

ARTIFICIAL INTELLIGENCE (A.I.)



SYLLABUS

PART- A

Introduction: Intelligence, Foundations of artificial Intelligence(AI), History of AI, Agents and Environments, Rationality of Agents, Nature and Structure of Agents, Communication among agents.

Problem formulation and Solution: Problem types, states and operators, state space, Uninformed Search Strategies , Informed Search Strategies- Best first search, A* algorithm, heuristic functions, Iterative deepening A*(IDA), small memory A*(SMA).

Game Playing: Perfect information game, imperfect information game, evaluation function, MiniMax algorithm, alpha-beta pruning.

Logical Reasoning: Inference in Propositional Logic, First order Predicate logic, Resolution, Logical Reasoning, Forward chaining, Backward chaining, Knowledge representation techniques: Semantic networks and frames.

CONTENTS

- **INTRODUCTION**
- **FOUNDATION OF AI**
- **HISTORY**
- **CURRENT STATUS**
- **GOALS**
- **APPLICATIONS**
- **ADVANTAGES & DISADVANTAGES**
- **FUTURE SCOPE**



INTELLIGENCE

Intelligence has been defined in many ways: the capacity for logic, understanding, self-awareness, learning, emotional knowledge, reasoning, planning, creativity, critical thinking, and problem-solving.

More generally, it can be described as the ability to perceive or infer information, and to retain it as knowledge to be applied towards adaptive behaviors within an environment or context.

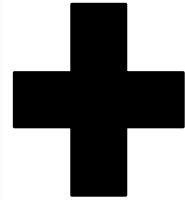


WHAT IS A.I.?

- 1) The study of computer systems that attempt to model and apply the intelligence of the human mind.
- 2) A branch of computer science dealing with the simulation of intelligent behavior in computers.
- 3) The capability of a machine to imitate intelligent human behavior.
- 4) AI is the simulation of human intelligence processes by machines, especially computer systems.

These processes include learning(the acquisition of information and rules for using the information), reasoning(using rules to reach approximate or definite conclusions) and self-correction.

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- ❑ Intelligence: “The capacity to learn and solve problems”
- ❑ Artificial Intelligence: Artificial intelligence (AI) is the simulation of human intelligence by machines.
 - The ability to solve problems
 - The ability to act rationally
 - The ability to act like humans

Definitions of artificial intelligence according to textbooks are shown in the table below. These definitions vary along two main dimensions. The ones on top are concerned with *thought processes and reasoning*, whereas the ones on the bottom address *behavior*. Also, the definitions on the left measure success in terms of *human performance*, whereas the ones on the right measure against an *ideal concept of intelligence*, which we will call **rationality**. A system is rational if it does the right thing.

<p>“The exciting new effort to make computers think ... <i>machines with minds</i>, in the 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>
<p>“The art of creating machines that perform functions that require intelligence when performed by people" (Kurzweil, 1990)</p> <p>“The study of how to make computers do things at which, at the moment, people are better" (Rich and Knight, 1991)</p>	<p>“A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes" (Schalkoff, 1990)</p> <p>“The branch of computer science that is concerned with the automation of intelligent behavior" (Luger and Stubblefield, 1993)</p>

There are four main views of AI in the literature, listed below. –

AI means acting humanly, i.e., acting like a person. The classic example of this is the “Turing test” .

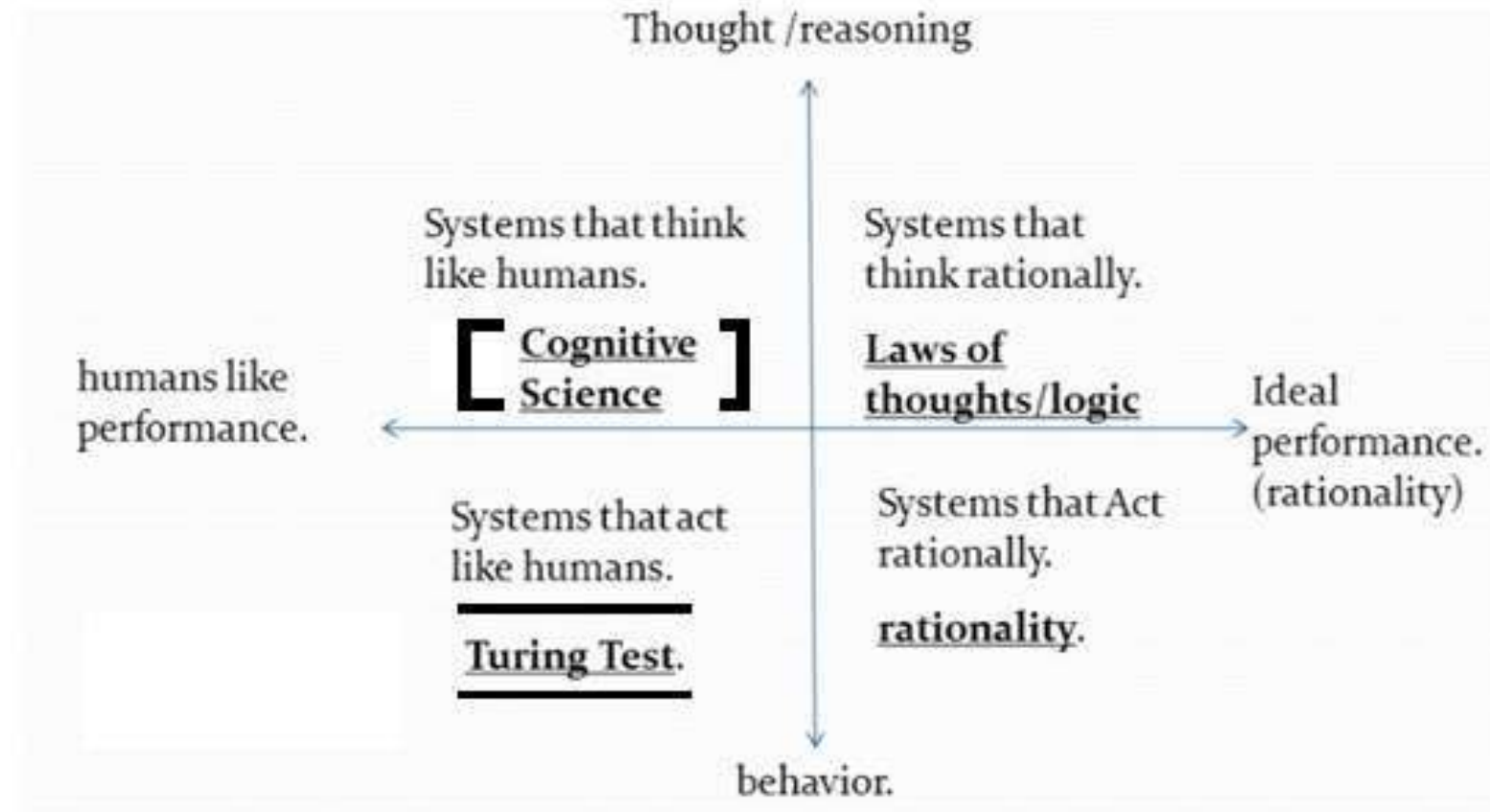
AI means thinking humanly, i.e., thinking like a person. The field of Cognitive Science delves into this topic, trying to model how humans think.

