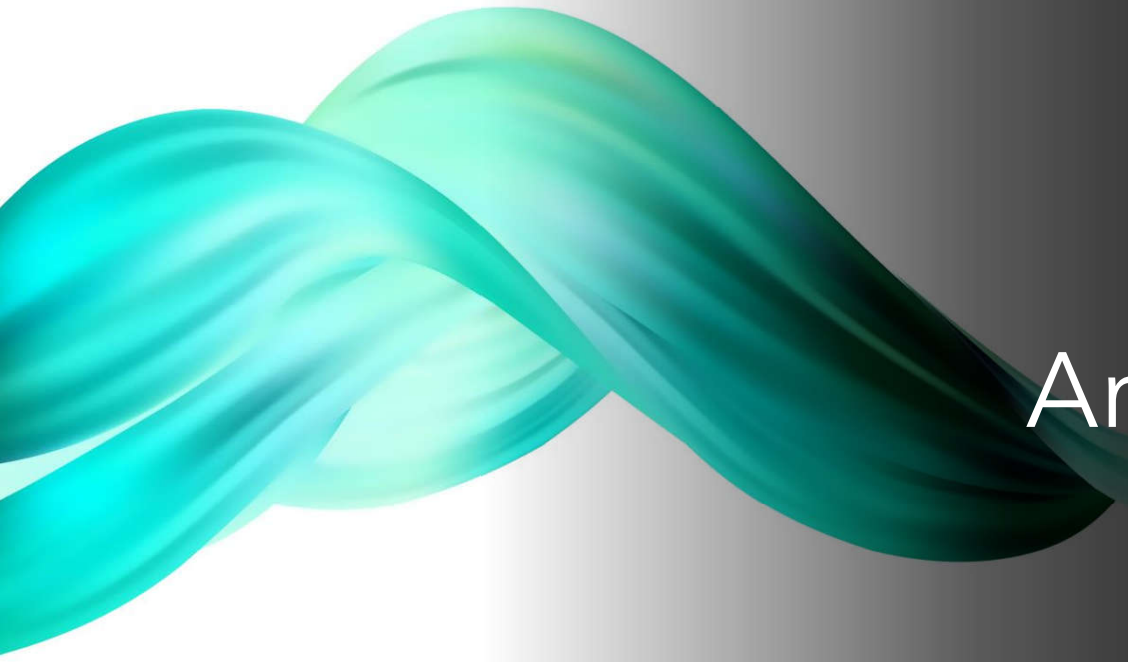


Artificial Intelligence

Dr. Mubashir Ahmad (Ph.D.)

What Is Artificial Intelligence?

- Intelligence: The ability to learn and solve problems (Webster's Dictionary).
- Artificial intelligence (AI) is the intelligence exhibited by machines or software (Wikipedia).
- The science and engineering of making intelligent machines (McCarthy).
- The study and design of intelligent agents, where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success. (Russel and Norvig AI book).

Definitions

- (Intelligent agents in AI are autonomous entities that act upon an environment using sensors and actuators to achieve their goals).
- An actuator is a device which causes something to happen. This could be a robot movement, which is often achieved using motors.
- An actuator is needed to make the robots wheels turn.
- Or the joints of a robot arm to rotate.
- Or for a robot gripper to open or close.
- A light being turned on to indicate the robot is working.
- Sound is being emitted – so the actuator is a loudspeaker.
- Communication in some form – so a transmitter is needed.
- An LCD (Liquid Crystal Display) screen for showing pictures and other data.

Why AI?

- Just as the Industrial Revolution freed up a lot of humanity from physical drudgery (donkeywork), I think AI has the potential to free up humanity from a lot of the mental drudgery. (Andrew Ng)

What is Artificial Intelligence (AI)?

- 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.

What is Artificial Intelligence (AI)?

- 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.
- 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."*

What is Artificial Intelligence (AI)?

- Artificial Intelligence exists when a machine can have human based skills such as learning, reasoning, and solving problems.
- With Artificial Intelligence 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.

Why Artificial Intelligence?

- Before Learning about Artificial Intelligence, 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.

Why Artificial Intelligence?

- 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:

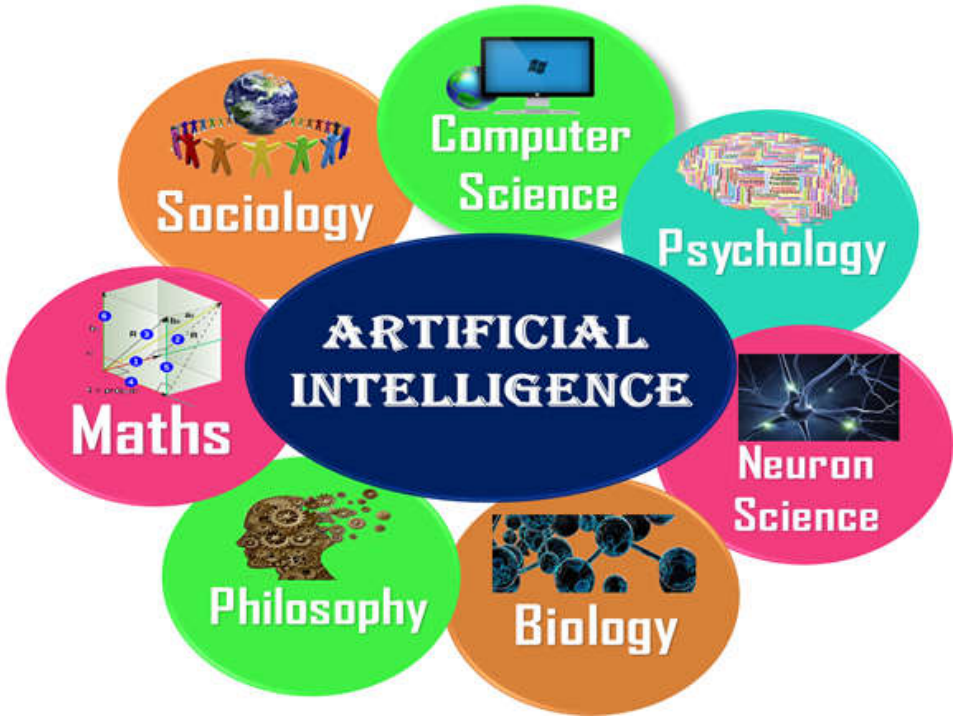
1. Replicate human intelligence
2. Solve Knowledge-intensive tasks
3. An intelligent connection of perception and action
4. Building a machine which can perform tasks that requires human intelligence such as:
    1. Proving a theorem
    2. Playing chess
    3. Plan some surgical operation
    4. Driving a car in traffic
5. 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?

