Introduction to Artificial Intelligence

Dr.Thyagaraju G S

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2. Biological Neuron
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Steps to Become AI Expertise

1. Understand the Fundamental concepts of AI
2. Learn Mathematical Concepts for AI
    a. Linear Algebra
    b. Probability
    c. Statistics
    d. Calculus (Multivariate)
    e. First order and Higher Order Logics
    f. Discrete Mathematics
    g. Optimization Tecnhiques

Steps to Become AI Expertise

3. Learn to Mathematical Modeling of Realtime Applications
4. Master the Following Topics :
   a. Problem Solving Techniques [*Searching , Classical Search , Adversarial Search, Constrain Satisfaction Problems*]
   b. Knowledge , Reasoning and Planning [*Agents , Logic , Planning , Knowledge Representation*]
   c. Uncertainty and Probabilistic Reasoning
5. Machine Learning Algorithms : Supervised Techniques
6. Machine Learning Algorithms : Unsupervised Techniques
7. Machine Learning Algorithms : Reinforced Techniques
8. Artificial Neural Network :
9. Deep Learning (DNN)

Steps to Become AI Expertise

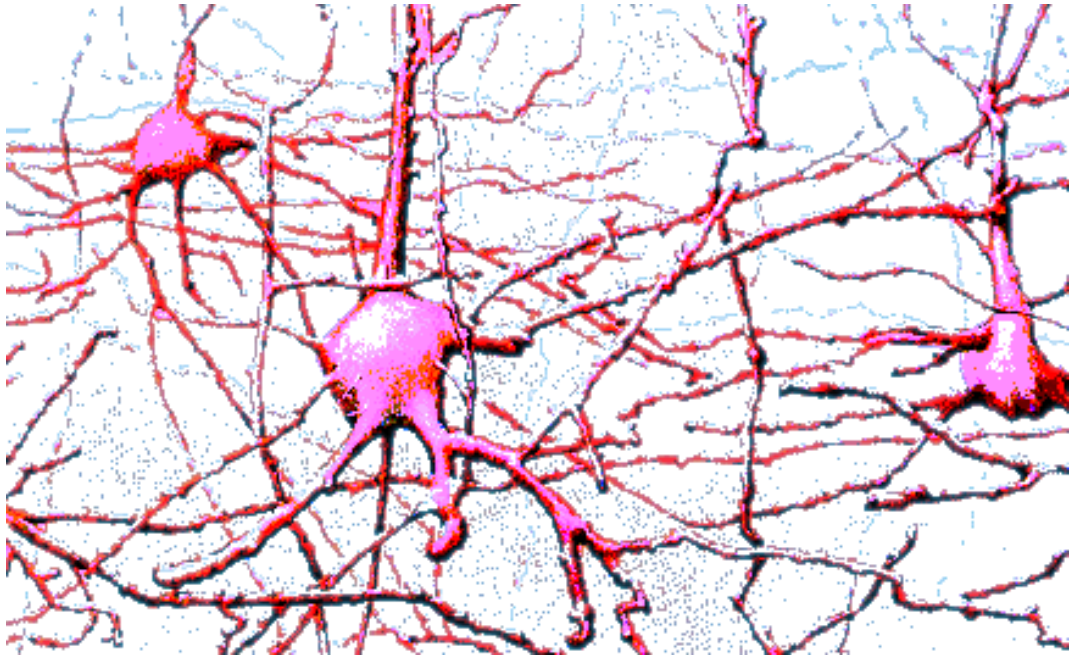
10. Data Analytics
11. Speech Processing
12. Natural Language Processing
13. Image Processing and Pattern Recognition
14. Video Processing
15. Robotics
16. Self Drive Car
17. Master Python Language and Tools [From Beginning to End]

    Fundamental Python , NumPy , Pandas , SciPy , Scikit Learn ,Tensor Flow , Keras , Theano , Speech Processing , Natural Language Processing Tool Kit ,etc.
18. Doing Projects Regulary

2. Biological Neuron

Animals are able to react adaptively to changes in their external and internal environment, and they use their nervous system to perform these behaviours.

An appropriate model/simulation of the nervous system should be able to produce similar responses and behaviours in artificial systems.



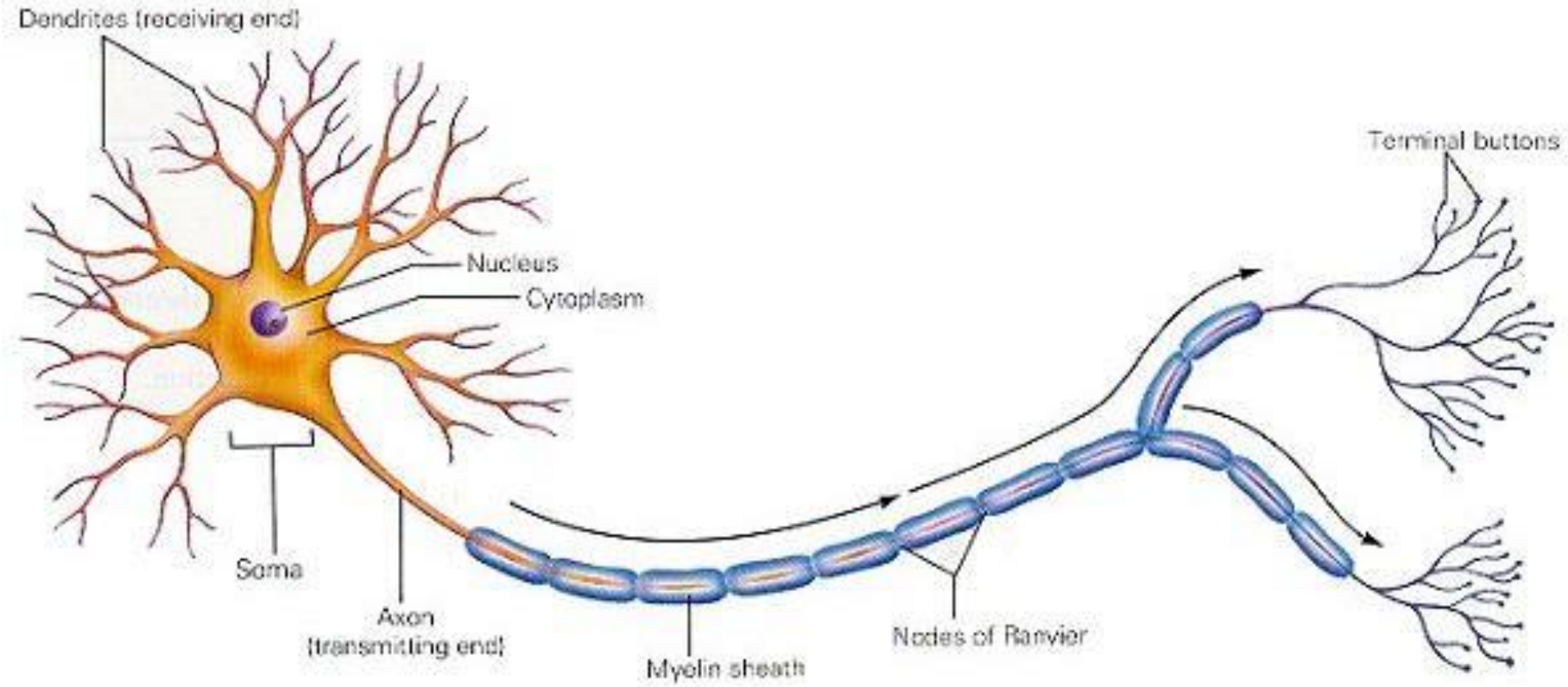
Neurons

The human brain consists has about 100 billion (10^{11}) neurons and 100 trillion (10^{14}) connections (synapses) between them.

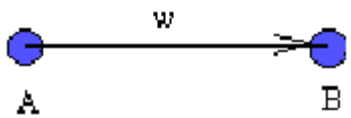
Many highly specialized types of neurons exist, and these differ widely in appearance. Characteristically, neurons are highly asymmetric in shape.

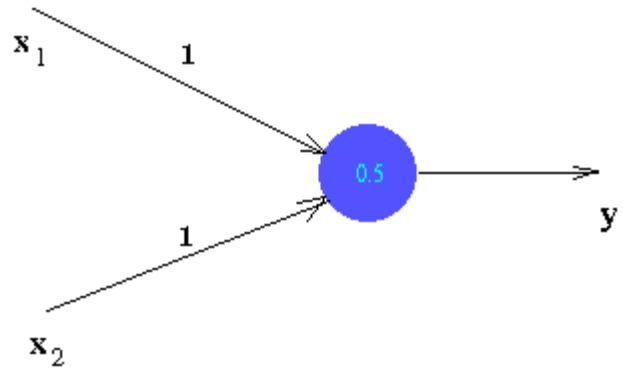
Neurons – cont.

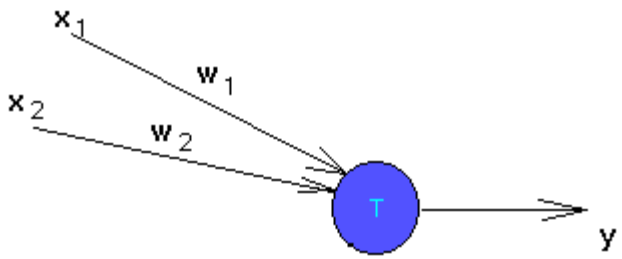
Here is what a typical neuron looks like:



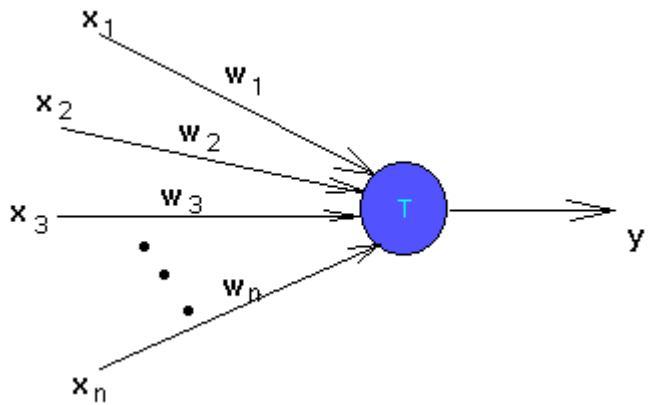
Artificial neurons Neuron







y = w1*x1 + w2*x2
Take X=1, ==> y=w1*x1+w2 ??