The difference between “acting humanly” and “thinking humanly” is that the first is only concerned with the actions, the outcome or product of the human’s thinking process; whereas the latter is concerned with modeling human thinking processes.

AI means thinking rationally, i.e., modeling thinking as a logical process, where conclusions are drawn based on some type of symbolic logic.

AI means acting rationally, i.e., performing actions that increase the value of the state of the agent or environment in which the agent is acting. For example, an agent that is playing a game will act rationally if it tries to win the game.

APPROACHES OF A.I.



Acting Humanly: Turing Test

- This is a problem that has greatly troubled AI researchers for years. They ask the question “when can we count a machine as being intelligent?”
- The most famous response is attributed to **Alan Turing**, a British mathematician and computing pioneer. The famous “**Turing Test**” was named after him, based on ideas he expressed in a paper published in 1950. Human interrogates entity via teletype for 5 minutes. If, after 5 minutes, human cannot tell whether entity is human or machine, then the entity must be counted as intelligent.

Thinking Humanly: Cognitive Science Approach

- Thinking humanly means trying to understand and model how the human mind works.
- There are (at least) two possible routes that humans use to find the answer to a question: – We reason about it to find the answer. This is called “introspection”. – We conduct experiments to find the answer, drawing upon scientific techniques to conduct controlled experiments and measure change.
- The field of Cognitive Science focuses on modeling how people think.

Thinking Rationally: Law of thought Approach

- Trying to understand how we actually think is one route to AI.
- But another approach is to model how we should think.
- The “thinking rationally” approach to AI uses symbolic logic to capture the laws of rational thought as symbols that can be manipulated.
- Reasoning involves manipulating the symbols according to well-defined rules, kind of like algebra.
- The result is an idealized model of human reasoning. This approach is attractive to theoretists, i.e., modeling how humans should think and reason in an ideal world.

Acting Rationally: Rational agent approach

- Acting rationally means acting to achieve one's goals, given one's beliefs or understanding about the world. An agent is a system that perceives an environment and acts within that environment. An intelligent agent is one that acts rationally with respect to its goals. For example, an agent that is designed to play a game should make moves that increase its chances of winning the game.
- When constructing an intelligent agent, emphasis shifts from designing the theoretically best decision-making procedure to designing the best decision-making procedure possible within the circumstances in which the agent is acting.
- Logical approaches may be used to help find the best action, but there are also other approaches.
- Achieving so-called “perfect rationality”, making the best decision theoretically possible, is not usually possible due to limited resources in a real environment (e.g., time, memory, computational power, uncertainty, etc.).
- The trick is to do the best with the information and resources you have. This represents a shift in the field of AI from optimizing (early AI) to satisfying (more recent AI).

TYPES OF AI

AI technologies are categorized by their capacity to mimic human characteristics, the technology they use to do this, their real-world applications, and the theory of mind.

Using these characteristics for reference, all artificial intelligence systems - real and hypothetical - fall into one of three types:

- 1. Artificial narrow intelligence (ANI)**, which has a narrow range of abilities.
- 2. Artificial general intelligence (AGI)**, which is on par with human capabilities.
- 3. Artificial super intelligence (ASI)**, which is more capable than a human.

1. Strong AI (AGI) – Also known as deep AI ; The idea that a computer can be made or raised to intelligence levels that match human beings.

AI researchers and scientists have not yet achieved strong AI.

2. Weak AI (ANI) – Otherwise known as narrow AI; The idea that computers can be endowed with features that mirror or mimic thought or thinking processes, making them useful tools for figuring out how our own mind works. Narrow AI systems also enhance or augments human “intelligence” by delivering calculations, patterns and analyses more efficiently than can be done by a human brain. **Examples of narrow AI:**

Siri by Apple, Alexa by Amazon, Cortana by Microsoft and other virtual assistants, Image / facial recognition software.

3. Artificial Superintelligence (ASI)- Artificial super intelligence (ASI), is the hypothetical AI that doesn't just mimic or understand human intelligence and behavior; ASI is where machines become self-aware and surpass the capacity of human intelligence and ability.

Differences between strong and weak AI

1. With strong AI, machines can actually think and carry out tasks on their own, just like humans do. With weak AI, the machines cannot do this on their own and rely heavily on human interference.
2. Strong AI has a complex algorithm that helps it act in different situations, while all the actions in weak AIs are pre-programmed by a human.
3. Strong AI-powered machines have a mind of their own. They can process and make independent decisions, while weak AI-based machines can only simulate human behavior.

Foundation of A.I

The various disciplines that contributed ideas, viewpoints and techniques to AI are given below:

Philosophy logic, methods of reasoning mind as physical system foundations of learning, language, rationality

Mathematics formal representation and proof algorithms, computation, (un)decidability, (in)tractability probability

Psychology adaptation phenomena of perception and motor control experimental techniques (psychophysics, etc.)