- Artificial Intelligence 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**.

What Comprises to Artificial Intelligence?

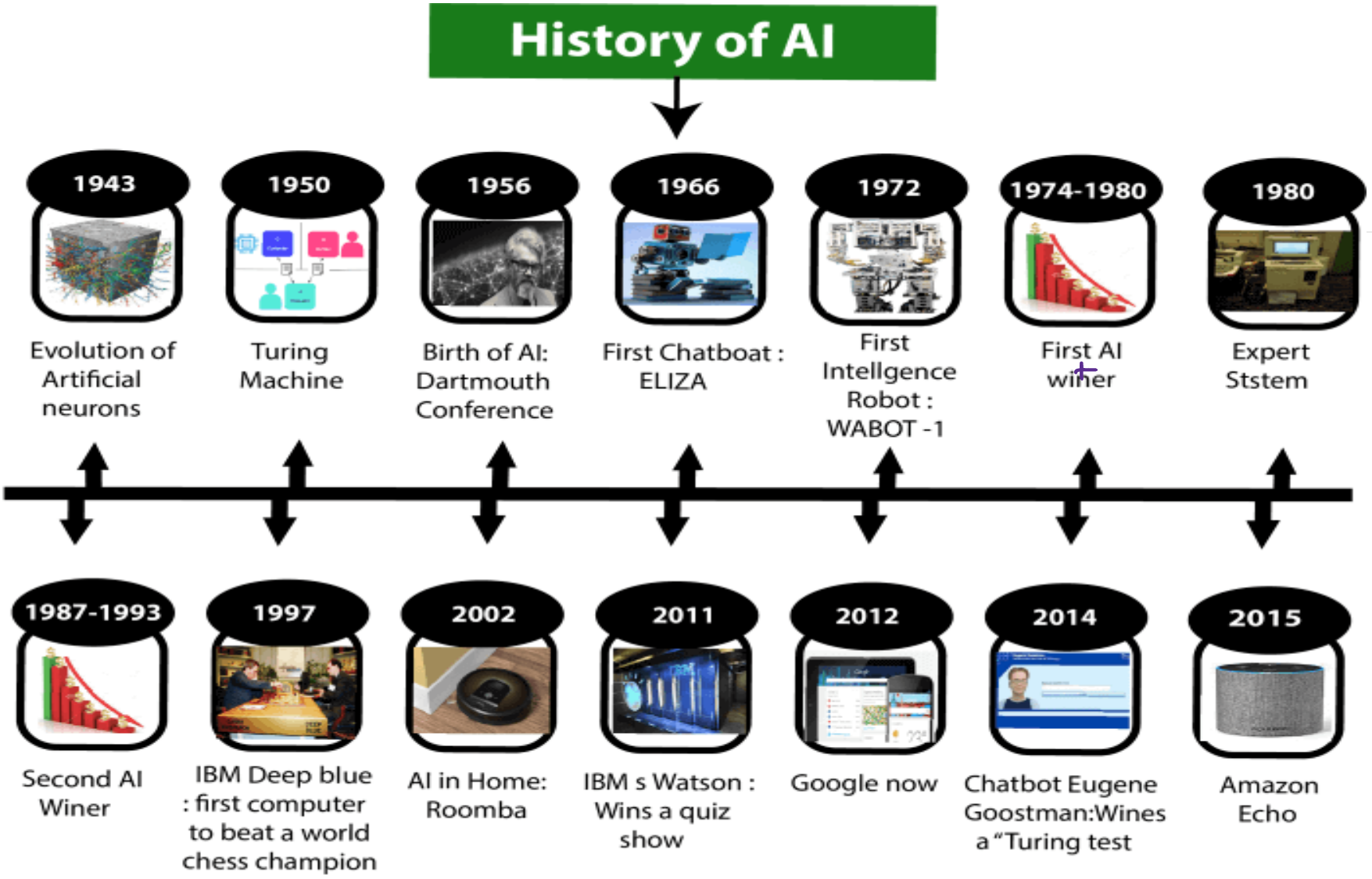
- To achieve the above factors for a machine or software Artificial Intelligence requires the following discipline:
- Mathematics
- Biology
- Psychology
- Sociology
- Computer Science
- Neurons Study
- Statistics



History of Artificial Intelligence

- 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.

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 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**.
- Turing machines provide a powerful computational model for solving problems in computer science and testing the limits of computation (1936).

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:** Between 1964 and 1966 Eliza was born, **one of the very first conversational agents**. Its creator, Joseph Weizenbaum was a researcher at the famous Artificial Intelligence Laboratory of the MIT (Massachusetts Institute of Technology). His goal was to enable a conversation between a computer and a human user.
- **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 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.