3.1 Cognition

- **Cognition** is "the mental action or process of acquiring knowledge and understanding through ***thought, experience, and the senses***".
- Simply put, cognition is thinking, and it encompasses the processes associated with *attention , perception, memory and working memory , knowledge , reasoning , computation, problem solving, judgment, evaluation, language, decision making and comprehension*.
- **Cognitive processes use existing knowledge and generate new knowledge.**

3.2 Categories

- A **category** is a set of objects that can be treated as equivalent in some way.
- For example, consider the following categories: **trucks, wireless devices, weddings, psychopaths, and trout**.

3.3 Concepts

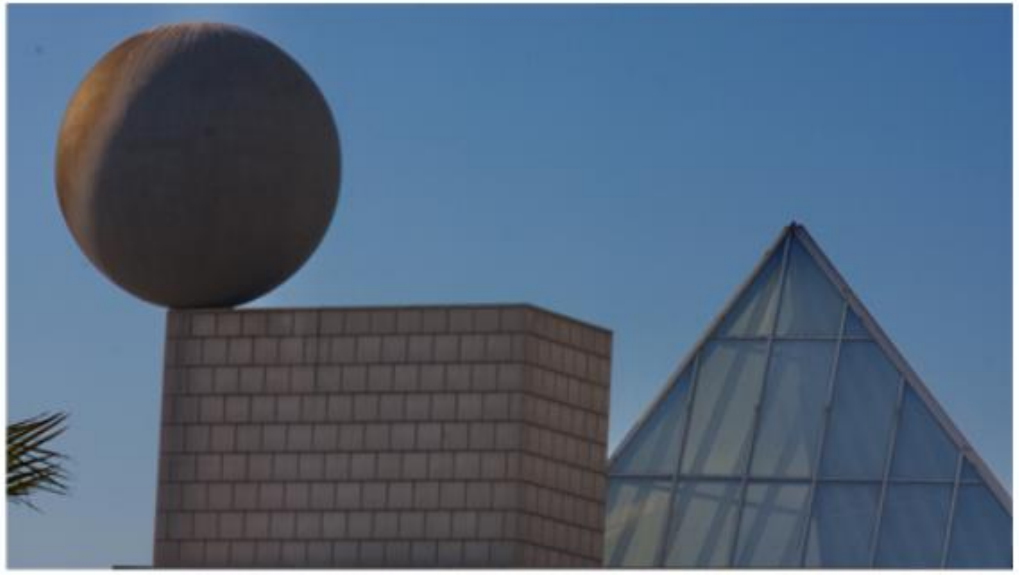
- The mental representations we form of categories are called **concepts**.

Natural Concept

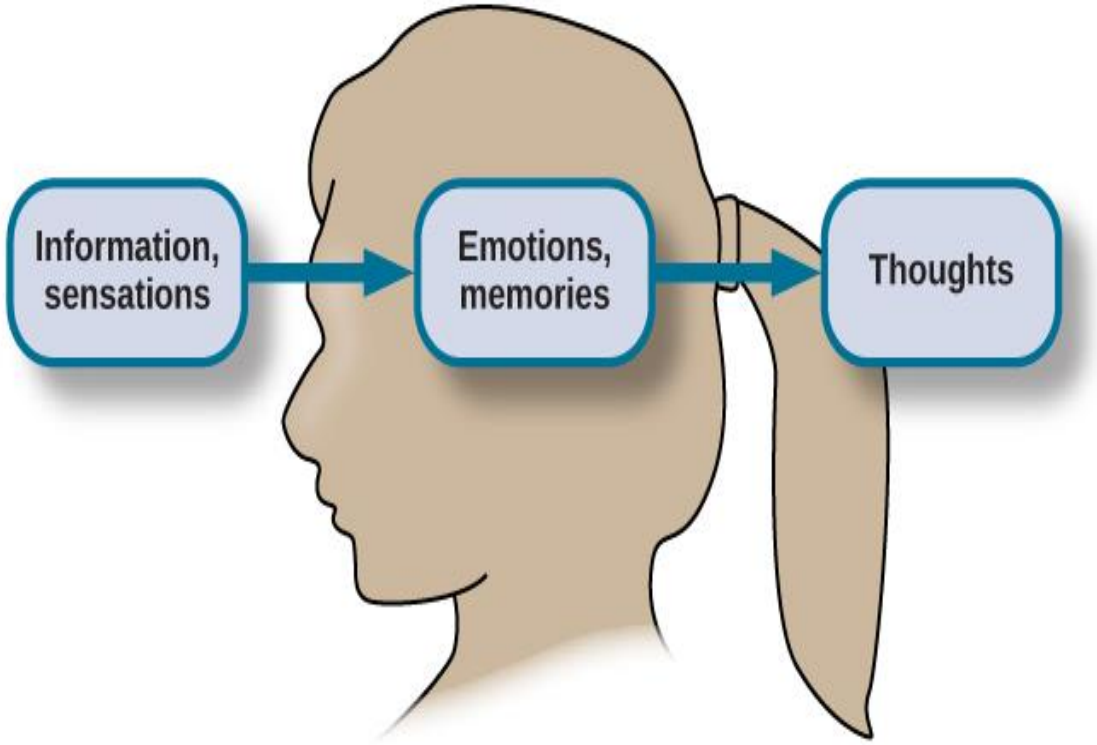
- **Natural concepts** are created “naturally” through your experiences and can be developed from either direct or indirect experiences.

Artificial Concept

- An **artificial concept**, on the other hand, is a concept that is defined by a specific set of characteristics.
- Various properties of geometric shapes, like squares and triangles, serve as useful examples of artificial concepts. A triangle always has three angles and three sides.
- A square always has four equal sides and four right angles. Mathematical formulas, like the equation for area (length × width) are artificial concepts defined by specific sets of characteristics that are always the same. Artificial concepts can enhance the understanding of a topic by building on one another.



3.4 Thoughts



- Mental Representation of Information Processing .
- Thoughts can be idea-like, memory-like, picture-like, or song-like. They are usually short-lived, discrete events, unlike a continuous events such as the constant murmurs of airconditioners and rain.
- We all experience thoughts and have no problem identifying them and speaking about them to others.

3.5 Prototypes

- Another technique used by your brain to organize information is the identification of prototypes for the concepts you have developed. A **prototype** is the best example or representation of a concept. For example, for the category of civil disobedience, your prototype could be Mahatma Gandhi.

TRY IT

Cognitive psychology is the branch of psychology that focuses on the study of _____.

- human behavior
- human thinking
- human development
- human society

TRY IT

Which of the following is an example of a prototype for the concept of leadership on an athletic team?

- the team captain
- the equipment manager
- the scorekeeper
- the quietest member of the team

TRY IT

Which of the following is an example of an artificial concept?

- Mammals
- Gemstones
- Teachers
- A triangle's area

4. What is Intelligence ?

- The ability to acquire and apply knowledge and skills
- Is defined as general cognitive problem-solving skills.
- A mental ability involved in reasoning, perceiving relationships and analogies, calculating, learning quickly… etc.

Intelligence Boosters

- **Deep thinking**
- **Good reasoning**
- **Learning from past experience :**
- **Practice**

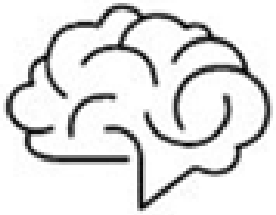
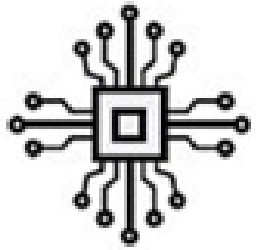
Brain Exercises [http://www.brainmetrix.com/]

- Brain Reflection Test
- Brain Creativity [level based games]
- Memory Test
- Brain Stretching [Tower of Hanoi]
- Sudoku Brain Stimulation
- Spatial Intelligence [Rubik's Cube]
- Math Problems
- Brain Concentration
- Arrange Game

4.1 Natural Intelligence

- Natural intelligence (NI) is the opposite of artificial intelligence: it is all the systems of control present in biology.
- Normally when we think of NI we think about how animal or human brains function, but there is more to natural intelligence than neuroscience.
- Nature also demonstrates non-neural control in plants and protozoa, as well as distributed intelligence in colony species like ants, hyenas and humans.
- Understanding natural intelligence requires understanding all of these influences on behavior and their interactions.

Comparison of Brain with a supercomputer

	Weight	Space	Processor Speed	Energy Efficiency
	3 pounds (1.4 kg)	1/6 basketball (80 cubic inches or 1,300 cm^3)	Up to 1,000,000 trillion operations per second	20 watts
	150 tons	Basketball court (cabinets over 4,350 square feet, or 400 m^2)	93,000 trillion operations per second	10 million watts

Advantages of Artificial Intelligence vs Human Intelligence:

- **Speed of execution –** While one doctor can make a diagnosis in ~10 minutes, AI system can make a million for the same time.
- **Less Biased –** They do not involve Biased opinions on decision making process
- **Operational Ability –** They do not expect halt in their work due to saturation
- **Accuracy –** Preciseness of the output obviously increases
- Artificial Intelligence has significant dominance in many tasks, especially when it comes to monotonous judgments.