Economics formal theory of rational decisions

Linguistics knowledge representation grammar

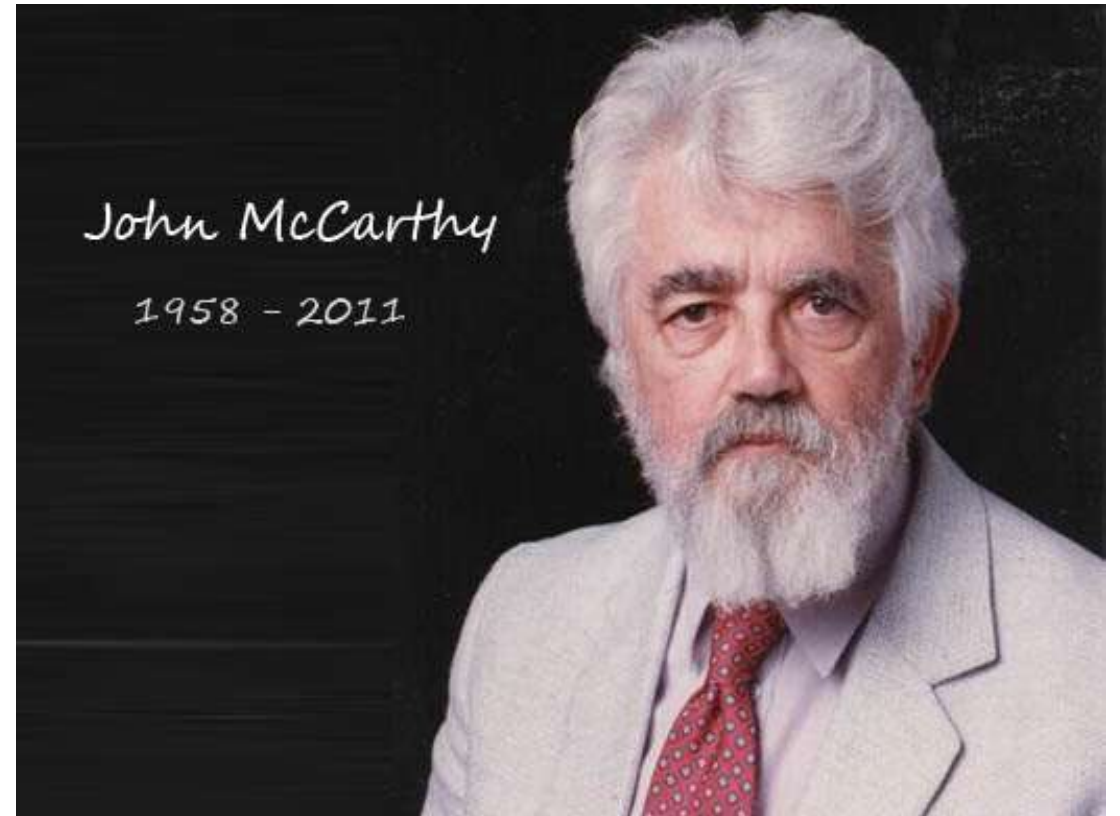
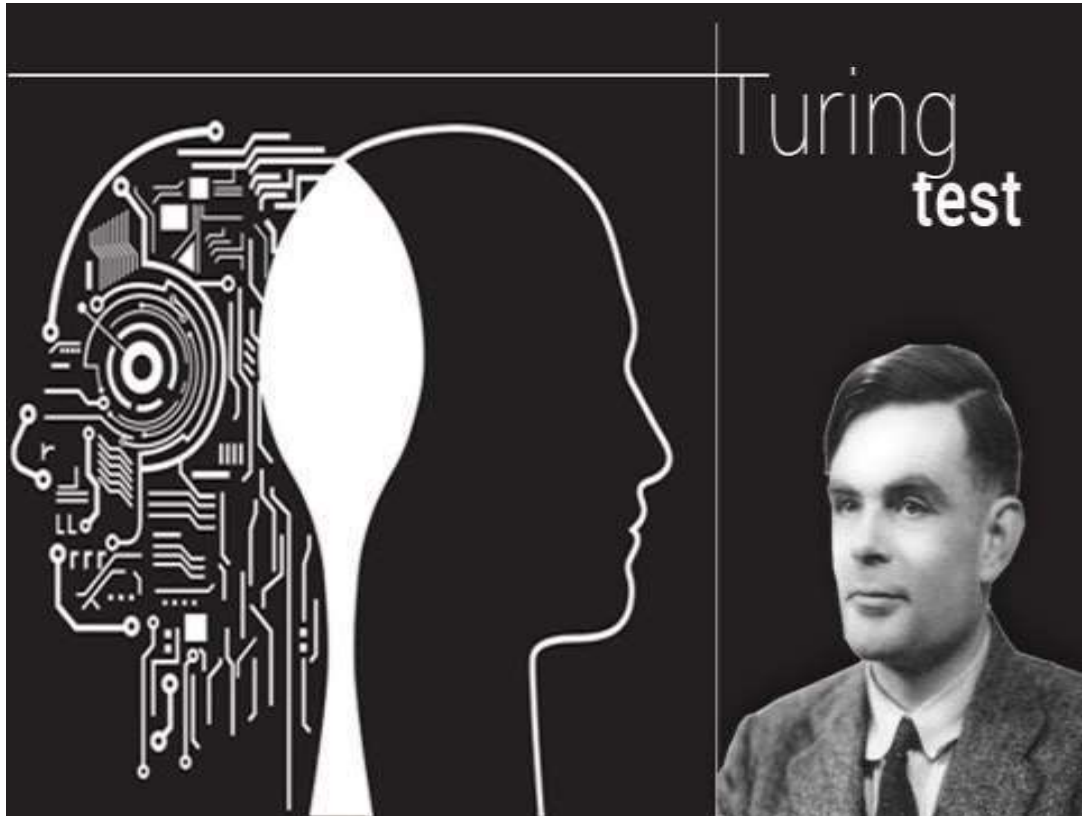
Neuroscience plastic physical substrate for mental activity

Control theory homeostatic systems, stability simple optimal agent designs

HISTORY OF A.I.