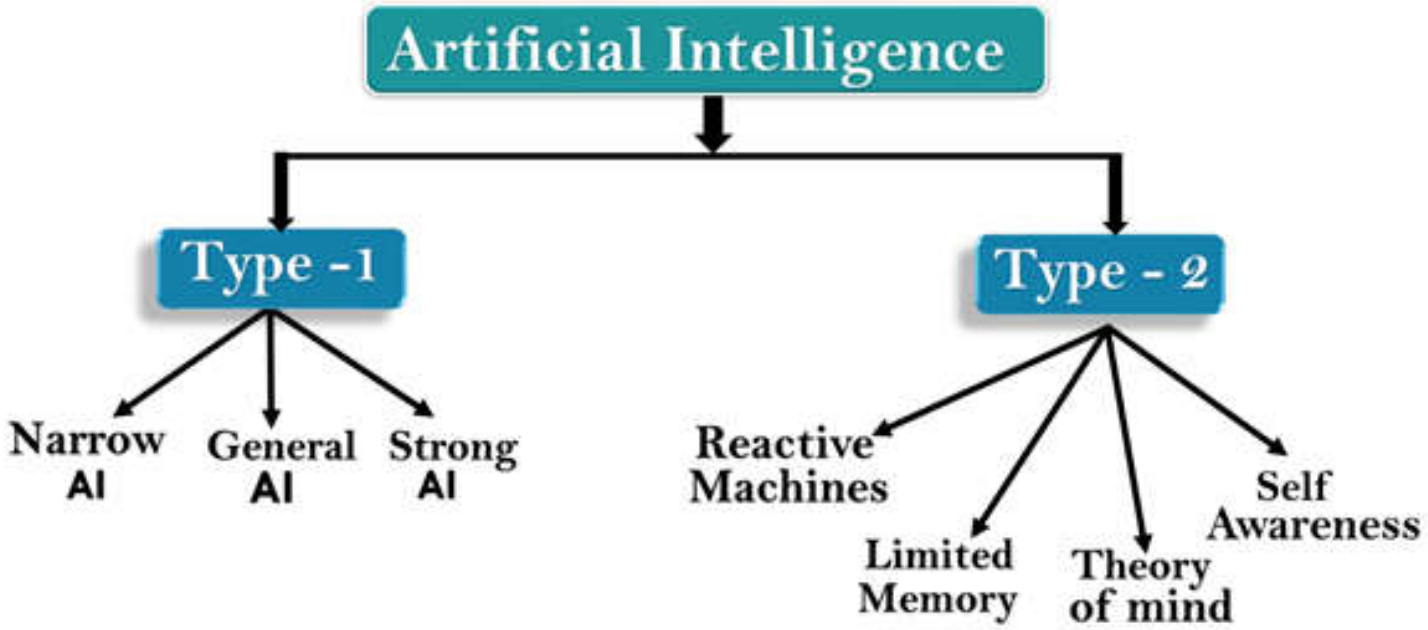
Deep learning, big data and artificial general intelligence (2011-present)

- 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.

Types of Artificial Intelligence:

- Artificial Intelligence can be divided in various types, there are mainly two 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.

Types of Artificial Intelligence:



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 Artificial Intelligence.
- 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 Siri is 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.

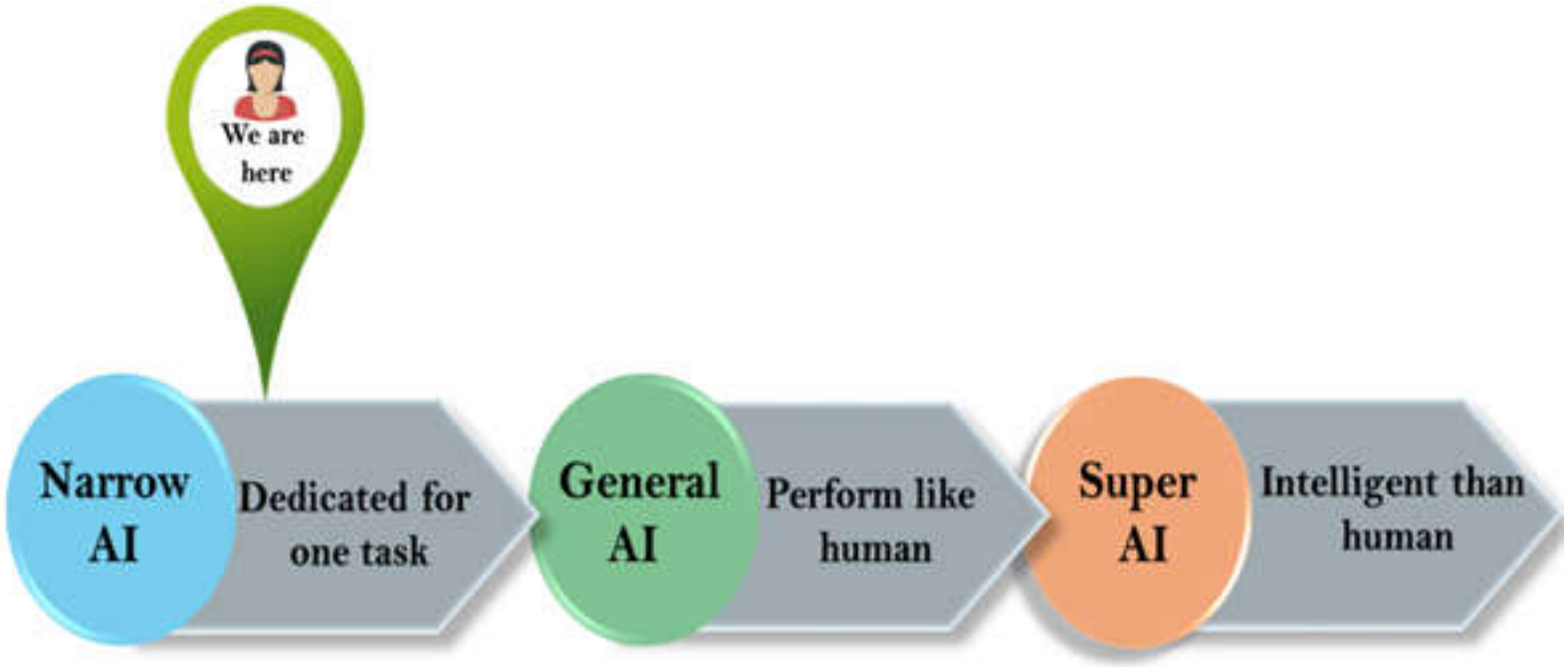
2. General AI:

- 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.

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-1: Based on Capabilities



Artificial Intelligence type-2: Based on functionality

- **1. Reactive Machines**
- Purely reactive machines are the most basic types of Artificial Intelligence.
- 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.