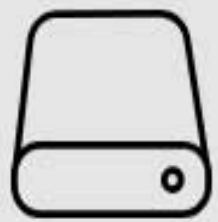
Head to Head Comparison Between Artificial Intelligence vs Human Intelligence

1#. Energy Efficiency

Human Intelligence

25
watts human brain

Artificial Intelligence



2 watts for modern machine learning machine.

2#. Universal

Human Intelligence

Humans usually learn how to manage hundreds of different skills during life.

Artificial Intelligence

While consuming kilowatts of energy, this machine is usually designed for a few tasks.

3#. Multi Tasking

Human Intelligence

Human worker work on multiple responsibilities.

Artificial Intelligence

The time needed to teach system on each and every responsibility is considerably high.

4#. Decision Making

Human Intelligence

Humans
have the ability to learn decision making from experienced scenarios.

Artificial Intelligence

Even the most advanced robots can hardly compete in mobility with 6 years old child. And this results we have after 60 years of research and development.

5#. State

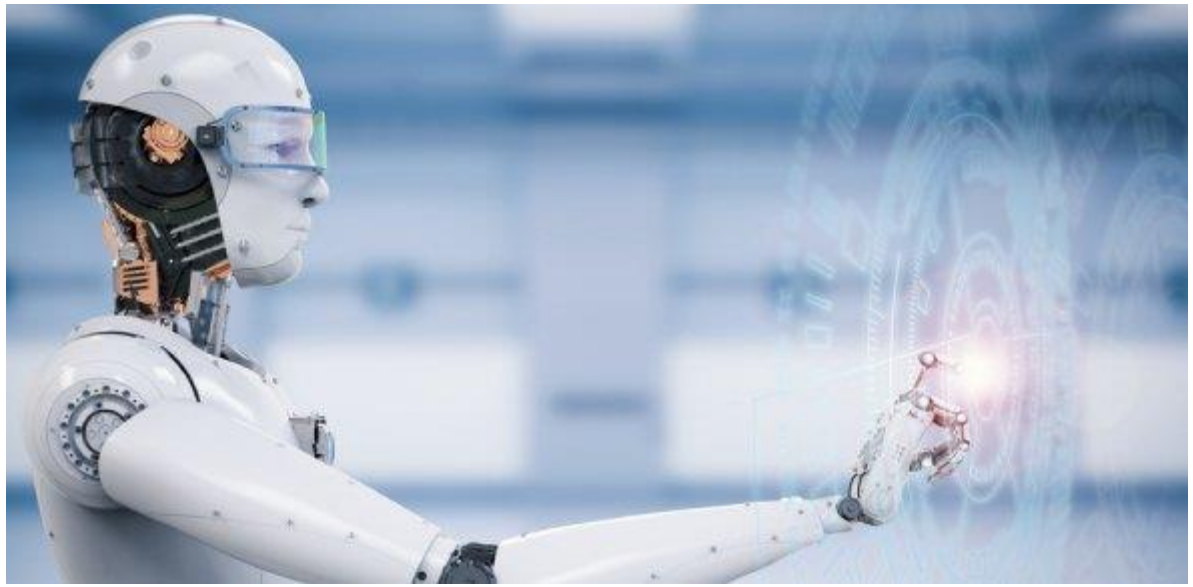
Human Intelligence

Brains
are Analogue

Artificial Intelligence

Computers
are digital

Knowledge Quiz



The total number of ways in which a robot arm can move is known as

- Functional orientation.
- Degrees of freedom.
- Dimensional versatility.
- Coordinate geometry.

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An android is well suited for operation in:

- Extreme weather conditions.
- Total darkness.
- An assembly line.
- An environment with children.

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What is the meaning of Android ?

The android takes the form of

- Insect
- Human Body
- Simple Robot Arm
- Binocular Vision

An android takes the form of:

- [ ] An insect.
- [x] A human body.
- [ ] A simple robot arm.
- [ ] Binocular vision.

- The region in space throughout which a robot arm can accomplish tasks is called its
  - Coordinate Geometry
  - Reference axis
  - Reference Frame
  - Work Envelope

The region in space throughout which a robot arm can accomplish tasks is called its

- Coordinate geometry.
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- Reference frame.
- ✓ Work envelope.

What is Telechir ?

- A telechir is a complex robot that is remotely controlled by a human operator in a telepresence system, which gives the person the sense of being on location in a remote, dangerous or alien environment.

A telechir is always used in conjunction with a specialized system of

- Track drive.
- Wheel drive.
- Remote control.
- Ionization potential measurement.

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What is manipulator in Robotics ?

- In **robotics** a **manipulator** is a device used to manipulate materials without direct contact. The applications were originally for dealing with radioactive or biohazardous materials, using **robotic** arms, or they were used in inaccessible places.

In robotics, the term manipulator refers to

- A robot propulsion system.
- A robot arm, and the device at its end (such as a gripper).
- The system used to remotely control a telechir.
- A computer that guides a fleet of mobile robots.

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- Optical sensitivity.
- Optical selectivity.
- Optical resolution.

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- Test the performance of a binaural hearing system.
- Detect the presence of ionized air.
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A device with an IR sensor can be used to detect the presence of

- Slow-moving objects.
- RF signals.
- Ionized air.
- Warm or hot objects.

A rule-based system is also known as

A. A logic gate.

B. An expert system.

C. A back-pressure sensor.

D. A telechir.

A device with an IR sensor can be used to detect the presence of

A. Slow-moving objects.

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C. Ionized air.

D. Warm or hot objects.

5 .1 What is Artificial Intelligence?

Some Definitions (I)

The exciting new effort to make
computers think …
machines with minds,
in the full literal sense.

Haugeland, 1985

(excited but not really useful)

Some Definitions (II)

The study of mental faculties through the use of computational models.

Charniak and McDermott, 1985

A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes.

Schalkoff, 1990

(Applied psychology & philosophy?)

Some Definitions (III)

The study of how to make computers do things at which, at the moment, people are better.

Rich & Knight, 1991

(I can almost understand this one).

5.2 What is Artificial Intelligence ?

- Artificial Intelligence (AI) is the science and engineering of getting machines to think, learn, perform task and make decisions like humans and enrich the way people live and work.

What is AI?

"[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning ..." (Bellman, 1978)	"The study of mental faculties through the use of computational models" (Charniak+McDermott, 1985)
"The study of how to make computers do things at which, at the moment, people are better" (Rich+Knight, 1991)	"The branch of computer science that is concerned with the automation of intelligent behavior" (Luger+Stubblefield, 1993)

Views of AI fall into four categories:

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

Examining these, we will plump for acting rationally (sort of)

Goal of AI

- The overall research goal of artificial intelligence is to create technology (software) that allows computers and machines to function in an intelligent manner.

Types of Artificial Intelligence

a) Weak AI vs. Strong AI:

- **Weak AI** describes **"simulated" thinking**. That is, a system which appears to behave intelligently, *but doesn't have any kind of consciousness about what it's doing*. For example, a chatbot might appear to hold a natural conversation, but it has no sense of who it is or why it's talking to you.
- **Strong AI** describes **"actual" thinking**. That is, behaving intelligently, thinking as human does, *with a conscious, subjective mind*. For example, when two humans converse, they most likely know exactly who they are, what they're doing, and why.

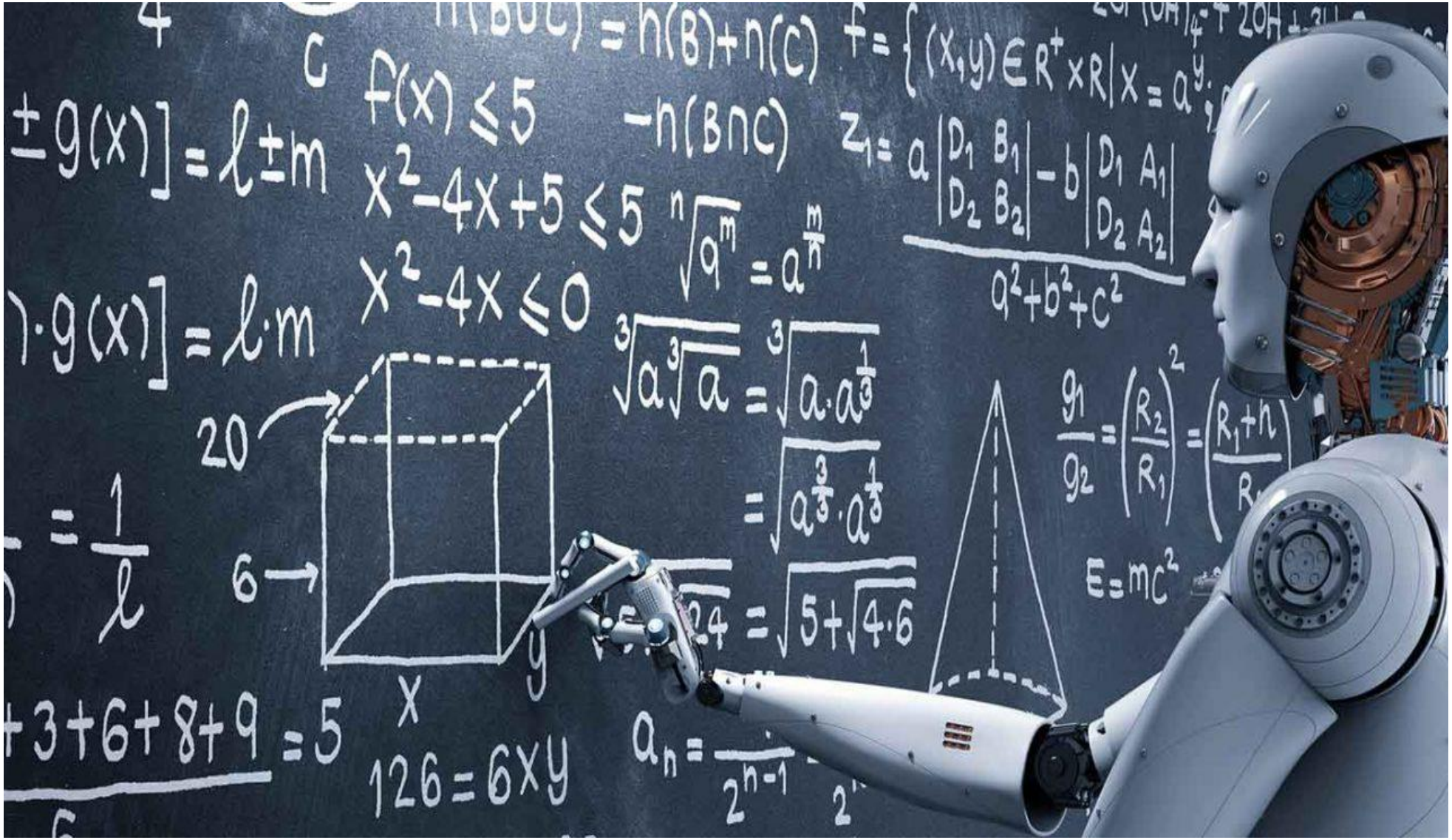
b) Artificial Narrow Intelligence vs Artificial General Intelligence vs Artificial Super Intelligence