In 1950 English mathematician Alan Turing wrote a landmark paper titled “**Computing Machinery and Intelligence**” that asked the question: “Can machines think?”

Further work came out of a 1956 workshop at Dartmouth sponsored by **John McCarthy**. In the proposal for that workshop, he coined the phrase a “study of **Artificial Intelligence**”



History of A.I

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.

History of A.I

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 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.
- 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.

A.I. TIMELINE

1943 McCulloch & Pitts: Boolean circuit model of brain

1950 Turing's "Computing Machinery and Intelligence"

1950s Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine

1956 Dartmouth meeting: "Artificial Intelligence" adopted

1965 Robinson's complete algorithm for logical reasoning

1966–74 AI discovers computational complexity Neural network research almost disappears

1969–79 Early development of knowledge-based systems

1980–88 Expert systems industry booms

1988–93 Expert systems industry busts: "AI Winter"

1985–95 Neural networks return to popularity

1988– Resurgence of probability; general increase in technical depth "Nouvelle AI": ALife, GAs, soft computing

1995– Agents, agents, everywhere ...

2003– Human-level AI back on the agenda

CURRENT STATUS OF A.I.

A.I. FOR GOOD



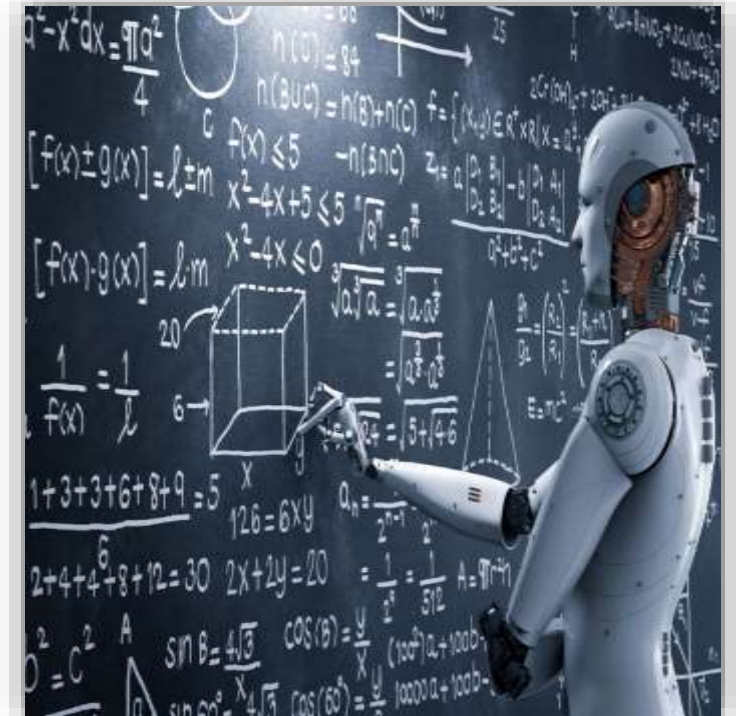
- Analyse Satellite Images to identify which areas have the highest poverty level.

AVIATION



- Gate allocation for plane while landing.
- Ticket price determination.

EDUCATION



- Companies are creating robots to teach subjects.

CURRENT STATUS OF A.I.

HEALTHCARE



- Solving a variety of problems of patients, hospitals & healthcare industry overall.
- Using Avatars in place of patients.

HEAVY INDUSTRY



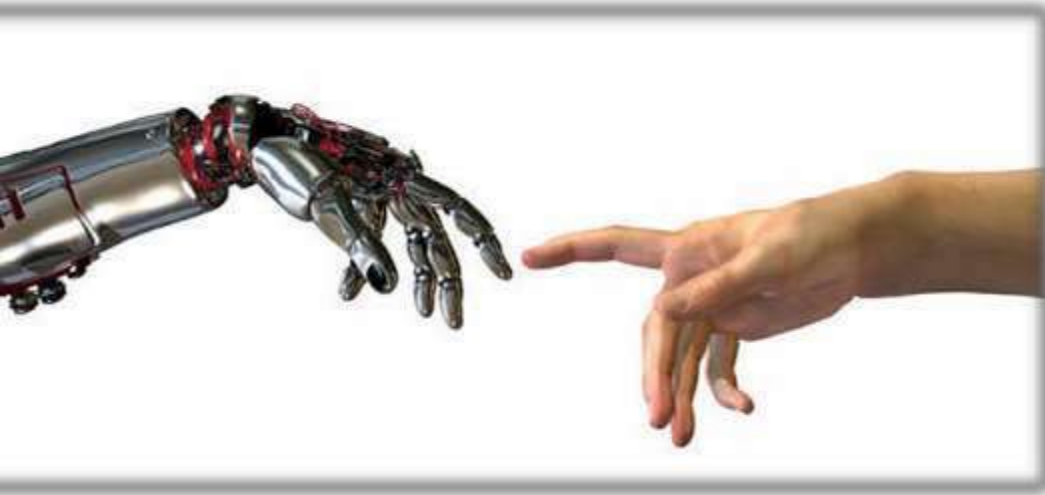
- Robots have become very common in many industries.
- Can do repetitive laborious tasks.

FINANCE



- Market analysis & data Mining.
- Personal Finance.
- Portfolio management.

GOALS OF A.I.



- **Deduction, Reasoning and Problem Solving:**

- To develop algorithms that human use.
- Algorithms can require enormous computational resources and problem goes beyond a certain size.

- **Knowledge Representation:**

- To build machine with the capability of making working assumption and commonsense.

GOALS OF A.I.

• Planning:

- In planning problems, the decision making tasks performed by computer programs to achieve a specific goal.
- The execution of planning is about choosing a sequence of actions with a likelihood to complete the specific task.



