

# Artificial Intelligence

(9618)

Artificial Intelligence is the ability of a computer or a robot controlled by a computer to do tasks that are usually done by humans because they require human intelligence.

## Dijkstra's Algorithm

- Single source shortest path
- Note: Maps, telephone networks, social networking are all represented by graphs(nodes) and to find the shortest path b/w the nodes we use Dijkstra's Algorithm.



- If distance of  $u + \text{cost}(u \text{ till } v) < \text{stored shortest distance on computer}$   
Then  $\rightarrow$  distance of  $u + \text{cost}(u \text{ till } v) = \text{stored shortest distance on computer}$

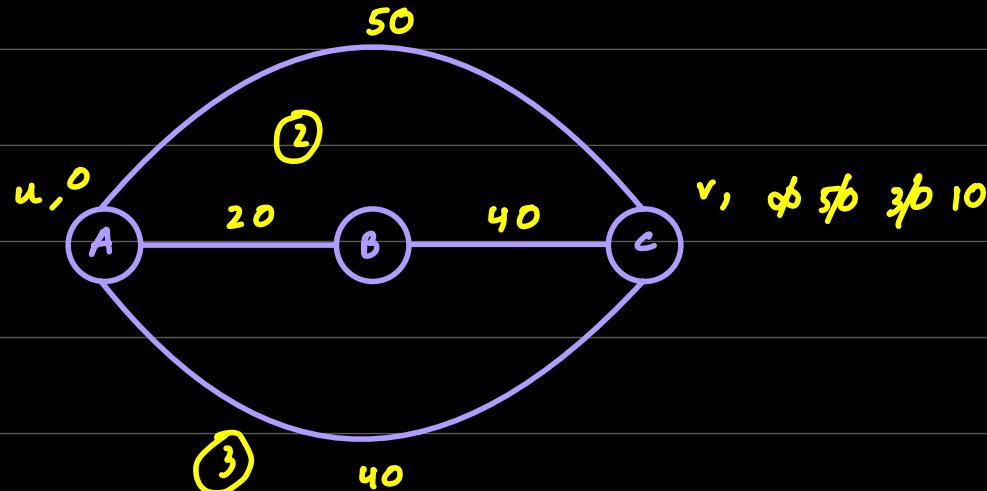
Note: The initial point is 'u' . Final point is 'v'. du is initialised 0 and dv is initialised as  $\infty$  at the beginning.