Artificial Narrow Intelligence (ANI)

- **It** describes an AI that is limited to a single/specific task or a set number of tasks. For example, the capabilities of IBM's Deep Blue, the chess playing computer that beat world champion Gary Kasparov in 1997, were limited to playing chess. It wouldn't have been able to win a game of tic-tac-toe - or even know how to play**.**
- Google search engine, Sophia, self-driving cars and even the famous AlphaGo, fall under the category of weak/narrow AI.

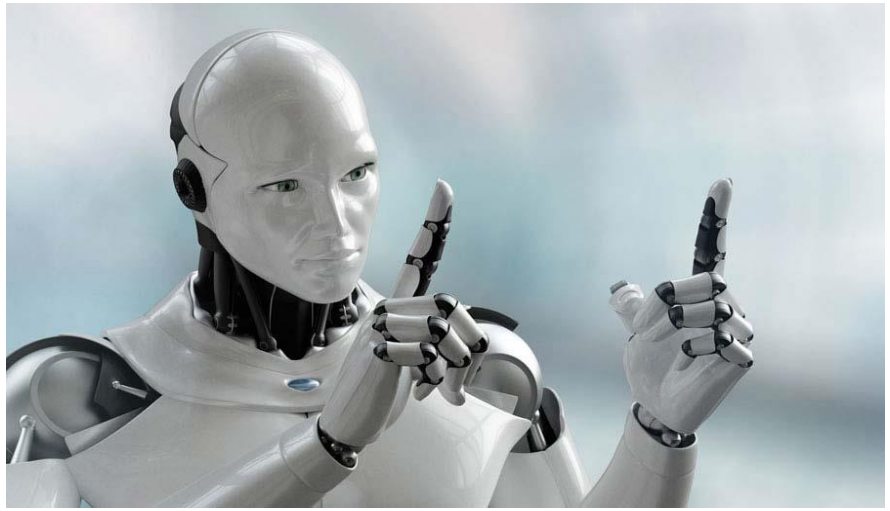
Artificial General Intelligence (AGI)

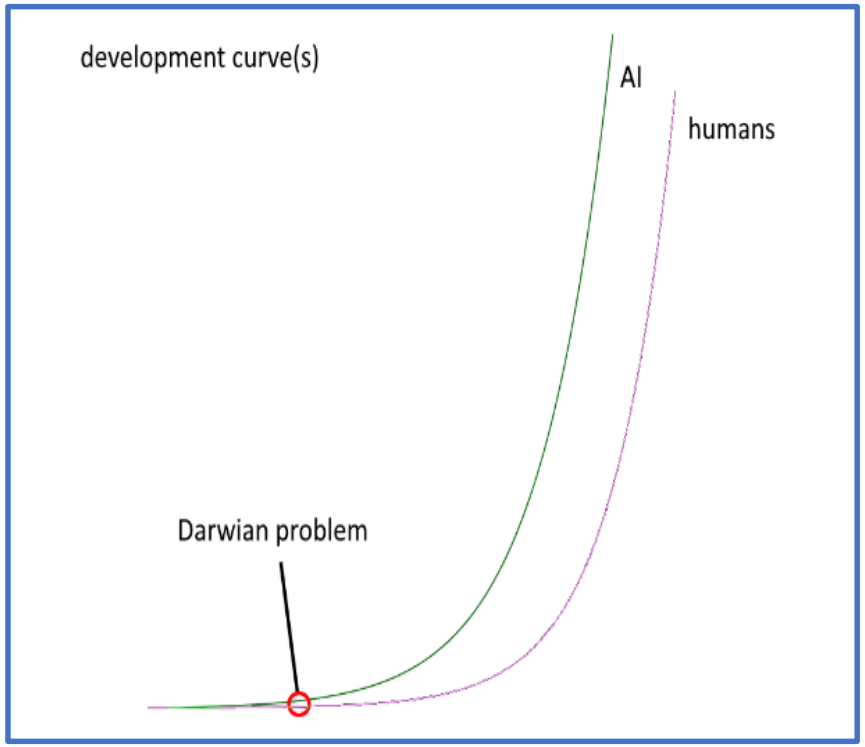
- General AI describes an AI which can be used to complete a wide range of tasks in a wide range of environments. As such, it's much closer to human intelligence.
- Commonly known as strong AI, Artificial General Intelligence involves machines that possess the ability to perform any intellectual task that a human being can.


f(x) ≤ 5
x²-4x+5 ≤ 5
x²-4x ≤ 0
20
6
x
y
126 = 6xy
E=mc²

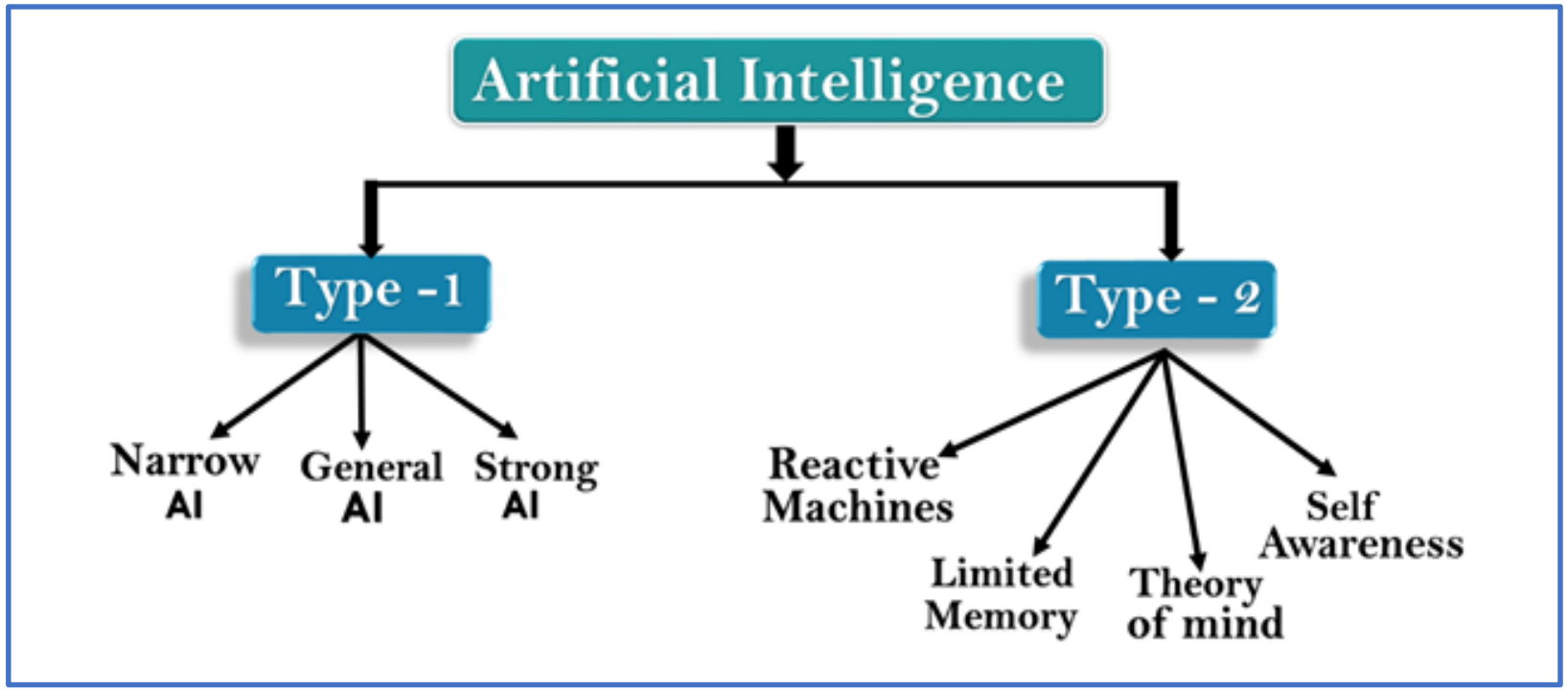
Artificial Super Intelligence (ASI)

- Artificial Super Intelligence is a term referring to the time when the capability of computers will surpass humans.