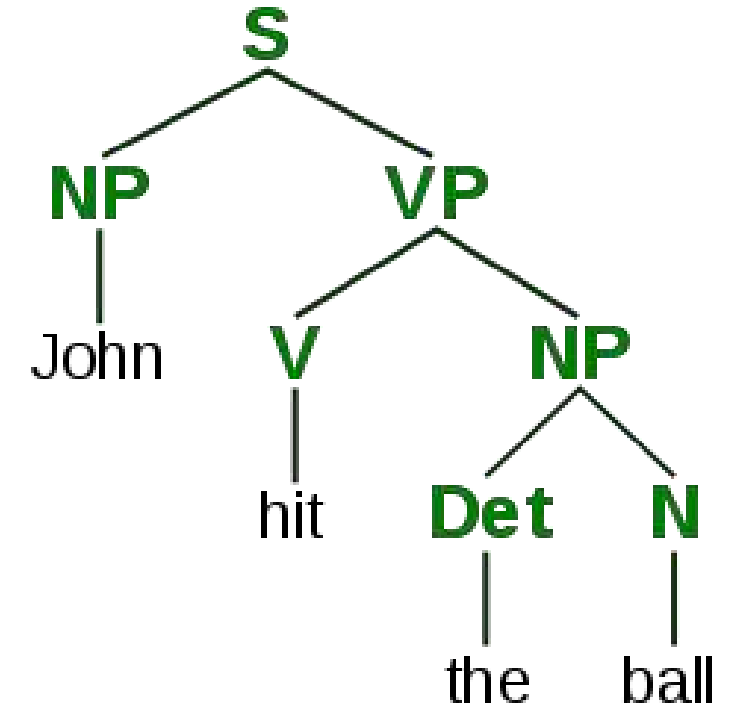
• Learning:

- Machine learning is the fundamental concept of AI search.
- **Unsupervised learning:** The outcomes or output for the given inputs is unknown. It is the ability to find patterns in a stream of input.
- **Supervised learning:** The outcome for the given input is known before itself. It includes both classification and regression.

GOALS OF A.I.

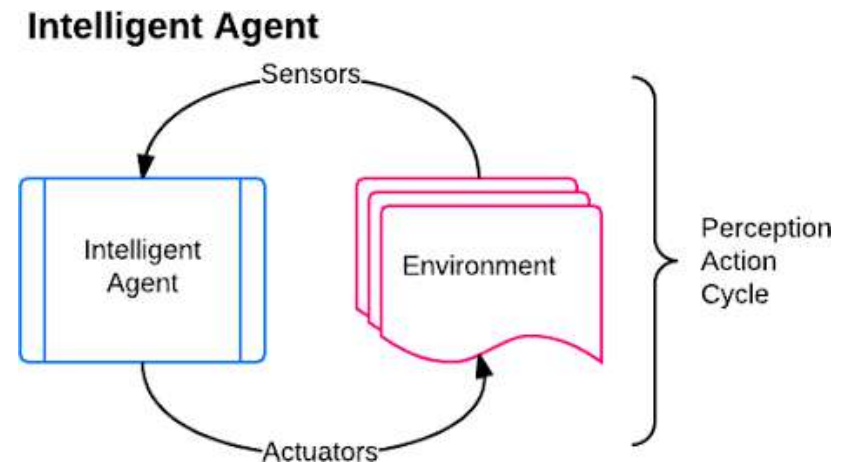
- **Natural Language Processing:**

- Natural Language Processing gives machines the ability to read and understand human language.
- Common method of processing meaning from natural language is through semantic indexing.

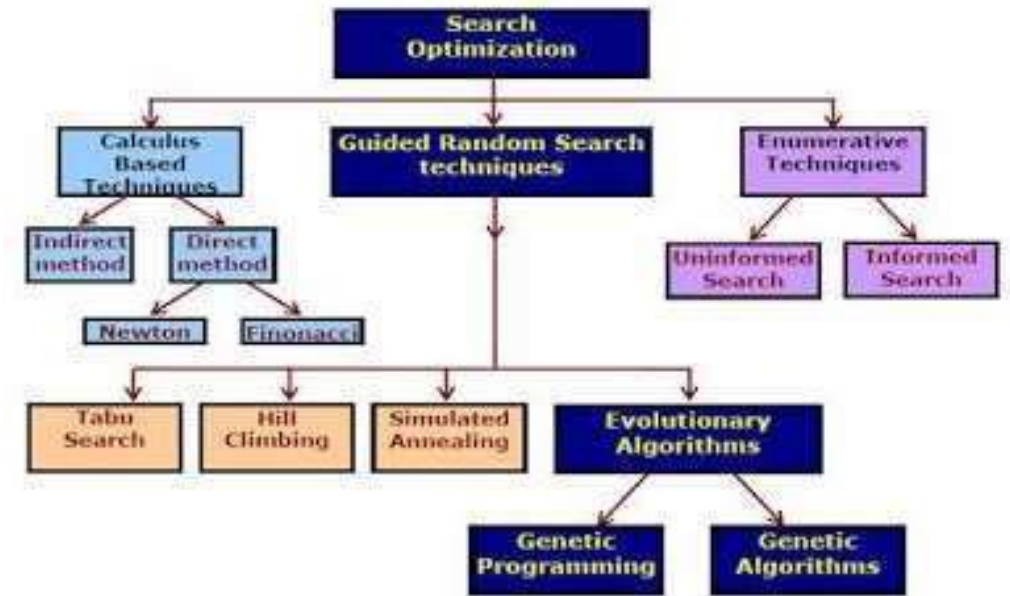
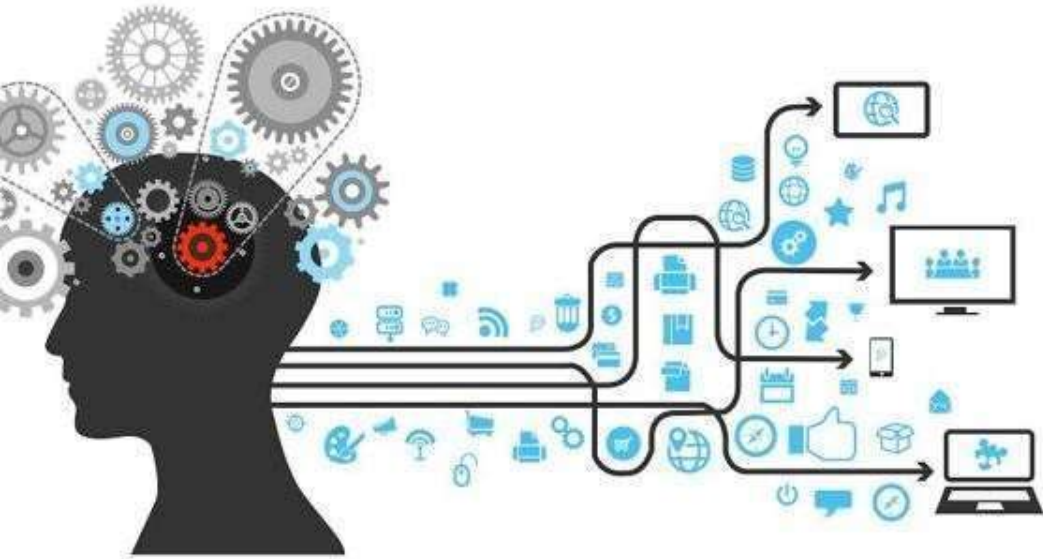