$$\rightarrow d(u) + c(u,v) < d(v)$$

$$0 + 20 < \infty \quad (\text{True})$$

$$d(v) = 20$$

① , ④ 10



$$\textcircled{2} \quad 0 + (20+10) < 50$$

$$30 < 50$$

$$\textcircled{1} \quad d(u) + c(u,v) < d(v)$$

$$d(v) = 30$$

$$0 + 50 < \infty$$

$$d(v) = 50$$

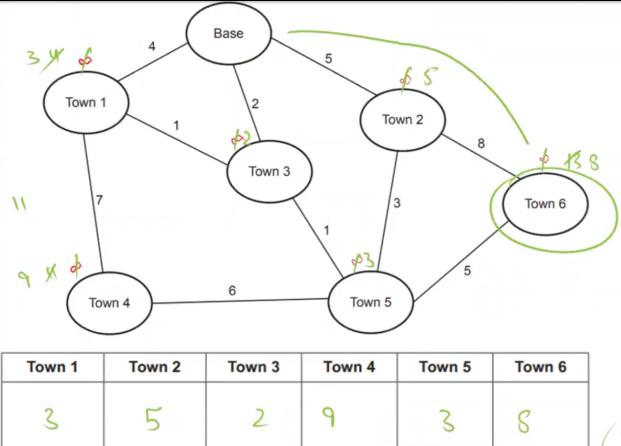
$$\textcircled{4} \quad 0 + 10 < 30$$

$$d(v) = 10$$

$$\textcircled{3} \quad 0 + 40 < 30$$

$$d(v) = 30$$

Q-



STEP 1: Initialize base to 0  
" " nodes to  $\infty$  on diagram

STEP 2: Make a table

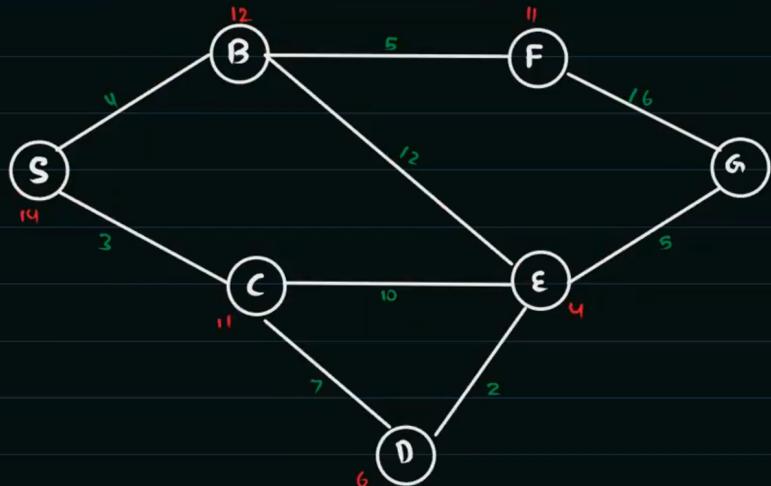
T1	T2	T3	T4	T5	T6
$\infty$	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$
4	5	2	$\infty$	$\infty$	$\infty$
3	5	2	$\infty$	$\infty$	$\infty$
3	5	2	11	3	13
3	5	2	9	3	8

## A\* Algorithm

A\* algorithm is based on Dijkstra, but adds an extra heuristic value (intelligent guess) on how far we have to go to reach the destination more efficiently

Formula :  $f(n) = g(n) + h(n)$

max separation    actual cost                      heuristic value



● = Actual cost (distance)  
● = Heuristic value

- Heuristic value  
 is a guess of cost  
 from the node to  
 the destination.

Find the shortest path to reach G from S

$SC\epsilon X$

$$\begin{aligned}
 f(n) &= g(n) + h(n) \\
 &= 3 + 4 \\
 &= 17
 \end{aligned}$$

$SCD$

$$\begin{aligned}
 f(n) &= g(n) + h(n) \\
 &= 10 + 6 \\
 &= 16
 \end{aligned}$$

$SC\epsilon E$

$$\begin{aligned}
 f(n) &= g(n) + h(n) \\
 &= 12 + 4 \\
 &= 16
 \end{aligned}$$

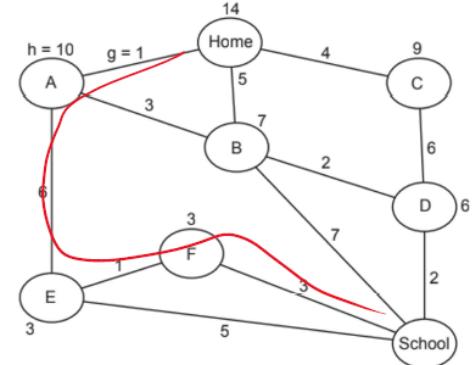
$SCDEG$

$$\begin{aligned}
 f(n) &= g(n) + h(n) \\
 &= 17 + 0 \\
 &= 17
 \end{aligned}$$

shortest path =  $SCDEG$

- (b) Find the shortest path between the Home and School nodes using the A\* algorithm. Show your working in the table provided.

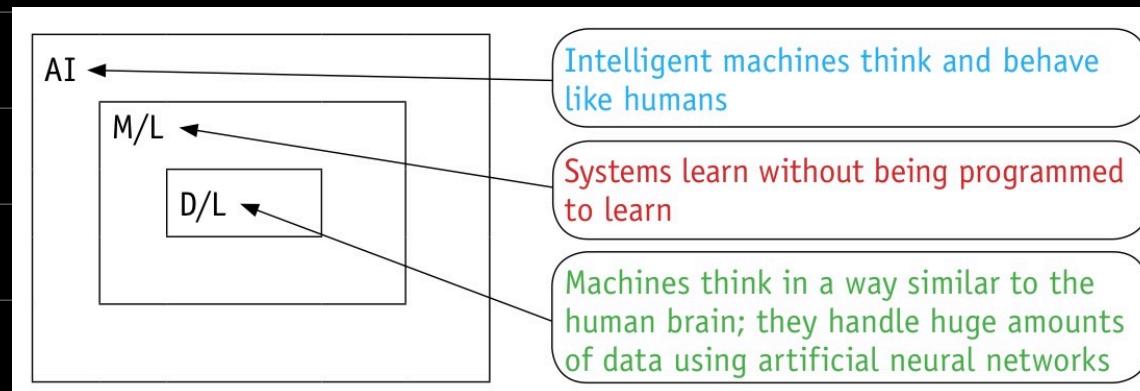
The first two rows in the table have been completed.