Type 1 and Type 2 AI

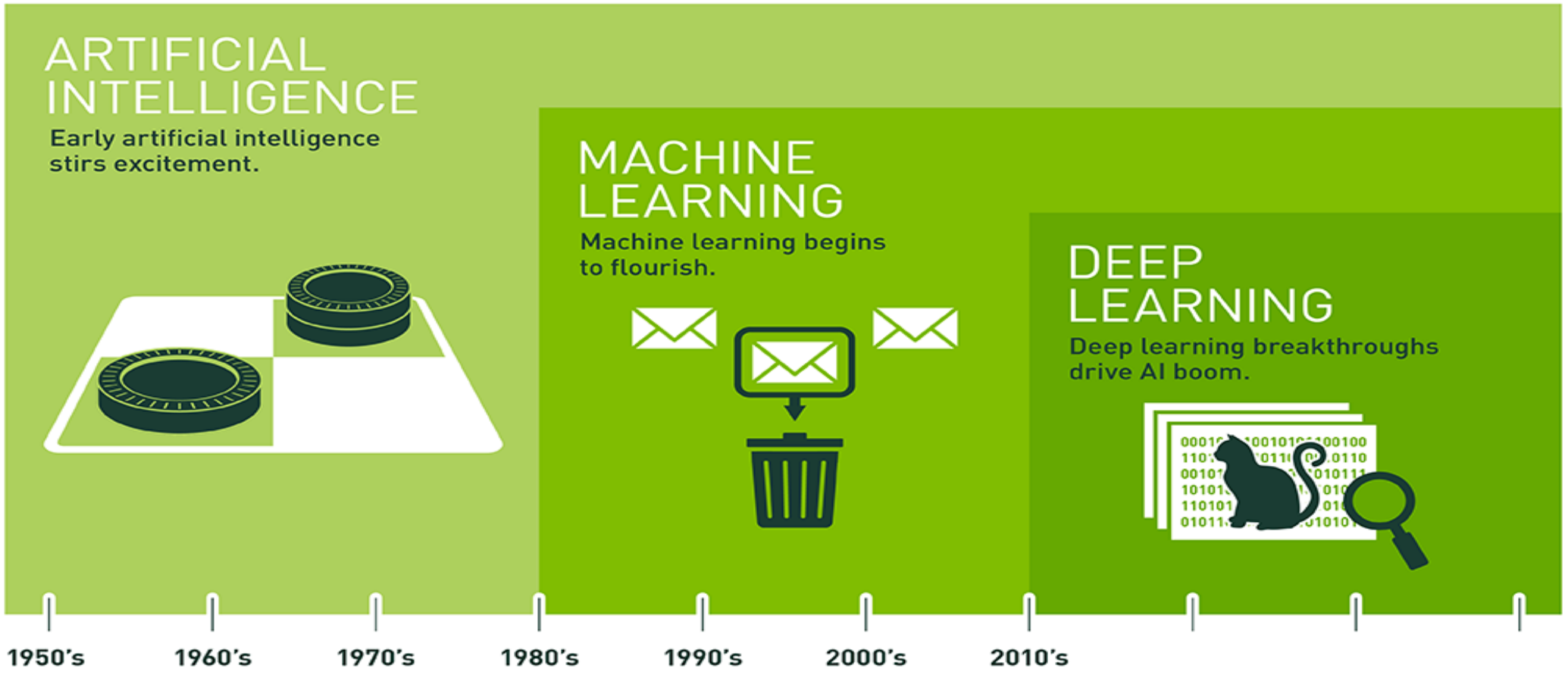


- **Reactive Machines**: An example is Deep Blue, an IBM chess program that can identify pieces on the chess board and can make predictions accordingly. But the major fault with this is that it has no memory and cannot use past experiences to inform future ones. It also analyzes possible moves of its own and its opponents. Deep Blue and AlphaGO were designed for narrow purposes and cannot easily be applied to any other situation.
-
- **Limited Memory:** These AI systems can use past experiences to inform future decisions. Most of the decision-making functions in the autonomous vehicles have been designed in this way.
-
- **Theory of mind:** This is a psychology term, which refers to the understanding that the other have in their own beliefs and intentions that impact the decisions they make. At present this kind of artificial intelligence does not exist.
-
- **Self-awareness:** In this category, AI systems have a sense of self, have consciousness. Machines with self-awareness understand their current state and can use the information to infer what others are feeling. This type of AI does not yet exist.

7. Four Waves of AI

First Wave	Second Wave	Third Wave	Fourth Wave
c. 1970s - 1990s	*c. 2000s - present*	*est. 2020s - 2030s*	*est. 2030s →*
Good at reasoning, but no ability to learn or generalize. • GOFAI - "Good Old Fashioned AI." • Symbolic, heuristic, rule based. • Handcrafted knowledge, "expert systems."	Good at learning and perceiving, but minimal ability to reason or generalize. • Statistical learning, "deep" neural nets, CNNs, RNNs. • Advanced text, speech, language and vision processing.	Excellent at perceiving, learning and reasoning, and able to generalize. • Contextual adaptation, able to explain decisions. • Can converse in natural language. • Requires far fewer data samples for training. • Able to learn and function with minimal supervision.	Able to perform any intellectual task that a human can. • AGI (Artificial General Intelligence), possibly leading to ASI (Artificial Superintelligence) and the "Technological Singularity."
		SingularityNET aigo.ai Pandai	

AI Technologies Timeline



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Quiz

Strong Artificial Intelligence is

- a) the embodiment of human intellectual capabilities within a computer
- b) a set of computer programs that produce output that would be considered to reflect intelligence if it were generated by humans
- c) the study of mental faculties through the use of mental models implemented on a computer
- d) all of the mentioned

Quiz

What is Artificial intelligence?

- a) Putting your intelligence into Computer
- b) Programming with your own intelligence
- c) Making a Machine intelligent
- d) Playing a Game

Quiz

- A certain Professor at the Stanford University coined the word ‘artificial intelligence’ in 1956 at a conference held at Dartmouth college. Can you name the Professor?

- a) David Levy

- b) John McCarthy

- c) Joseph Weizenbaum

- d) Hans Berliner

Quiz

Who is the “father” of artificial intelligence?

a) Fisher Ada
b) John McCarthy
c) Allen Newell
d) Alan Turning

Quiz

The conference that launched the AI revolution in 1956 was held at:

a) Dartmouth

b) Harvard

c) New York

d) Stanford

Quiz

A robot's "arm" is also known as its:

a) end effector

b) actuator

c) manipulator

d) servomechanism

Quiz

Which term is used for describing the judgmental or commonsense part of problem solving?

a) Heuristic

b) Critical

c) Value based

d) Analytical

Academic Disciplines important to AI.

- **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.
- **Economics:** utility, decision theory, rational economic agents
- **Neuroscience :** neurons as information processing units.
- **Psychology :** how do people behave, perceive, process Cognitive Science information, represent knowledge.
- **Computer Enginee**ring : building fast computers
- **Control theory :** design systems that maximize an objective function over time
- **Linguistics :**knowledge representation, grammar

History of AI

- 1943 McCulloch & Pitts: Boolean circuit model of brain
- 1950 Turing's "Computing Machinery and Intelligence"
- 1956 Dartmouth meeting: "Artificial Intelligence" adopted
- 1950s Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
- 1965 Robinson's complete algorithm for logical reasoning
- 1966—73 AI discovers computational complexity
  Neural network research almost disappears
- 1969—79 Early development of knowledge-based systems
- 1980-- AI becomes an industry
- 1986-- Neural networks return to popularity
- 1987-- AI becomes a science
- 1995-- The emergence of intelligent agents

9.What Does AI Really Do?

- **Solve Problem :** [Searching , Constrain Satisfaction Problem]
- **Represent Knowledge** : [First Oder and higher Order Logics]
- **Automated reasoning and Decision Making :** [Probabilistic Reasoning]
- **Plan: [** Classical Planning , Time Schedule and Resources **]**
- **Learn** : [**ML,DL ,REINFORCEMENT LEARNING**].
- **Communicate :** [NLP, Speech Recognition , Machine Translation].
- **Perceive :** [Object Recognition, Voice Recognition]
- **Act** : [Robotics]
- **Find Pattern :** [Data Analytics , Recommendation]

10. State of the Art : **Currently artificial intelligence can do following tasks quite efficiently:**

- It can classify images, voice(speech recognition) and other types of data with very high accuracy.
- It can predict future values such as sales forecasts, real estate values based on previously recorded data of required parameters.
- It can create new images, music and other data similar to previously seen data.
- It can analyze and detect patterns. This helps in making decisions
- It can assist residents of Smart Home
- It can recommend appropriate information/services in social sites.
- It can drive Car
- It can monitor Health
- It can support doctors in operations
- It can detect frauds in bank transaction.
- It can provide learning materials based on learner capability .
- It can compose music
- It can assist Farmer

11. Artificial Intelligence Technologies

- **Natural Language Generation**:
- **Speech Recognition**:
- **Virtual Agent**:
- **Machine Learning**
- **Deep Learning**
- **Biometrics**
- **Robotic Process Automation**
- **Text Analysis**