3. Theory of Mind

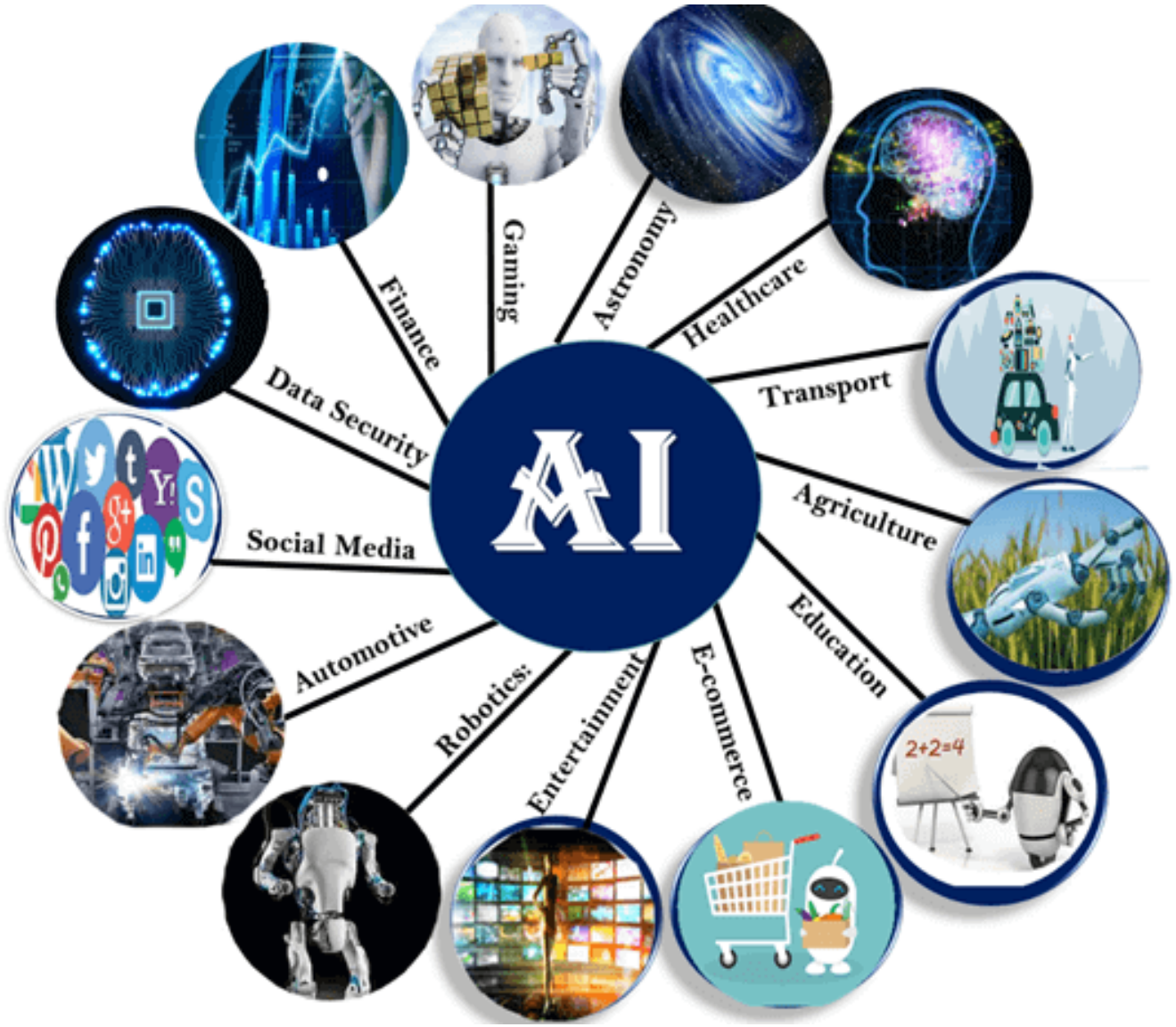
- Theory of Mind AI should understand the human emotions, people, beliefs, and be able to interact socially like humans.
- This type of AI machines are still not developed, but researchers are making lots of efforts and improvement for developing such AI machines.

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.

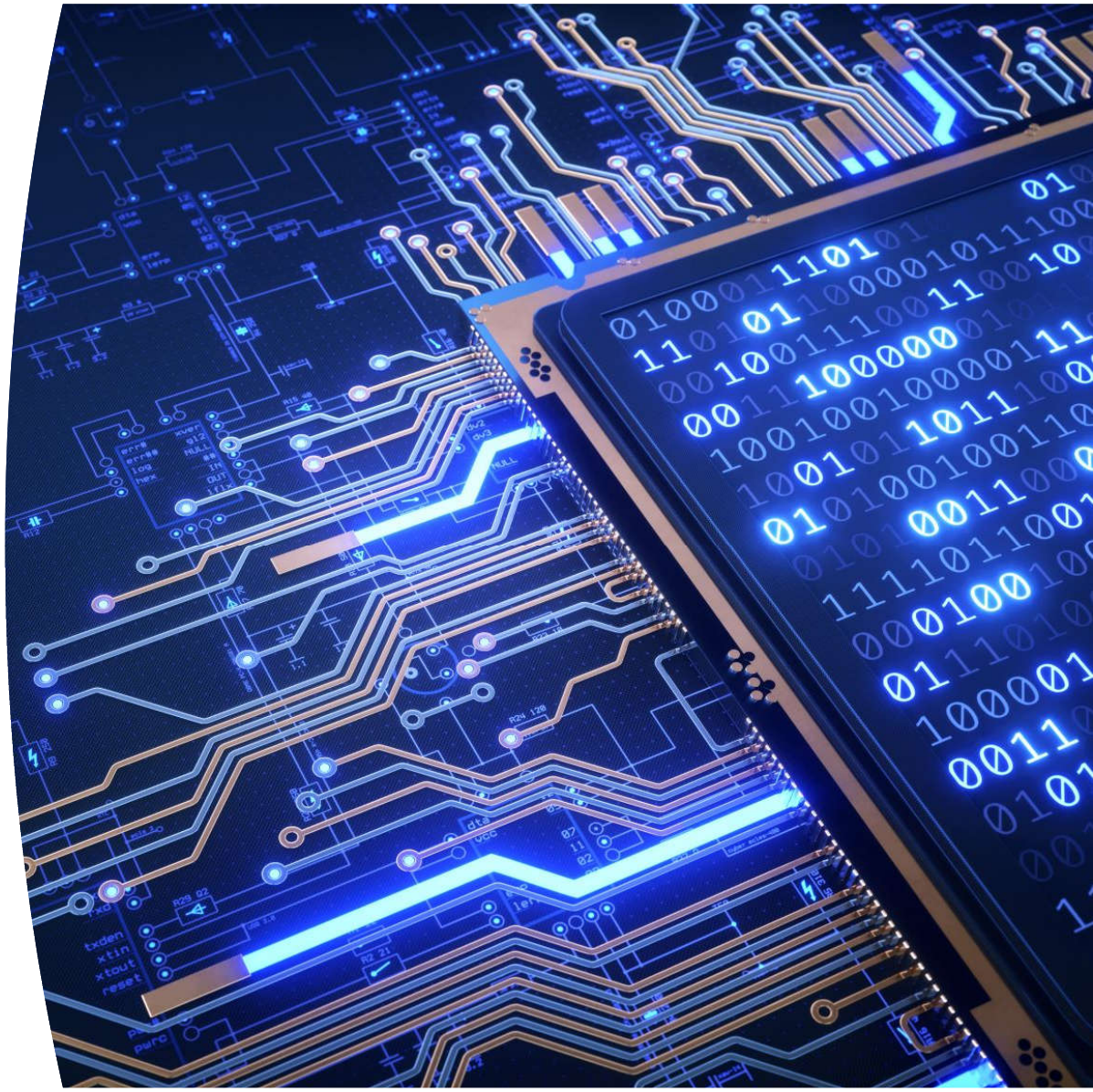
Application of AI

- Artificial Intelligence has various applications in today's society. It is becoming essential for today's time because it can solve complex problems with an efficient way in multiple industries, such as Healthcare, entertainment, finance, education, etc. AI is making our daily life more comfortable and fast.
- Following are some sectors which have the application of Artificial Intelligence:


AI
Finance
Gaming
Astronomy
Healthcare
Transport
Agriculture
Education
E-commerce
Entertainment
Robotics:
Automotive
Social Media
Data Security
2+2=4

1. AI in Astronomy

- Artificial Intelligence 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.

4. AI in Finance

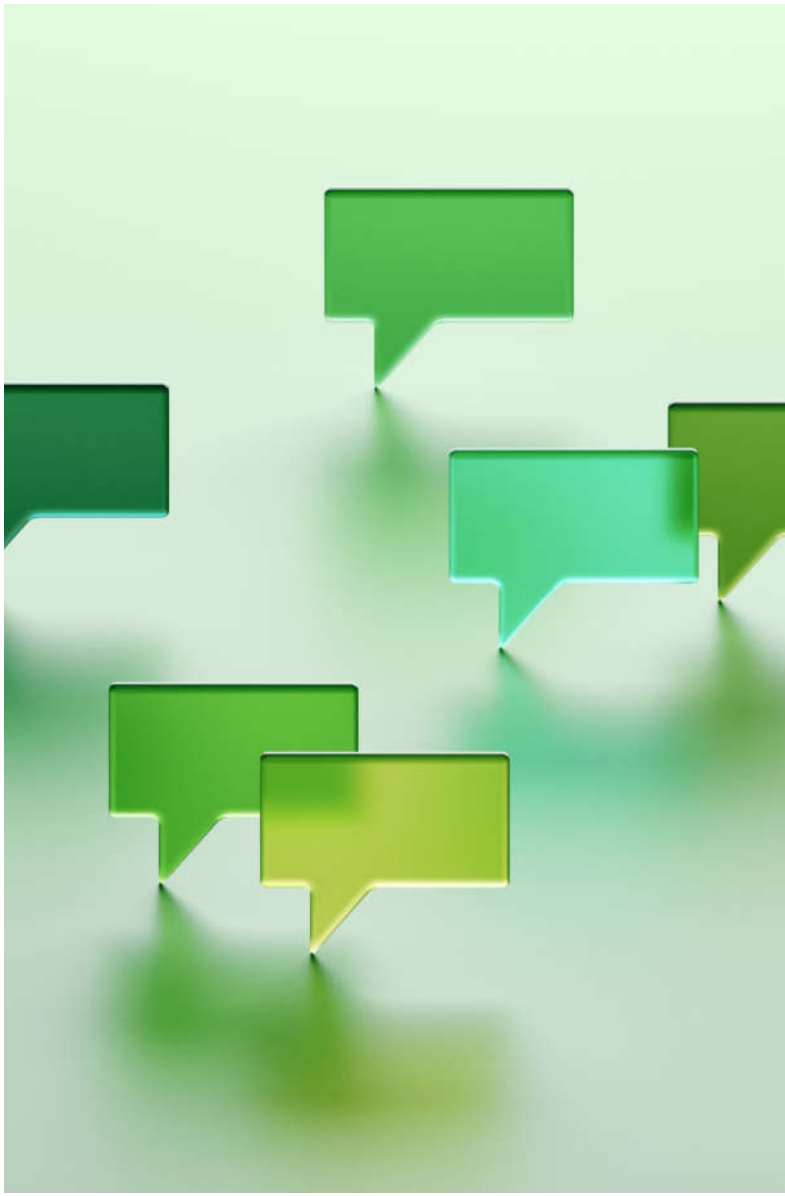
- AI and finance industries are the best matches for each other. The finance industry is implementing automation, chatbot, adaptive intelligence, algorithm trading, and machine learning into financial processes.

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.