- **Perception:**

- Machine perception is the ability to use input from sensors to deduce aspects of the world.



TOOLS FOR A.I.



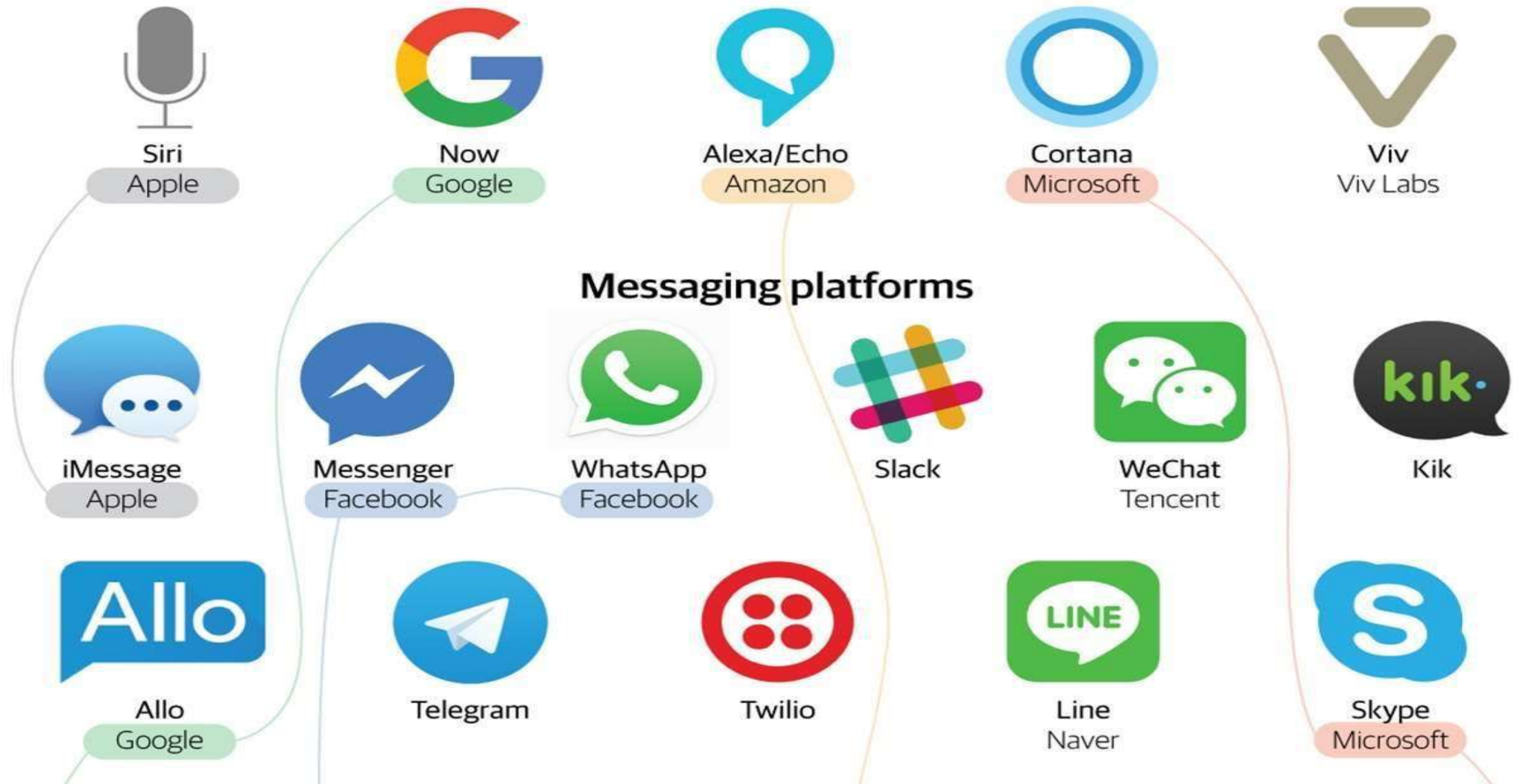
- Search & Optimization
- Logic
- Probabilistic Methods
- Neural Networks