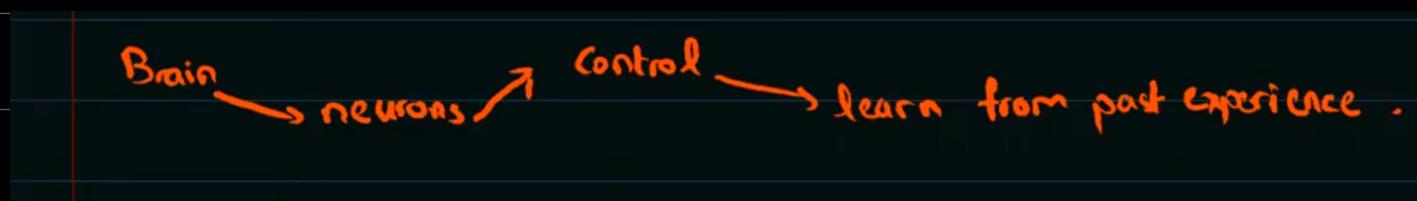
Node	Cost from Home node (g)	Heuristic (h)	Total (f = g + h)
Home	0	14	14
A	1	10	11
B	5	7	12
C	4	9	13
D	4	7	11
E	7	3	10
F	8	3	11
School	12	0	12
school	11	0	11

Final path: Home → A → E → F → school.

# Machine And Deep Learning



## Human Neural Network



This concept is used in Artificial neural network i.e: deep learning

# Artificial Neural Network

- Machines are created to learn from past experience.

## Machine Learning

- Machine learning is a subset of AI in which algorithms are trained and they learn from their past experience

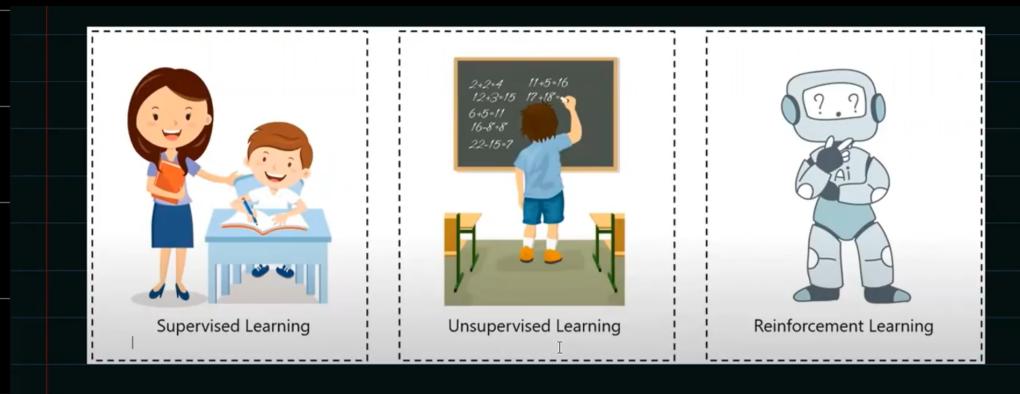


# Labelled And Unlabelled Data

**Unlabelled Data:** The data to which tag or label is not attached

**Labelled Data:** The unlabelled data becomes labelled data the moment a meaning is attached (label / tag)

## Types of Machine Learning



labelled data

① **Supervised Learning:** Using (known tasks with given outcomes) to enable a computer program to improve its performance in accomplishing similar tasks

② **Unsupervised Learning:** Using a large number of tasks with unknown outcomes to enable a computer

program to improve its performance in accomplishing similar tasks

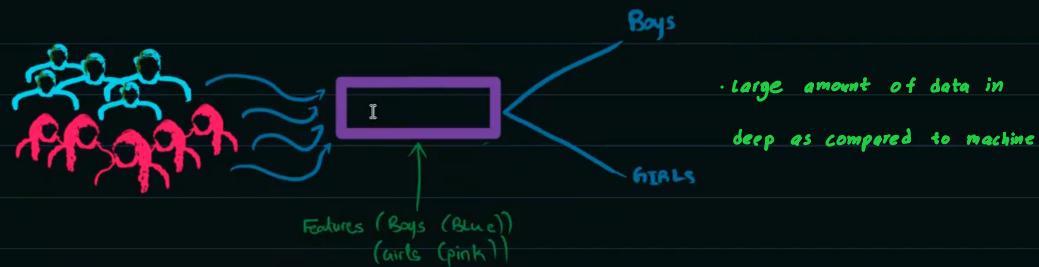
③ Reinforcement Learning: Using a large number of tasks with unknown outcomes and the use of feedback to enable a computer program to improve its performance in accomplishing similar tasks.