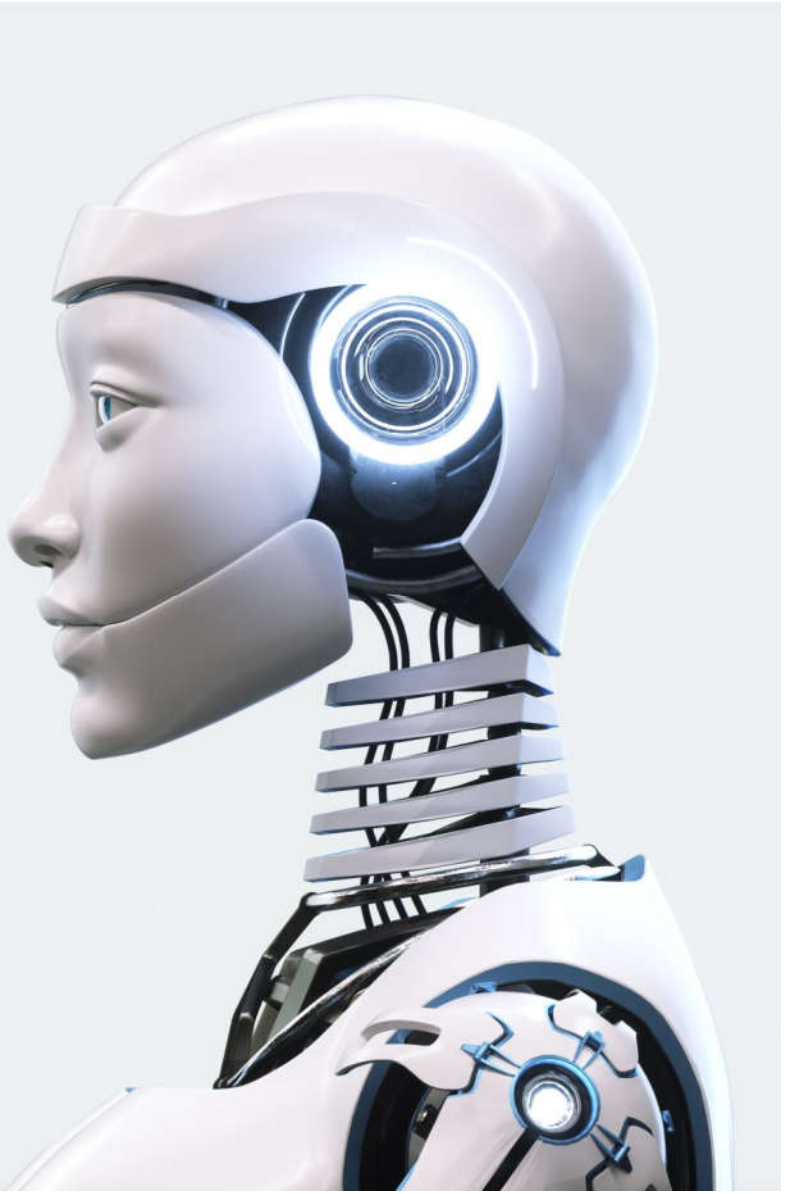


7. AI in Travel & Transport

- 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.



9. AI in Robotics:

- Artificial Intelligence 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.

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

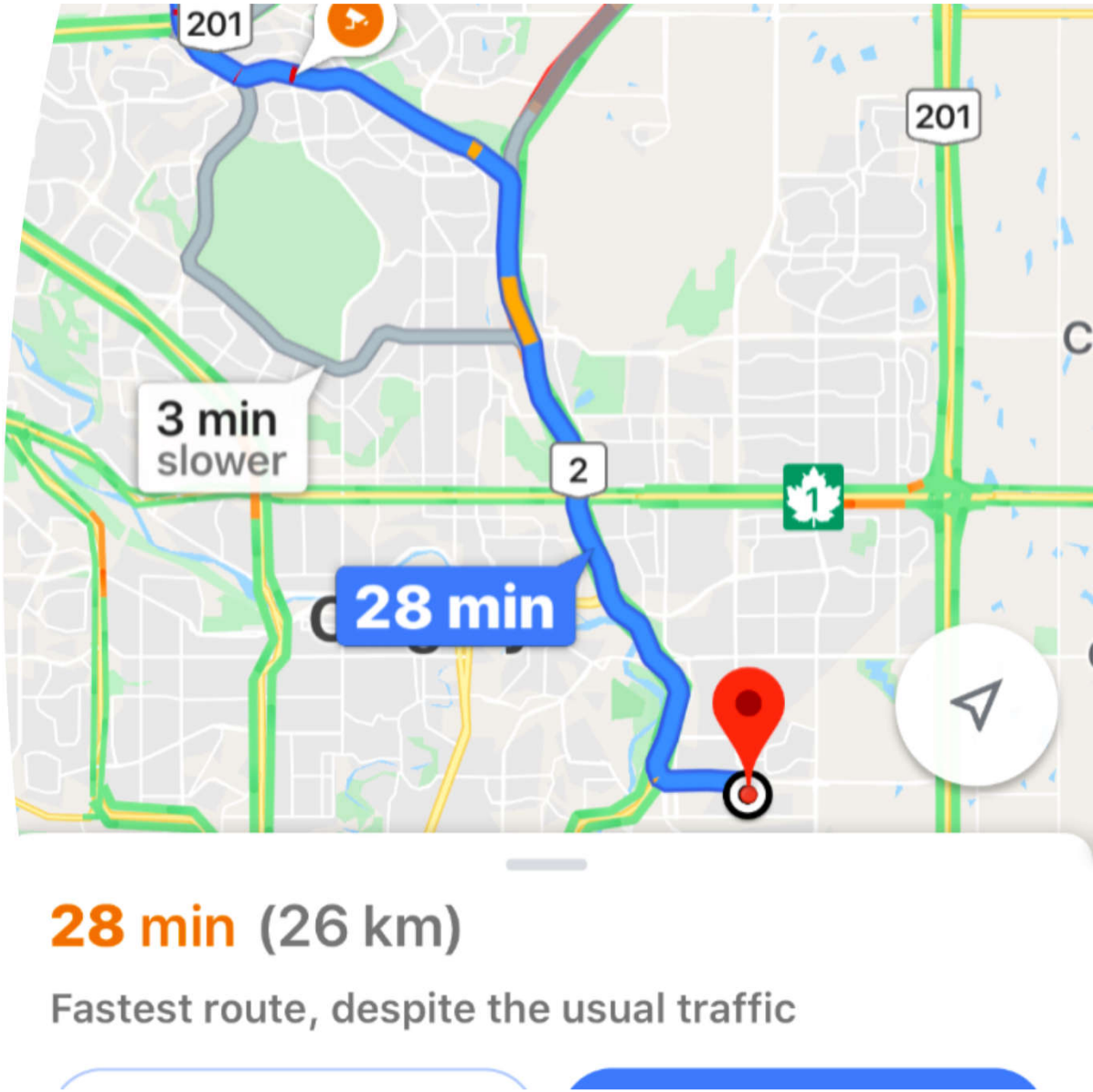
- AI is providing a competitive edge to the e-commerce industry, and it is becoming more demanding in the e-commerce business. AI is helping shoppers to discover associated products with recommended size, color, or even brand.

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.