Artificial Intelligence Technologies

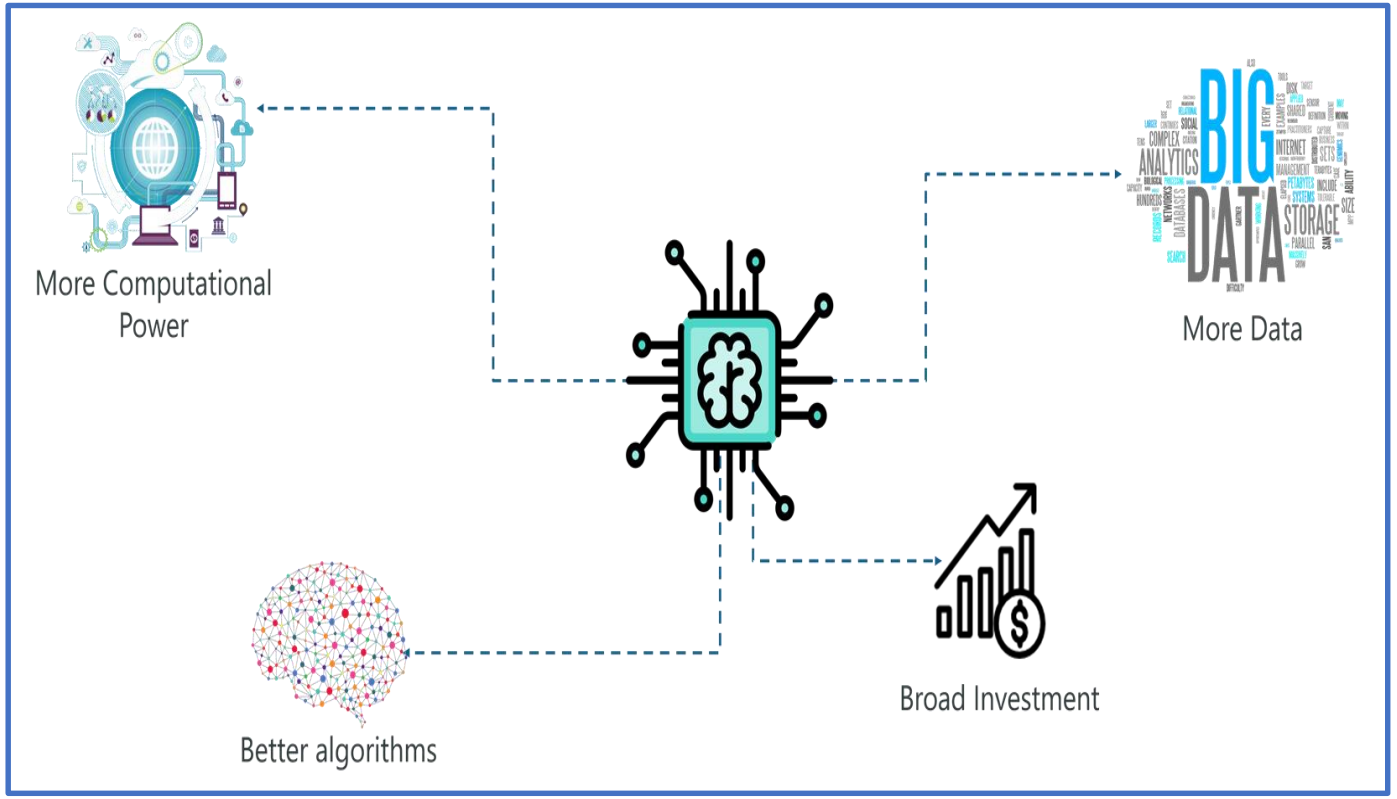
- **Predictive Analytics ,**
- **Neural Networks**
- **Pattern Recognition ,**
- **Computer Vision ,**
- **Natural Language Processing ,**
- **Autonomous Systems ,**
- **Robotics ,**
- **Chatbots ,**
- **Speech Processing ,**

Artificial Intelligence Technologies

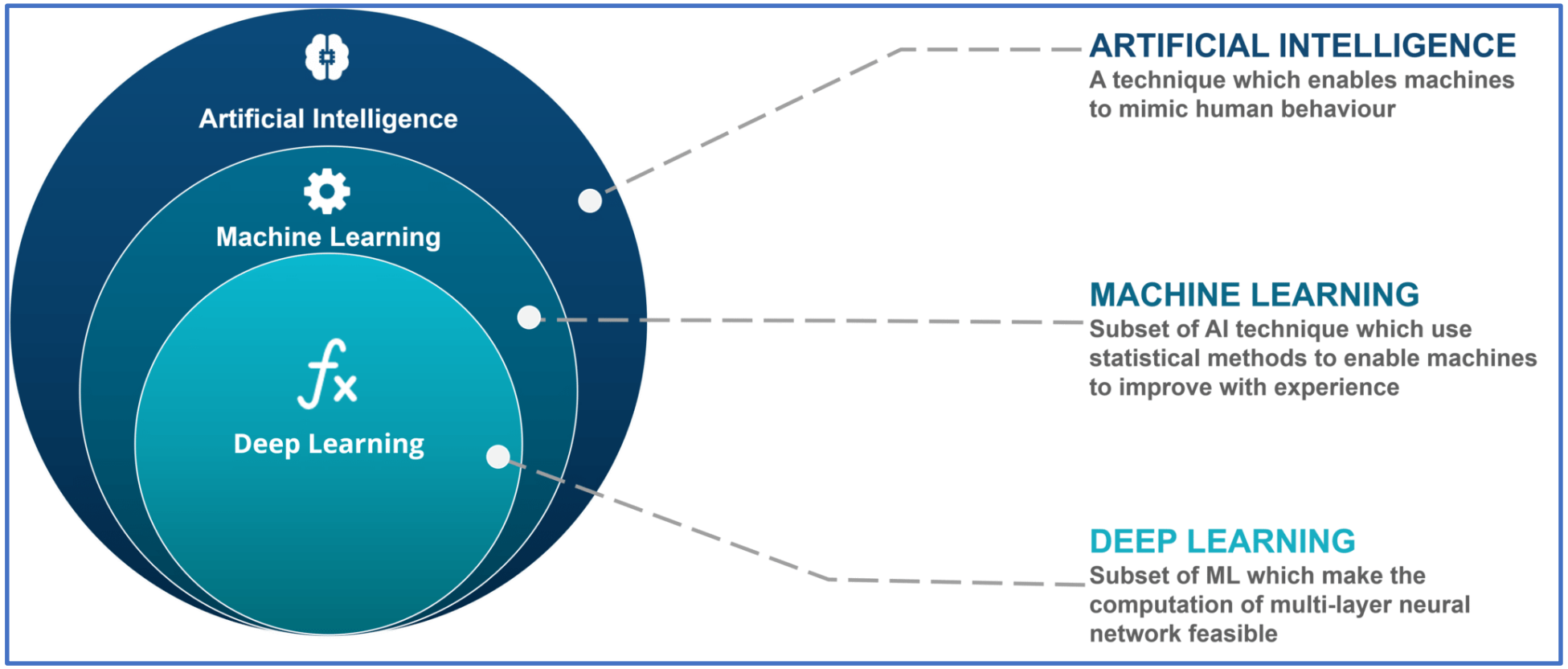
- **Planning and Optimization ,**
- **Expert Systems ,**
- **Cloud Computing ,**
- **IoT ,**
- **Gaming ,**
- **Translators ,**
- **Virtual Companions ,**
- **Emotion Analytics and**
- **Personal Assistants.**

12.Why AI is Important?

- Today, the amount of data that is generated, by both humans and machines, far outpaces humans' ability to absorb, interpret, and make complex decisions based on that data. It has become indispensable to utilize the power of Artificial Intelligence to handle the more computational power, massive data, better algorithms and broad investment

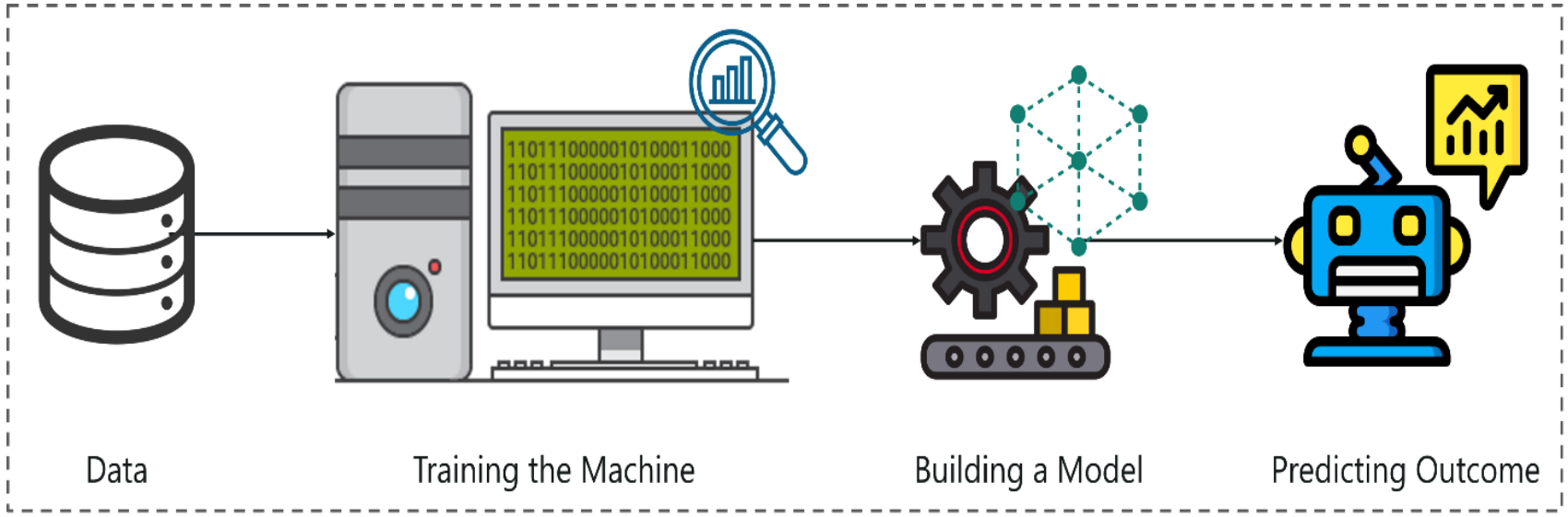


13.AI vs ML vs DL (Artificial Intelligence vs Machine Learning vs Deep Learning)

