are getting in touch with different new technologies day by day.
- Here, one of the booming technologies of computer science is Artificial Intelligence which is ready to create a new revolution in the world by making intelligent machines. The Artificial Intelligence is now all around us. It is currently working with a variety of subfields, ranging from general to specific, such as self-driving cars, playing chess, proving theorems, playing music, Painting, etc.
- AI is one of the fascinating and universal fields of Computer science which has a great scope in future. AI holds a tendency to cause a machine to work as a human.

What is Artificial Intelligence?

- Artificial Intelligence is composed of two words Artificial and Intelligence, where Artificial defines "man-made," and intelligence defines "thinking power", hence AI means "a man-made thinking power."
- So, we can define AI as:

"It is a branch of computer science by which we can create intelligent machines which can behave like a human, think like humans, and able to make decisions."

Cont..

- AI exists when a machine can have human based skills such as learning, reasoning, and solving problems
- With AI you do not need to preprogram a machine to do some work, despite that you can create a machine with programmed algorithms which can work with own intelligence, and that is the awesomeness of AI.
- It is believed that AI is not a new technology, and some people says that as per Greek myth, there were Mechanical men in early days which can work and behave like humans.

Why Artificial Intelligence?

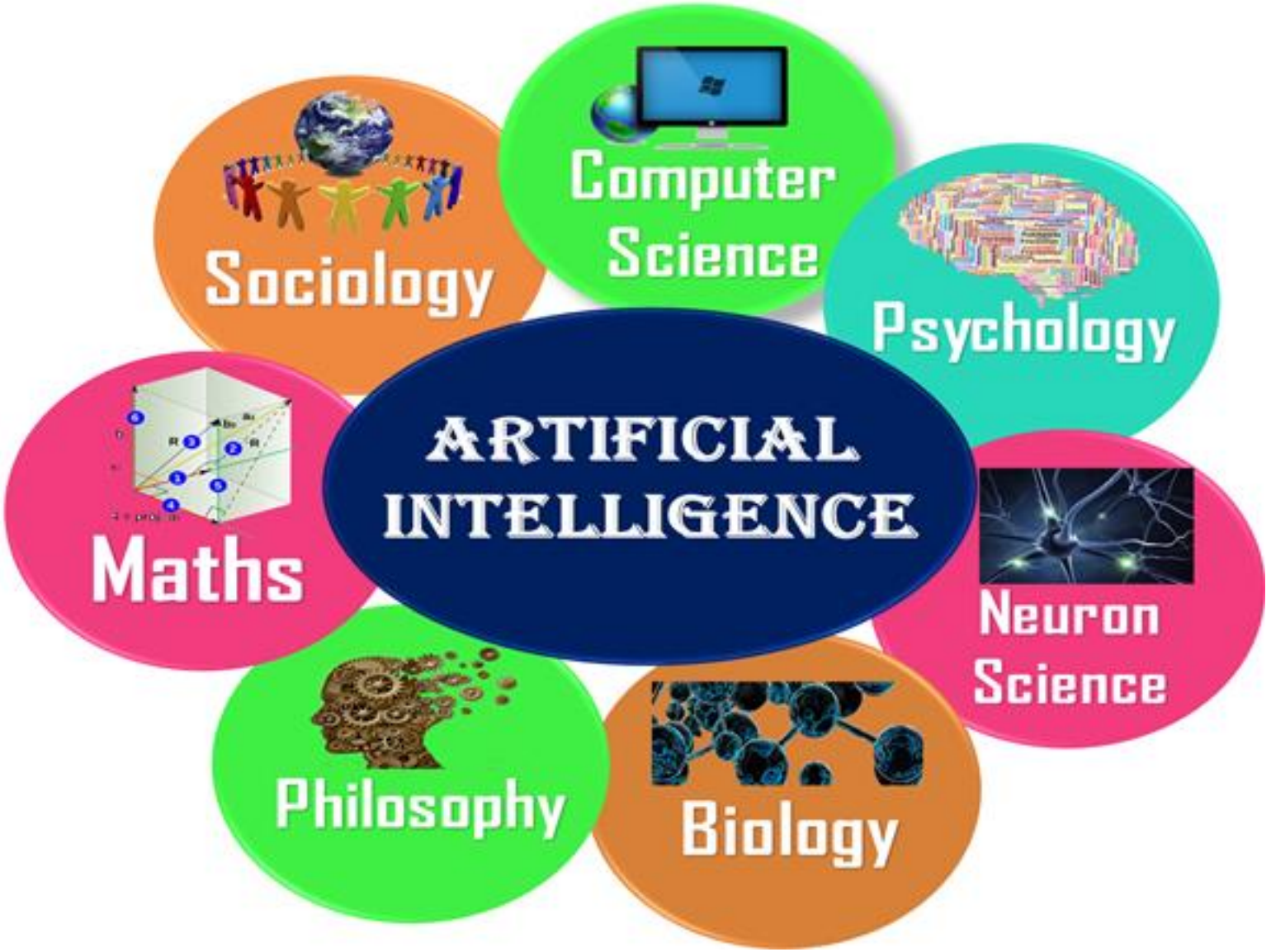
- Before Learning about AI, we should know that what is the importance of AI and why should we learn it. Following are some main reasons to learn about AI:
  - With the help of AI, you can create such software or devices which can solve real-world problems very easily and with accuracy such as health issues, marketing, traffic issues, etc.
  - With the help of AI, you can create your personal virtual Assistant, such as Cortana, Google Assistant, Siri, etc.
  - With the help of AI, you can build such Robots which can work in an environment where survival of humans can be at risk.
  - AI opens a path for other new technologies, new devices, and new Opportunities.