GENERAL A.I. AGENTS WITH PLATFORMS

General AI agents with platforms

Developer access available now or announced



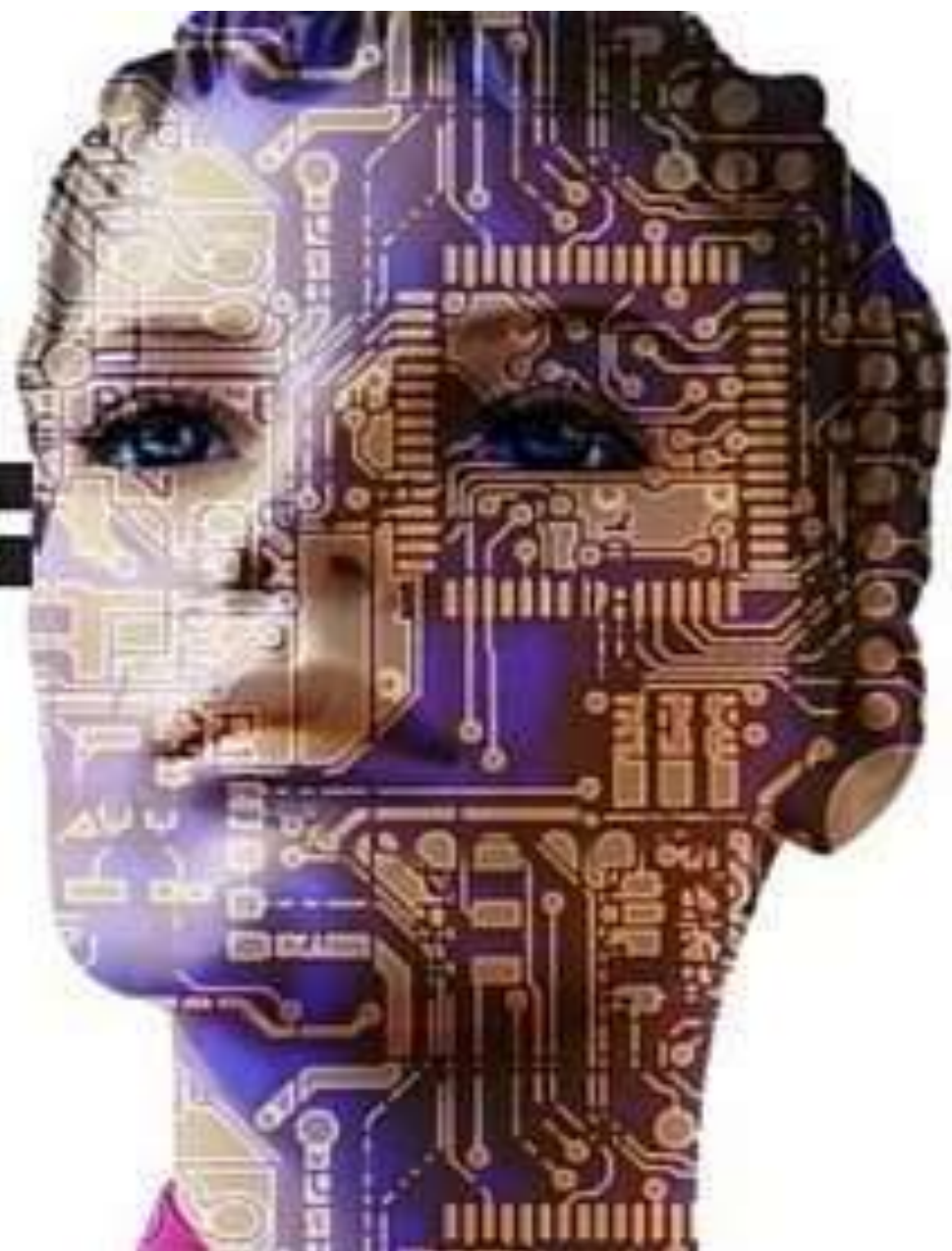
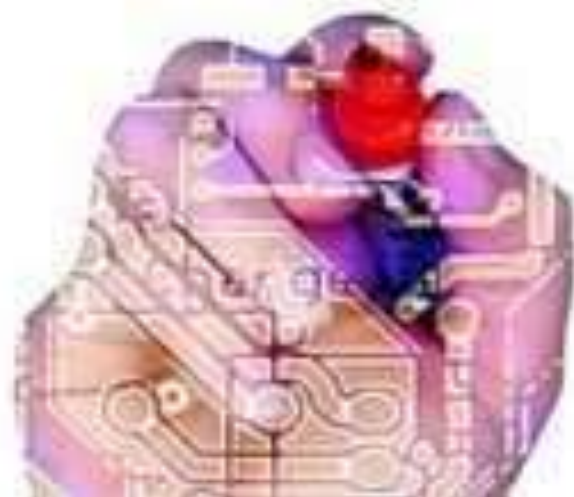
DAILY LIFE APPLICATIONS OF A.I.



- Healthcare
- Video games
- Finance & Economics
- Robotics
- Education

ARTIFICIAL INTELLIGENCE

Advantages and Disadvantages



ADVANTAGES OF A.I.



- The chances of error are almost nil.
- It can be used to explore space, depths of Ocean.
- Machines do not require sleep or break and are able to function without stopping.

- It can be used in time-consuming tasks efficiently.
- Algorithms can help the doctors to access patients and their health risks.



ARTIFICIAL INTELLIGENCE A DEVIL IN DISGUISE?

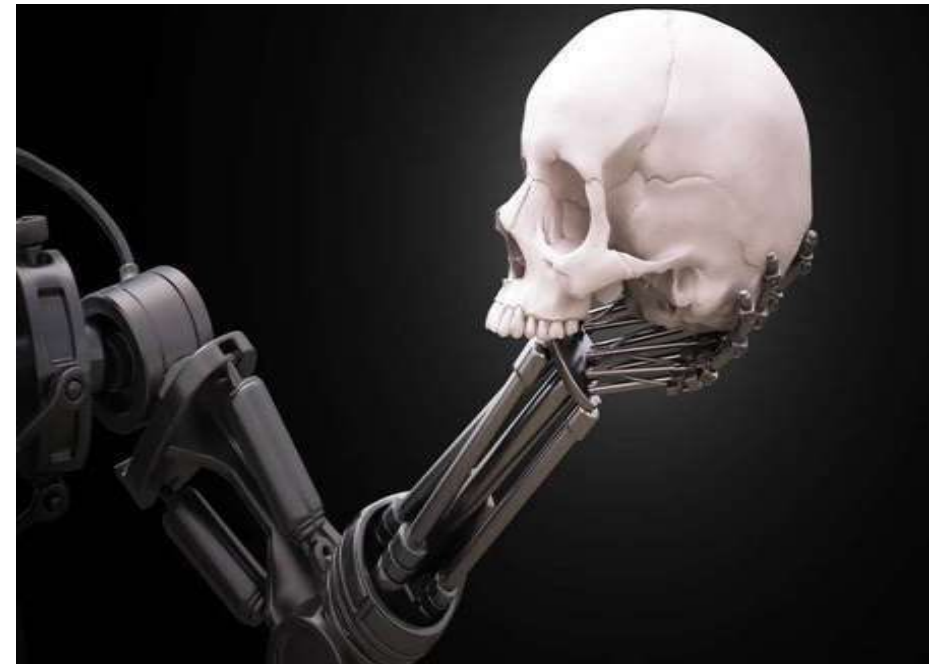


DISADVANTAGES OF A.I.