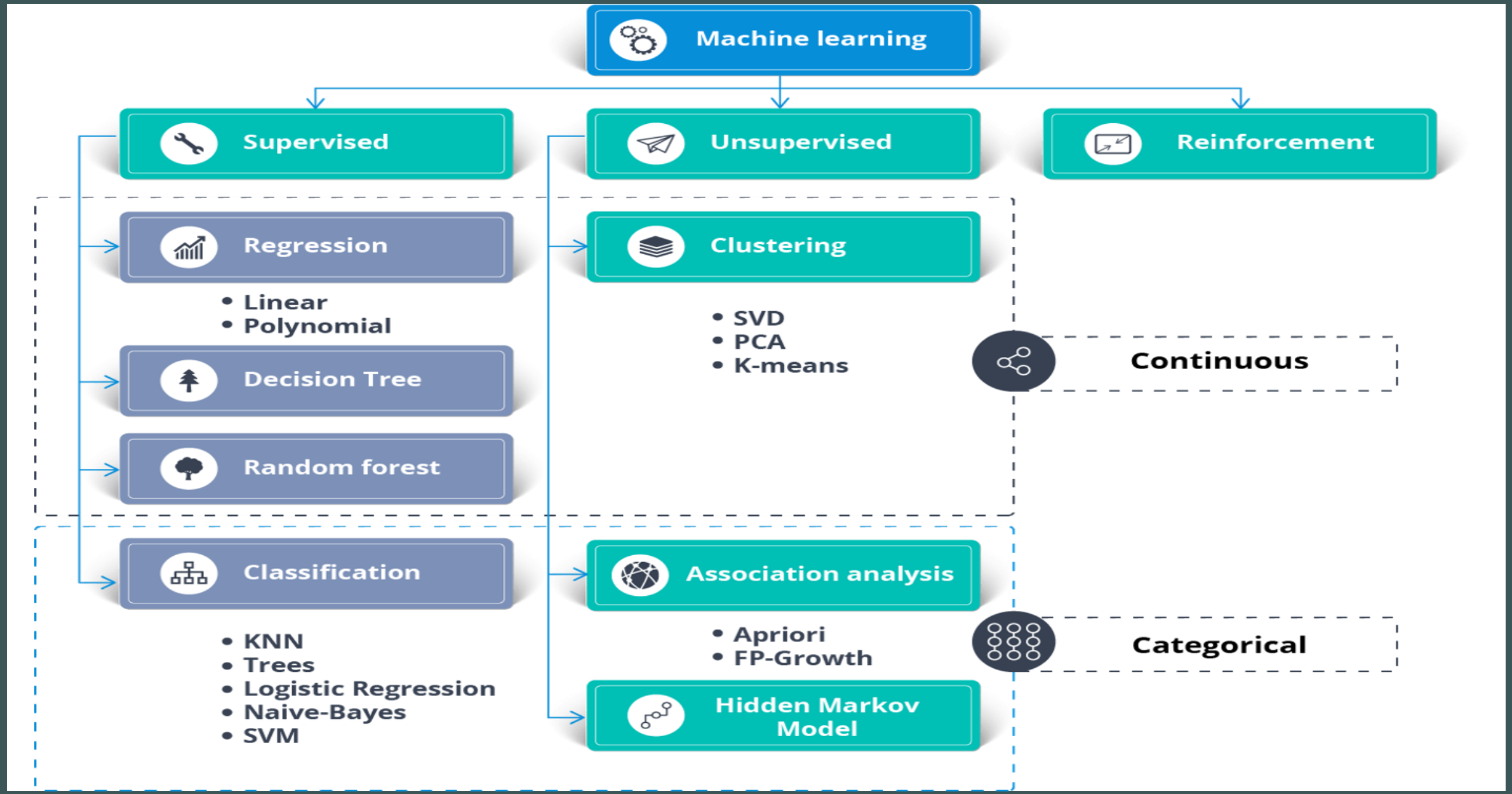


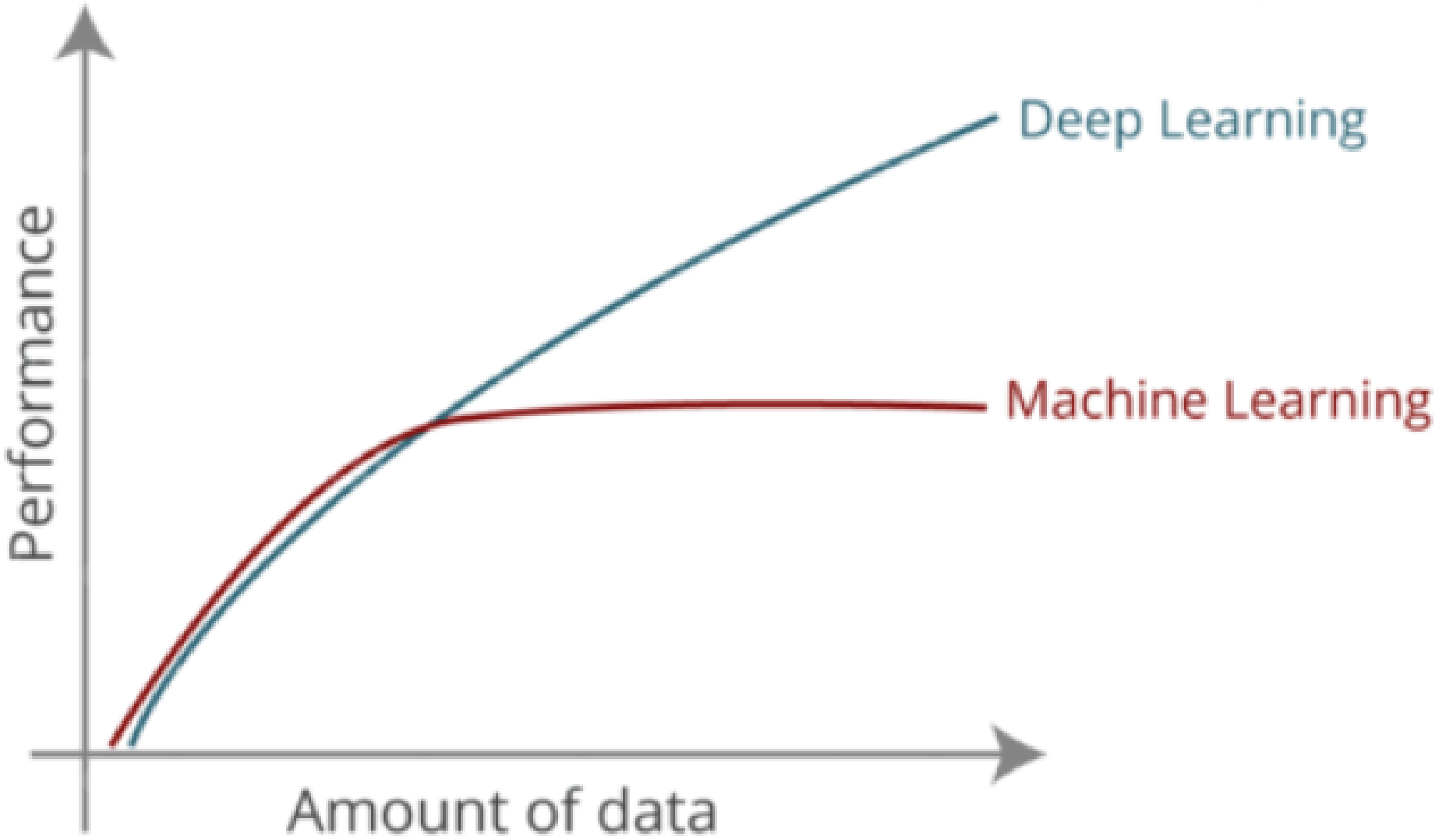
Machine Learning

- Machine learning is a subset of Artificial Intelligence (AI) which provides machines the ability to learn automatically by feeding it tons of data & allowing it to improve through experience. Thus, Machine Learning is a practice of getting Machines to solve problems by gaining the ability to think.