Goals of Artificial Intelligence

- **Following are the main goals of Artificial Intelligence:**
  - Replicate human intelligence
  - Solve Knowledge-intensive tasks
  - An intelligent connection of perception and action
  - Building a machine which can perform tasks that requires human intelligence such as:
    - Proving a theorem
    - Playing chess
    - Plan some surgical operation
    - Driving a car in traffic
  - Creating some system which can exhibit intelligent behavior, learn new things by itself, demonstrate, explain, and can advise to its user.

What Comprises to Artificial Intelligence?

- AI is not just a part of computer science even it's so vast and requires lots of other factors which can contribute to it. To create the AI first we should know that how intelligence is composed, so the Intelligence is an intangible part of our brain which is a combination of **Reasoning, learning, problem-solving perception, language understanding, etc**.
- To achieve the above factors for a machine or software AI requires the following discipline:
  - Mathematics
  - Biology
  - Psychology
  - Sociology
  - Computer Science
  - Neurons Study
  - Statistics



Advantages of Artificial Intelligence

- **High Accuracy with less errors:** AI machines or systems are prone to less errors and high accuracy as it takes decisions as per pre-experience or information.
- **High-Speed:** AI systems can be of very high-speed and fast-decision making, because of that AI systems can beat a chess champion in the Chess game.
- **High reliability:** AI machines are highly reliable and can perform the same action multiple times with high accuracy.
- **Useful for risky areas:** AI machines can be helpful in situations such as defusing a bomb, exploring the ocean floor, where to employ a human can be risky.

Cont..

- **Digital Assistant:** AI can be very useful to provide digital assistant to the users such as AI technology is currently used by various E-commerce websites to show the products as per customer requirement.

- **Useful as a public utility:** AI can be very useful for public utilities such as a self-driving car which can make our journey safer and hassle-free, facial recognition for security purpose, Natural language processing to communicate with the human in human-language, etc.

Disadvantages of Artificial Intelligence

- Every technology has some disadvantages, and the same goes for Artificial intelligence. Being so advantageous technology still, it has some disadvantages which we need to keep in our mind while creating an AI system. Following are the disadvantages of AI:

- **High Cost:** The hardware and software requirement of AI is very costly as it requires lots of maintenance to meet current world requirements.

- **Can't think out of the box:** Even we are making smarter machines with AI, but still they cannot work out of the box, as the robot will only do that work for which they are trained, or programmed.

Cont..