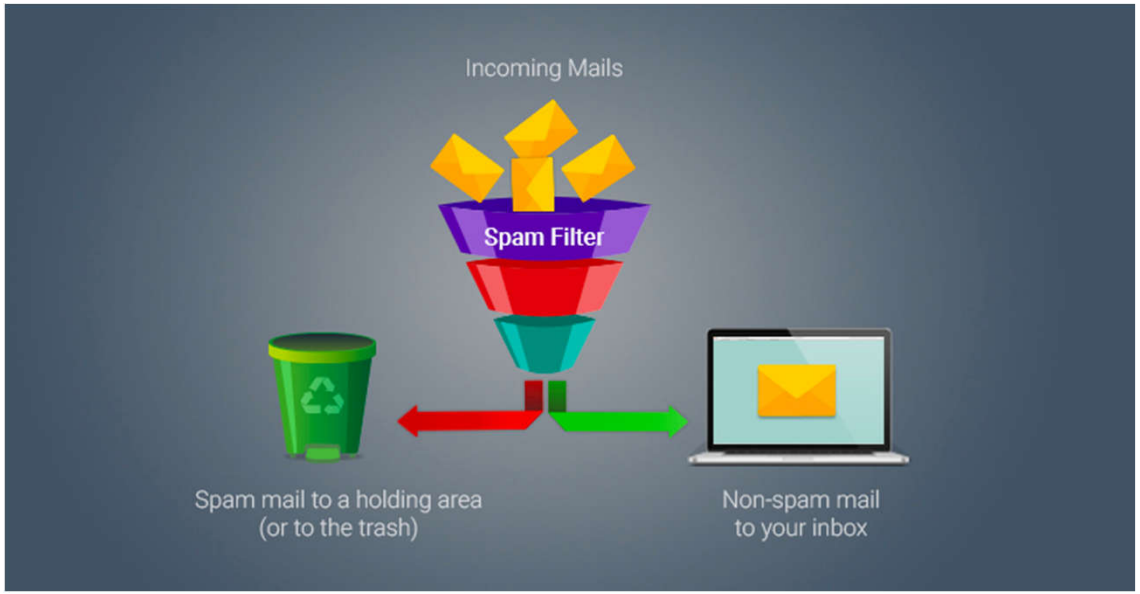
14. Google's AI-powered Predictions

- We all know that while traveling, Google Maps can examine the rate of movement of traffic at any instant of time.



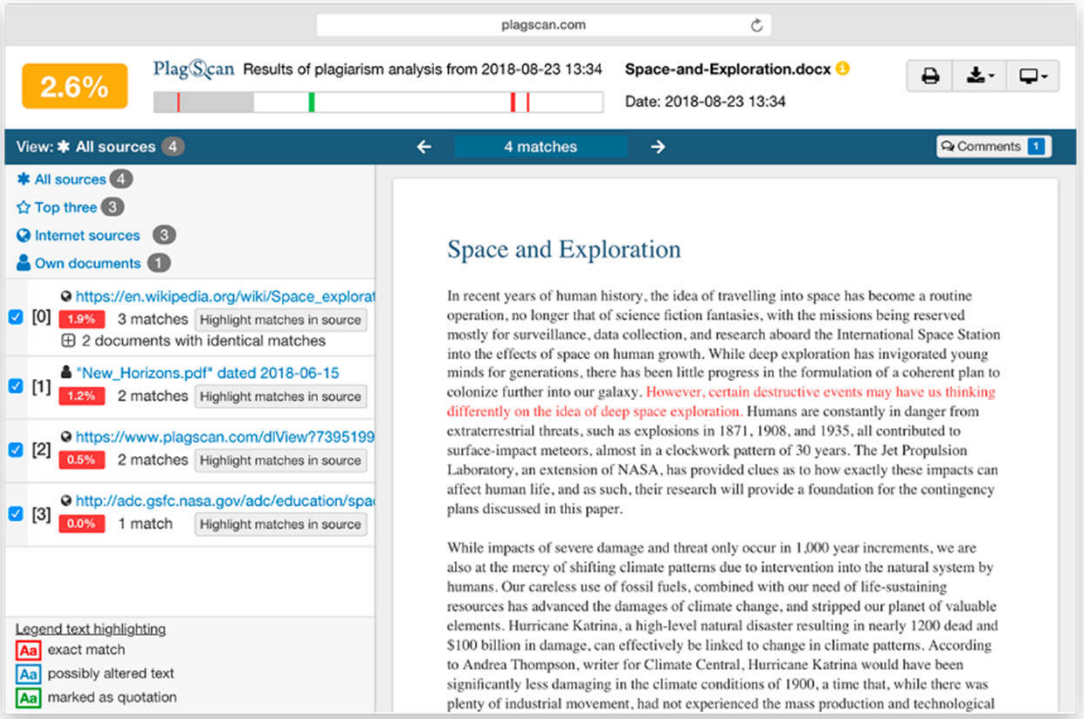
15. AI in Spam Filtering

- You will think that email inboxes do not have the use of Artificial Intelligence, but this technology is mostly operating in the email i.e. spam filter. It filters out the messages that come from hidden addresses. Spam filters continuously keep on updating themselves by refining different emails with some signals and words in the messages.



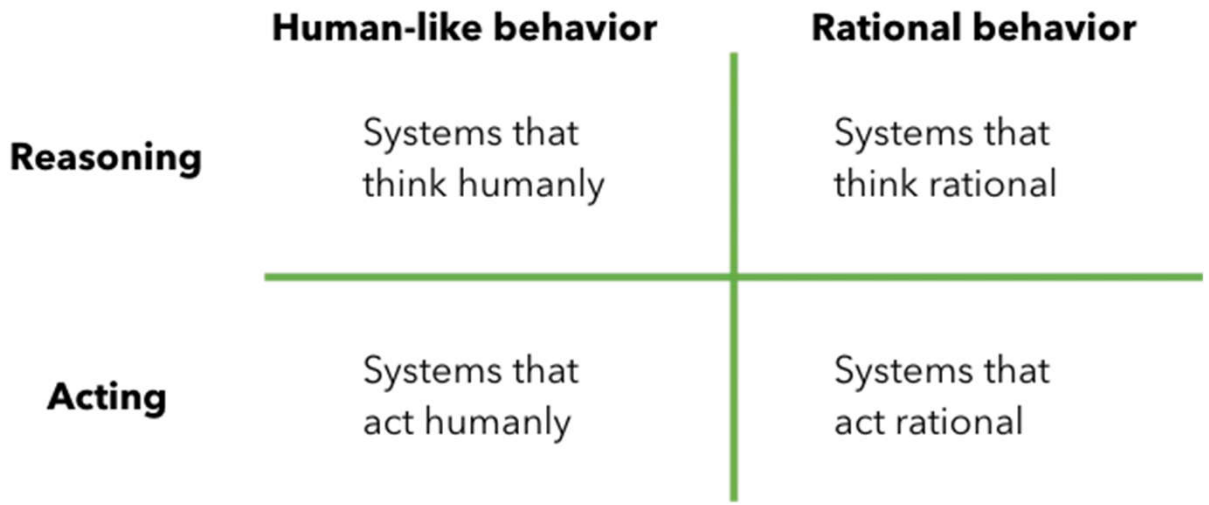
16. Plagiarism Checker

- As content writers, we regularly use tools like Turnitin, small SEO tools, plagiarism detectors, and many more to check the plagiarism of any article. These tools are in demand as they are used by many high schools and college students to check duplication.