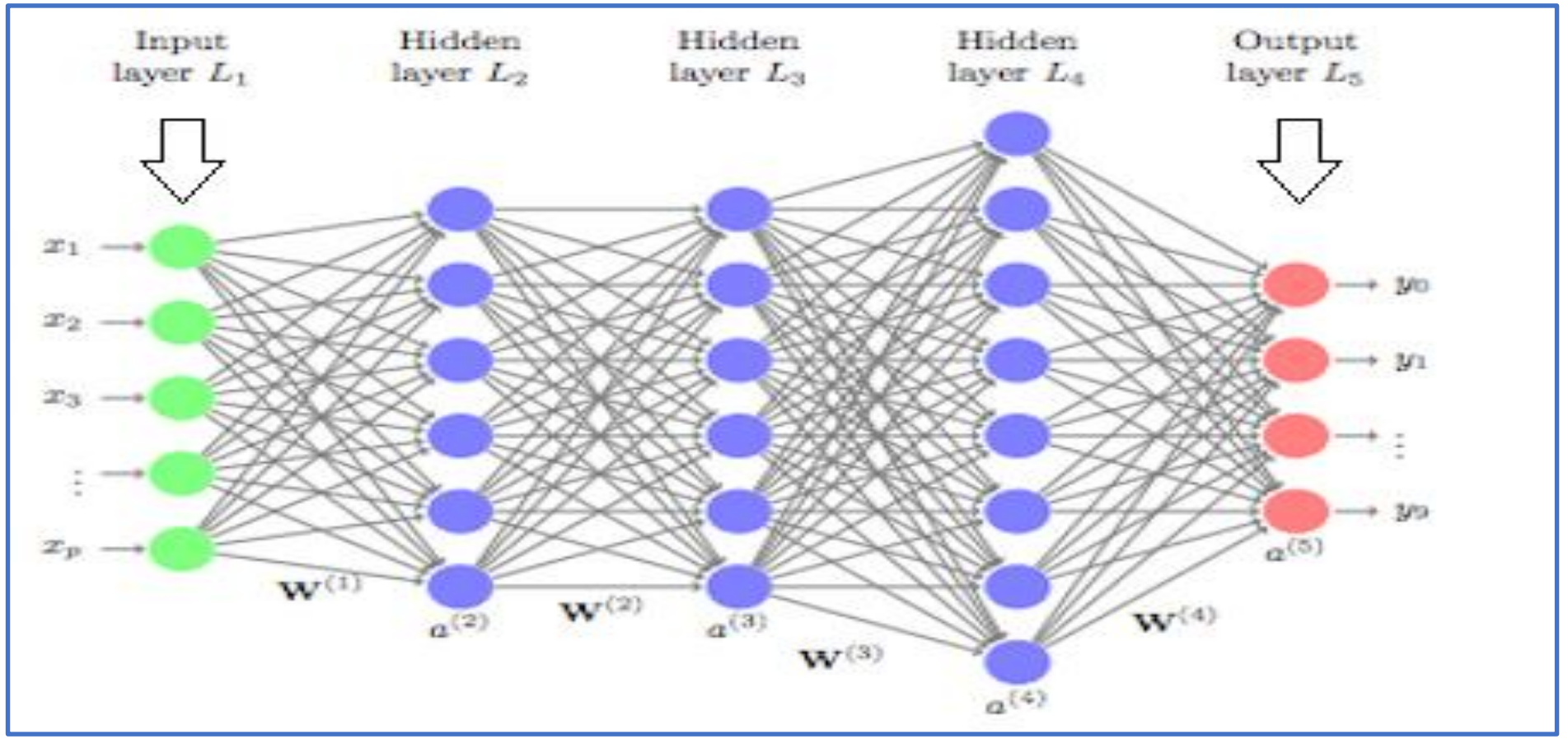


Types of Machine Learning


Machine learning
Supervised
Unsupervised
Reinforcement
Regression
Linear
Polynomial
Decision Tree
Random forest
Clustering
SVD
PCA
K-means
Continuous
Classification
KNN
Trees
Logistic Regression
Naive-Bayes
SVM
Association analysis
Apriori
FP-Growth
Hidden Markov Model
Categorical


Deep Learning
Machine Learning
Performance
Amount of data

Deep Learning



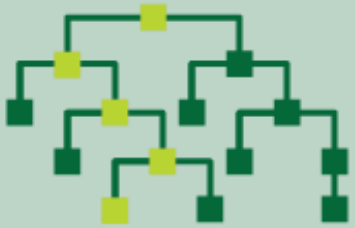
AI

Artificial Intelligence

Any technique that enables computers to mimic human behavior.

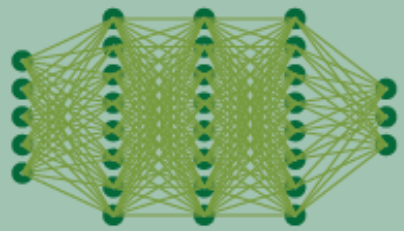
Machine Learning

The ability to learn without directly being programmed.



Deep Learning

The learning of underlying features in data using deep neural networks.



14.AI use Cases

Marketing

- Optimize Product, Pricing & Placement
- Optimize marketing spend
- Personalize recommendations
- Connect & leverage customer feedback
- Analytics

- Sales
  - Forecast Sales
  - Enable Sales Reps
  - Automate Sales Activities
  - Sales Analytics

14.AI use Cases

- Customer Service
- Data
- Analytics
  - Generalist solutions
  - Specialized solutions
- FinTech
- HealthTech
- HR
- IT
- Operations
  - Back office automation
  - Industrials
  - Other
- Self-Driving Cars

14. AI use cases in Agriculture

Agriculture is a major segment powering the Asian economy. A small transformation in agricultural outcomes can have a huge impact on 2 dimensions – economic and human

Agriculture AI use case-1: Early detection of pests, disease and weeds

- One of the most important activities of a farmer is to make sure that he/she detects onset of diseases in plants and takes corrective action on the same. The current process of disease detection involves a farmer manually eyeballing every part of his field. This has 2 big problems to solve
- All farmers may not have the visual sensitivity to detect it
- It’s a cumbersome process when the farm size is multiple acres
- It may not be detected early enough

Agriculture AI use case-1: Early detection of pests, disease and weeds

- So how can AI help.
- A drone can scan the field and take images every week. These images can be fed to convolution neural network which can be trained to detect the onset of diseases by taking a look at color change of leaves. The color change can form the signature for disease detection

Agriculture AI use case-2: Precision agriculture

- Today the farmer uses water in a uniform way where he “carpet bombs” the entire field with water and other chemical nutrients. With IoT based sensors one can detect multiple conditions required for optimal farming like soil moisture conditions, light, humidity and temperature in real time. This can be fed to a deep learning algorithm which can recommend the right next best action for each specific square meter of the field resulting in massive savings in water and pesticides being used.

Agriculture AI use case-3: Calculating yield of a field

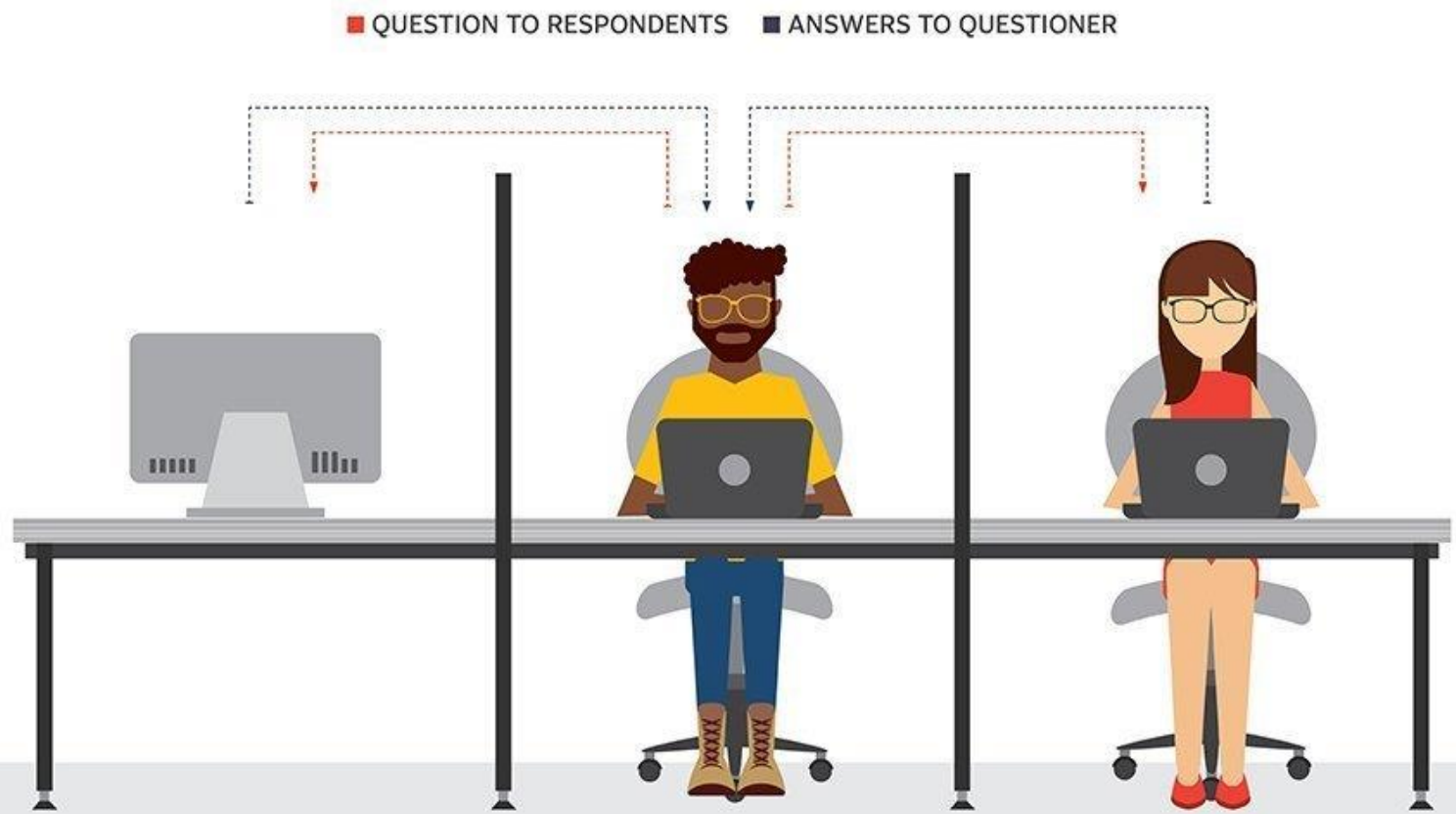
- Imagine a mango farm. Today a mango farmer has to manually eye ball the number of mangoes in the field and use that to calculate the yield of mangoes per acre. This activity of detecting mangoes in a field can be augmented by an AI algorithm which can take drone images of a field as input and calculate the yield of the farm

15. Turing Test

- Turing Test is a method of inquiry in artificial intelligence (AI) for determining whether or not a computer is capable of thinking like a human being. The test is named after Alan Turing, the founder of the Turning Test and an English computer scientist, cryptanalyst, mathematician and theoretical biologist.

Turing test

During the Turing test, the human questioner asks a series of questions to both respondents. After the specified time, the questioner tries to decide which terminal is operated by the human respondent and which terminal is operated by the computer.



Introduction to AI

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