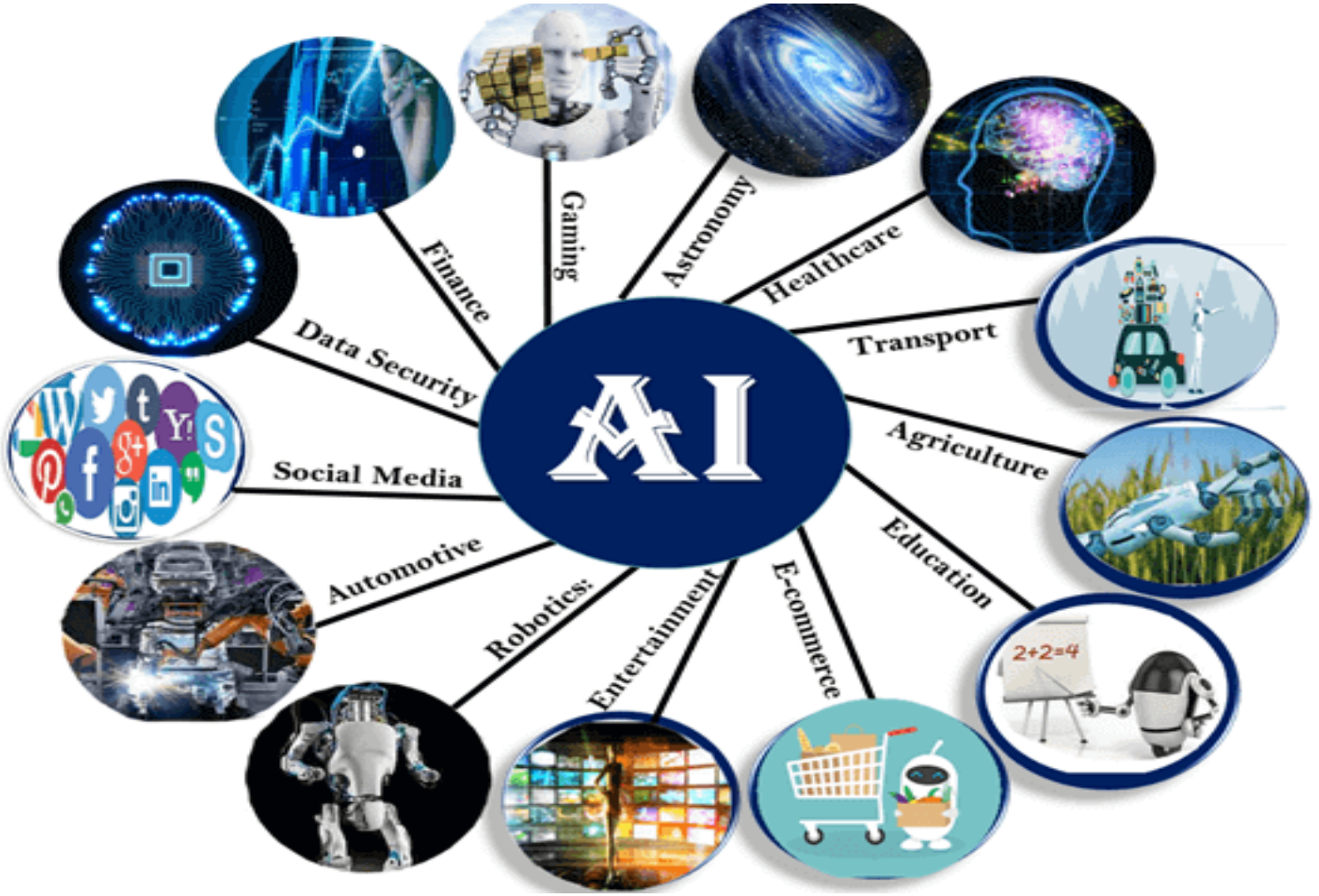
- **No feelings and emotions:** AI machines can be an outstanding performer, but still it does not have the feeling so it cannot make any kind of emotional attachment with human, and may sometime be harmful for users if the proper care is not taken.

- **Increase dependency on machines:** With the increment of technology, people are getting more dependent on devices and hence they are losing their mental capabilities.