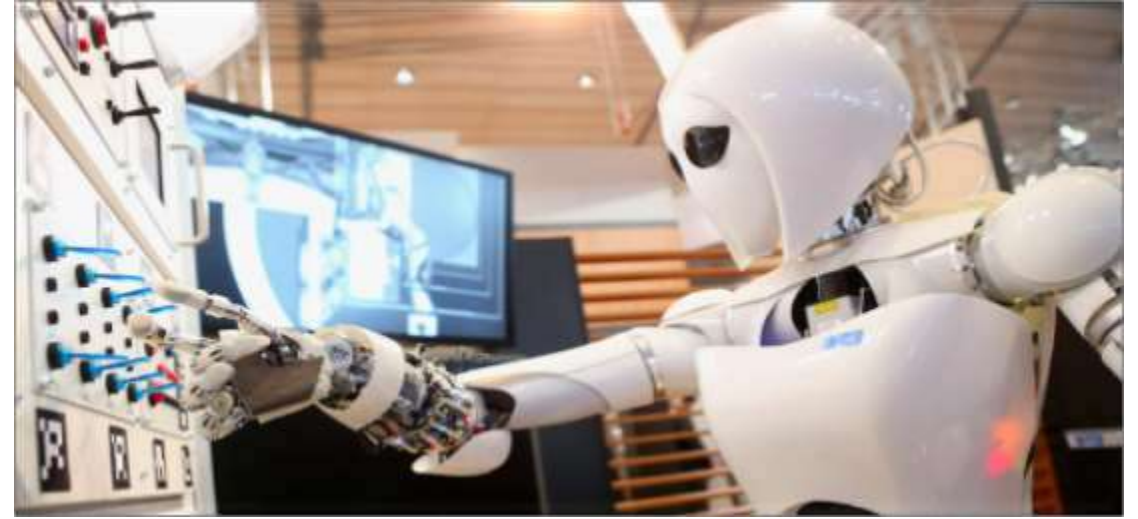
- **High Cost.**
- **Difficult Code.**
- **Many people end up without any job.**

- **Decrease in demand for human labour.**
- **No improvement with experience.**
- **The storage and access are not as effective as human brain.**



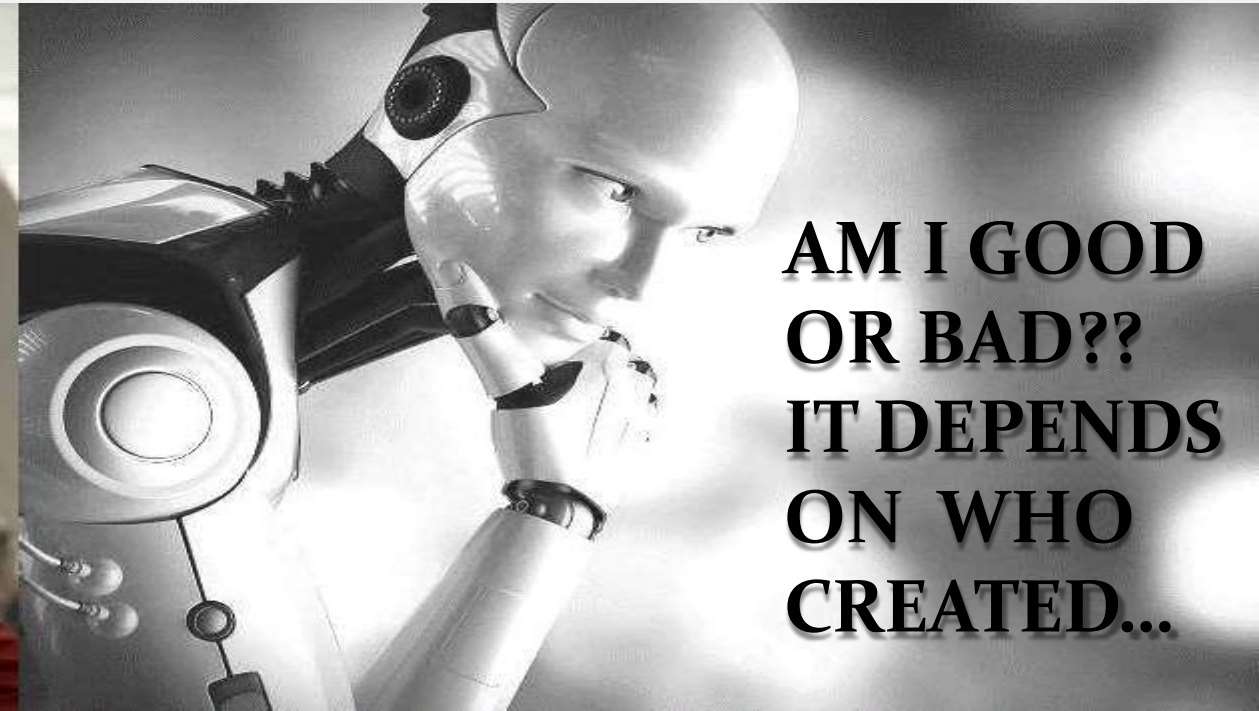


WHAT WILL BE THE NEXT DECADE BRINGS ??



- Improved speech, voice, image ,video recognition will change the way devices interact.
- Personal assistants will become more personal and context aware.
- More and more systems will run autonomously to a point.
- The positive impact AI research can have on humanity will start to be across many walks of life - much of it behind the scenes.

OBJECTIVES



**AM I GOOD
OR BAD??
IT DEPENDS
ON WHO
CREATED...**

**A.I. IS LIKE TWO EDGED SWORD , AT ONE END THEY CAN
SOLVE PROBLEMS INTELLIGENTLY, AT ANOTHER END
THEY POSE A PROBLEM THEMSELVES.....SO WE HAVE TO
HANDLE IT PROPERLY.**

Thank you!