4 different schools of thought

- Stuart *Russell* and Peter *Norvig* approach the definition of the term by distinguishing between the following four "schools of thought":



1. Systems that think humanly

- If we understand how the human brain works, we can simulate or rebuild it. Through psychological experiments, introspection and brain imaging we can try to gain insights about the mechanisms and patterns in the human mind. Mostly cognitive scientists follow this approach, but also psychologists and neuroscientists contribute on that field.
- "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)

2. Systems that act humanly

- One of the most popular approaches to the definition of AI is the **Turing Test**, proposed by Alan Turing (1950).

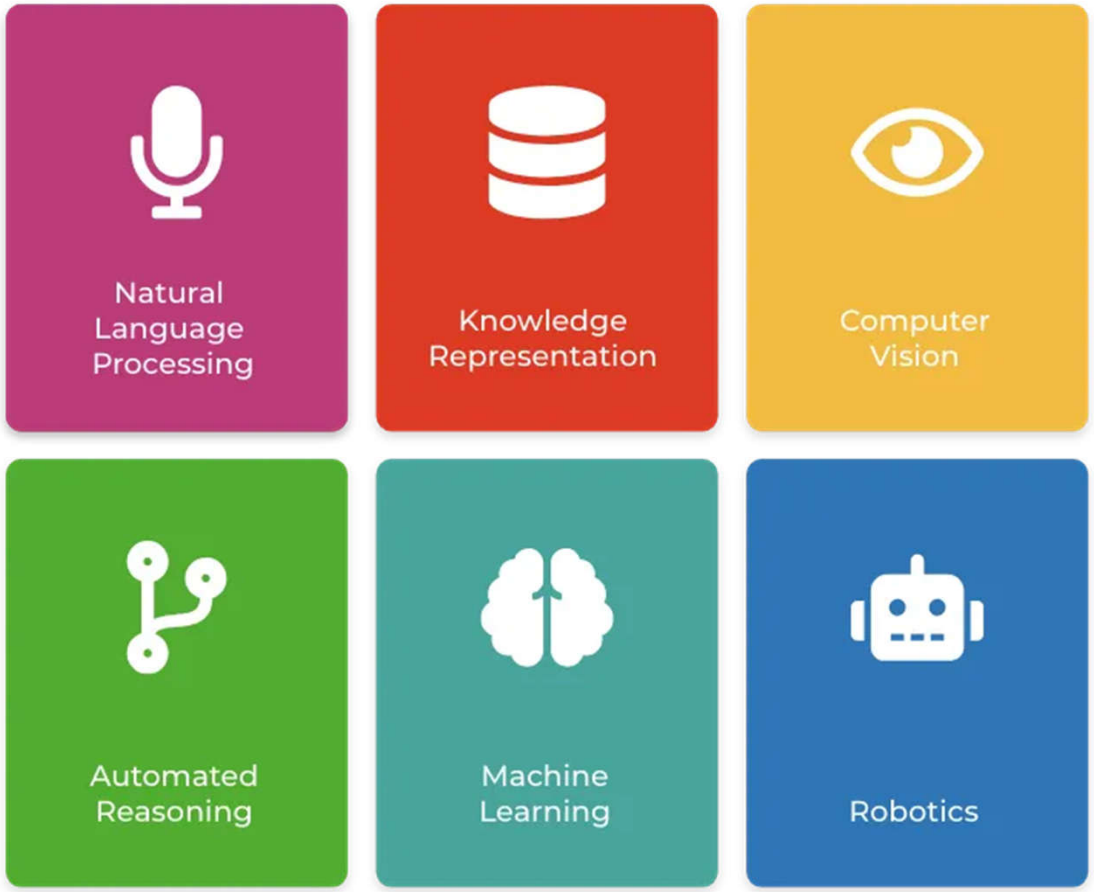
2. Systems that act humanly

- According to Russel and Norvig an AI would need the following capabilities to process the messages and return answers:
- **Natural Language Processing**: in order to understand and use language to communicate,
- **Knowledge Representation**: so that the AI can store what it knows and hears,
- **Automated Reasoning**: which means the AI is able to use the stored information and derive knowledge from it,
- **Machine Learning**: in order to learn from past input and actions, so the AI can adapt to a changing environment and detect patterns.

2. Systems that act humanly

- Moreover the **Total Turing test** additionally requires the human interrogator to see the AI system through video and give it mechanical tasks. In order to pass this far more complicated challenge, the AI would need:
- **Computer Vision**: the ability to perceive objects in the environment,
- **Robotics**: in order to fulfil mechanical tasks.

2. Systems that act humanly



2. Systems that act humanly

- “The study of how to make computers do things at which, at the moment, people are better.” (Rich and Knight, 1991)
- What is environment perception in AI?
- In the context of AI, perception generally refers to **the ability of a system to interpret and make sense of information from the environment**. In the case of AI, perception often involves the use of sensors and data processing techniques to understand the world.

3. Systems that think rationally

- This approach is mainly based on **logic** and has its routes in the Greece philosophy. A logic-based AI system uses a set out of rules, so called **syllogisms**, which it uses to draw conclusions.
- "Expert Systems" that encode the thinking of their developers, when working as intended, make decisions and act according to the rules of logic (**they are rational**). Machine Learning (ML) systems learn from experience; they do not follow rules. They are not in any sense rational.
- **Rational thinking is a process. It refers to the ability to think with reason**. It encompasses the ability to draw sensible conclusions from facts, logic and data. In simple words, if your thoughts are based on facts and not emotions, it is called rational thinking.

4. Systems that act rationally

- The last school of thought is the most modern approach in AI. It tries to define AI, with the concept of so called **rational agents**. An agent is just something that acts and a rational agent is one that acts so as to achieve the best outcome or, when there is uncertainty, the best expected outcome (Russel and Norvig, 2016).
- Some experts also define **AI** as a system that acts rationally. Here we use rational agents which can operate autonomously, perceive their environment, persist over a certain time period, adaptive and be able to create and pursue goals. It uses cognitive modelling.
- "Computational Intelligence is the study of the design of intelligent agents." (Pooleet al., 1998)

4. Systems that act rationally

- Rational Thinker: "Lots of people make mistakes. I doubt anyone even noticed, it didn't take away from the overall message, and I'll do better next time." Irrational Thinker: "I am such an idiot! People probably think I am incompetent and I'll never be asked to present again."