- **No Original Creativity:** As humans are so creative and can imagine some new ideas but still AI machines cannot beat this power of human intelligence and cannot be creative and imaginative.

Application of AI

- AI has various applications in today's society.
- Following are some sectors which have the application of AI:



Cont..

1. AI in Astronomy

AI can be very useful to solve complex universe problems. AI technology can be helpful for understanding the universe such as how it works, origin, etc.

2. AI in Healthcare

In the last, five to ten years, AI becoming more advantageous for the healthcare industry and going to have a significant impact on this industry.

Healthcare Industries are applying AI to make a better and faster diagnosis than humans. AI can help doctors with diagnoses and can inform when patients are worsening so that medical help can reach to the patient before hospitalization.

3. AI in Gaming

AI can be used for gaming purpose. The AI machines can play strategic games like chess, where the machine needs to think of a large number of possible places.

Cont..

4. AI in Finance

AI and finance industries are the best matches for each other. The finance industry is implementing automation, chatbot, adaptive intelligence, algorithm trading, and machine learning into financial processes.

5. AI in Data Security

The security of data is crucial for every company and cyber-attacks are growing very rapidly in the digital world. AI can be used to make your data more safe and secure. Some examples such as AEG bot, AI2 Platform, are used to determine software bug and cyber-attacks in a better way.

6. AI in Social Media

Social Media sites such as Facebook, Twitter, and Snapchat contain billions of user profiles, which need to be stored and managed in a very efficient way. AI can organize and manage massive amounts of data. AI can analyze lots of data to identify the latest trends, hashtag, and requirement of different users.

Cont..

7. AI in Travel &Transport

AI is becoming highly demanding for travel industries. AI is capable of doing various travel related works such as from making travel arrangement to suggesting the hotels, flights, and best routes to the customers. Travel industries are using AI-powered chatbots which can make human-like interaction with customers for better and fast response.

8. AI in Automotive Industry

Some Automotive industries are using AI to provide virtual assistant to their user for better performance. Such as Tesla has introduced TeslaBot, an intelligent virtual assistant.

Various Industries are currently working for developing self-driven cars which can make your journey more safe and secure.

Application of AI

9. AI in Robotics:

AI has a remarkable role in Robotics. Usually, general robots are programmed such that they can perform some repetitive task, but with the help of AI, we can create intelligent robots which can perform tasks with their own experiences without pre-programmed.

Humanoid Robots are best examples for AI in robotics, recently the intelligent Humanoid robot named as Erica and Sophia has been developed which can talk and behave like humans.

10. AI in Entertainment

We are currently using some AI based applications in our daily life with some entertainment services such as Netflix or Amazon. With the help of ML/AI algorithms, these services show the recommendations for programs or shows.

Cont..

11. AI in Agriculture

Agriculture is an area which requires various resources, labor, money, and time for best result. Now a day's agriculture is becoming digital, and AI is emerging in this field. Agriculture is applying AI as agriculture robotics, solid and crop monitoring, predictive analysis. AI in agriculture can be very helpful for farmers.

12. AI in E-commerce

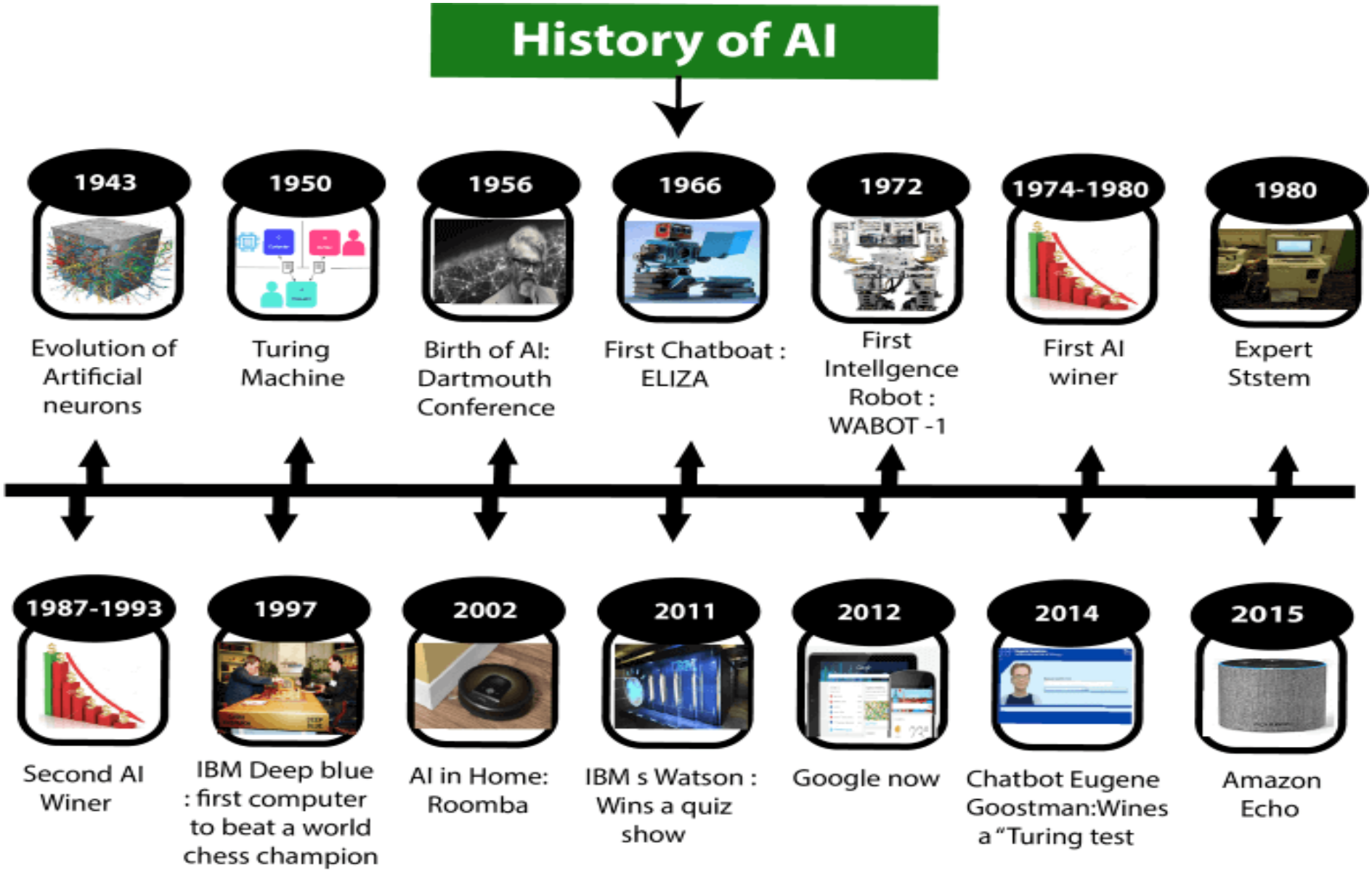
AI is providing a competitive edge to the e-commerce industry, and it is becoming more demanding in the e-commerce business. AI is helping shoppers to discover associated products with recommended size, color, or even brand.

13. AI in education:

AI can automate grading so that the tutor can have more time to teach. AI chatbot can communicate with students as a teaching assistant.

AI in the future can be work as a personal virtual tutor for students, which will be accessible easily at any time and any place.

- Following are some milestones in the history of AI which defines the journey from the AI generation to till date development.



Maturation of Artificial Intelligence (1943-1952)

- **Year 1943:** The first work which is now recognized as AI was done by Warren McCulloch and Walter pits 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**.

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.
- **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.

- **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.
- **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**.
- **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.
- **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.

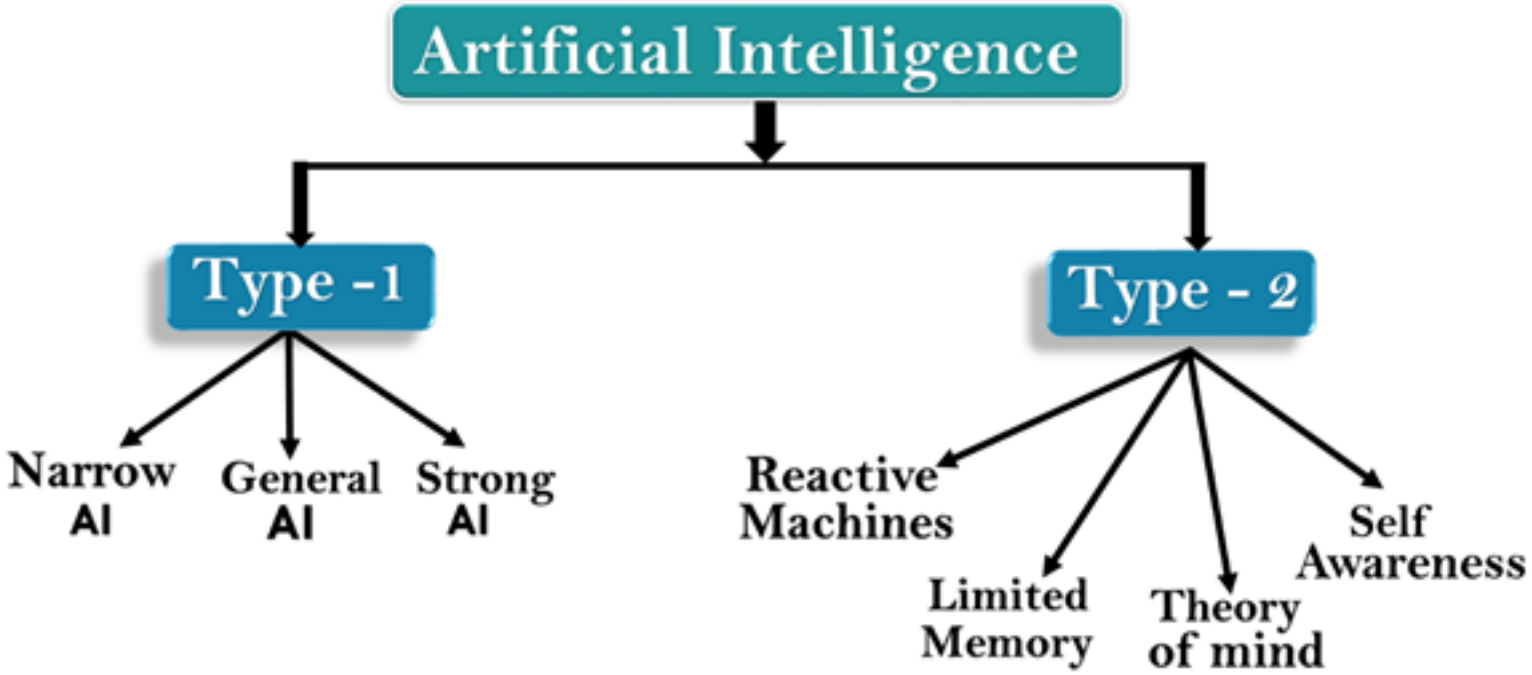
Deep learning, big data and AI(2011-present)

- **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.

- 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 AI is inspiring and will come with high intelligence.

Types of Artificial Intelligence:

- AI can be divided in various types, there are mainly 2 types of main categorization which are based on capabilities and based on functionally of AI. Following is flow diagram which explain the types of AI.



AI type-1: Based on Capabilities

1. Weak AI or Narrow AI:

- **Narrow AI** is a type of AI which is able to perform a **dedicated task** with intelligence. The most common and currently available AI is Narrow AI in the world of AI.
- Narrow AI cannot perform beyond its field or limitations, as it is only trained for one specific task. Hence it is also termed as weak AI. Narrow AI can fail in unpredictable ways if it goes beyond its limits.
- **Apple Siriis** a good example of Narrow AI, but it operates with a **limited pre-defined range of functions**.
- **IBM's Watson** supercomputer also comes under **Narrow AI**, as it uses an Expert system approach combined with **Machine learning** and **natural language processing**.
- Some Examples of Narrow AI are playing **chess, purchasing suggestions** on **e-commerce site, self-driving cars, speech recognition,** and **image recognition.**

Cont..

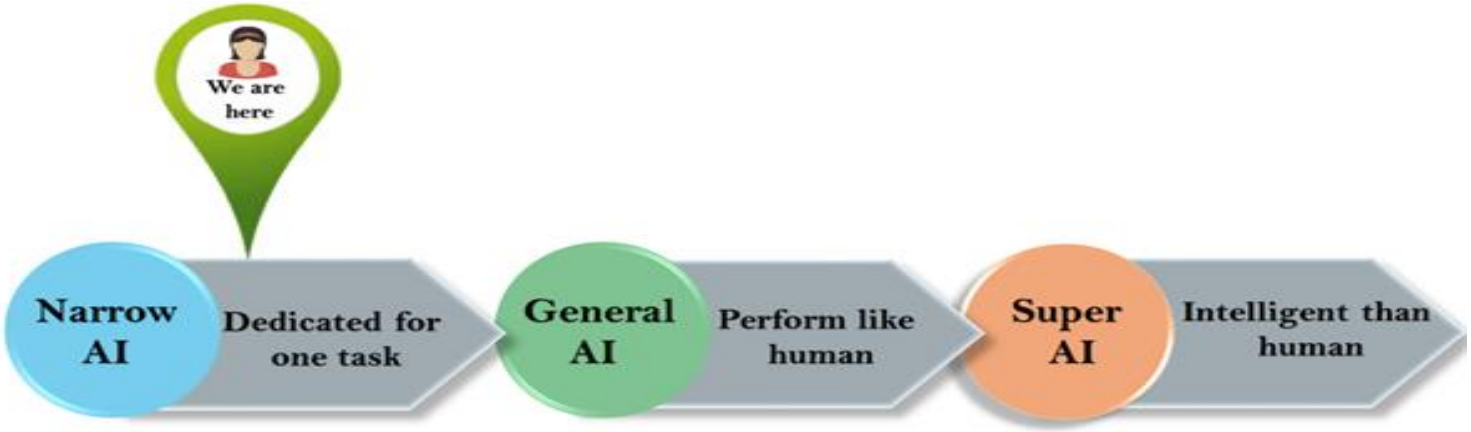
2. General AI:

- General AI is a type of intelligence which could perform any **intellectual task** with efficiency like a human.
- The idea behind the general AI to make such a system which could be smarter and think like a human by its own.
- Currently, there is no such system exist which could come under **general AI** and can perform any task as perfect as a human.
- The worldwide researchers are now focused on developing machines with General AI.
- As systems with general AI are still under research, and it will take lots of efforts and time to develop such systems.

Cont..

3. Super AI:

- Super AI is a level of Intelligence of Systems at which machines could **surpass human intelligence**, and can perform any task better than human with **cognitive properties**. It is an outcome of general AI.
- Some key characteristics of strong AI include capability include the ability to **think, to reason, solve the puzzle, make judgments, plan, learn,** and **communicate** by its own.
- Super AI is still a hypothetical concept of Artificial Intelligence. Development of such systems in real is still world changing task.



AI type-2: Based on functionality

1. Reactive Machines

- Purely reactive machines are the most basic types of AI.
- Such AI systems do not store memories or past experiences for **future actions**.
- These machines only focus on current scenarios and react on it as per possible best action.
- **IBM's Deep Blue system** is an example of reactive machines.
- **Google's AlphaGo** is also an example of reactive machines.

2. Limited Memory

- Limited memory machines can store past experiences or some data for a short period of time.
- These machines can use stored data for a limited time period only.
- **Self-driving cars** are one of the best examples of Limited Memory systems. These cars can store recent speed of **nearby cars**, the **distance of other cars**, **speed limit**, and other information to navigate the road.

Cont..

3. Theory of Mind

- Theory of Mind AI should understand the **human emotions**, people, beliefs, and be able to interact socially like humans.
- This type of AI machines are still not developed, but researchers are making lots of efforts and improvement for developing such AI machines.

4. Self-Awareness

- Self-awareness AI is the **future** of Artificial Intelligence. These machines will be super intelligent, and will have their own **consciousness, sentiments,** and **self-awareness**.
- These machines will be smarter than human mind.
- Self-Awareness AI does not exist in reality still and it is a hypothetical concept.

Thank You