## Deep Learning

- Subset of machine learning
- Deep learning is a type of machine learning inspired by the structure of human brain.  
This structure is called Artificial neural Networks
- Extract pattern of data using neural networks

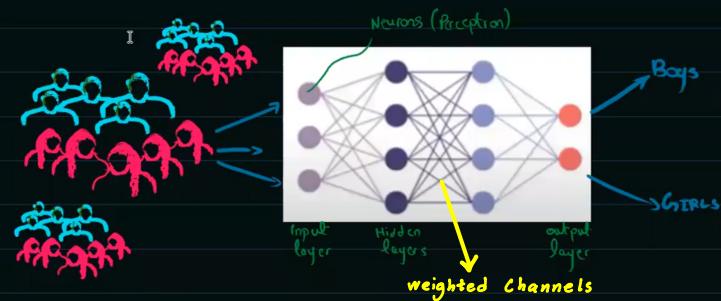
# Examples of Machine and Deep Learning

MACHINE LEARNING

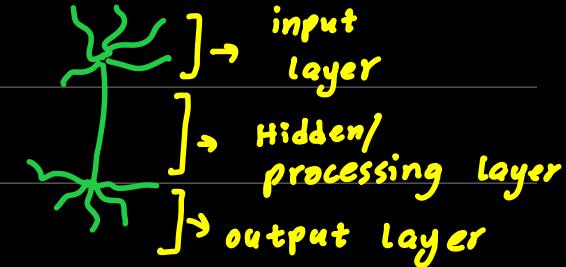
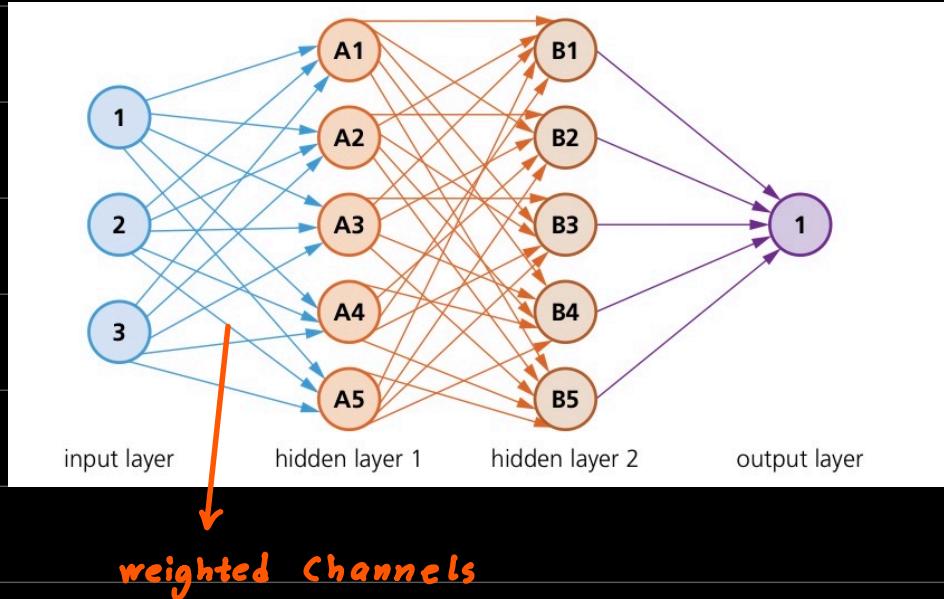


large amount of data in  
deep as compared to machine

DEEP LEARNING



- Artificial Neural Networks are based on the interconnection b/w neurons in the human brain. The system is able to think like human using these neural networks and its performance improves with more data
- The hidden layers are where data from the input layer is processed into something which can be sent to the output layer.

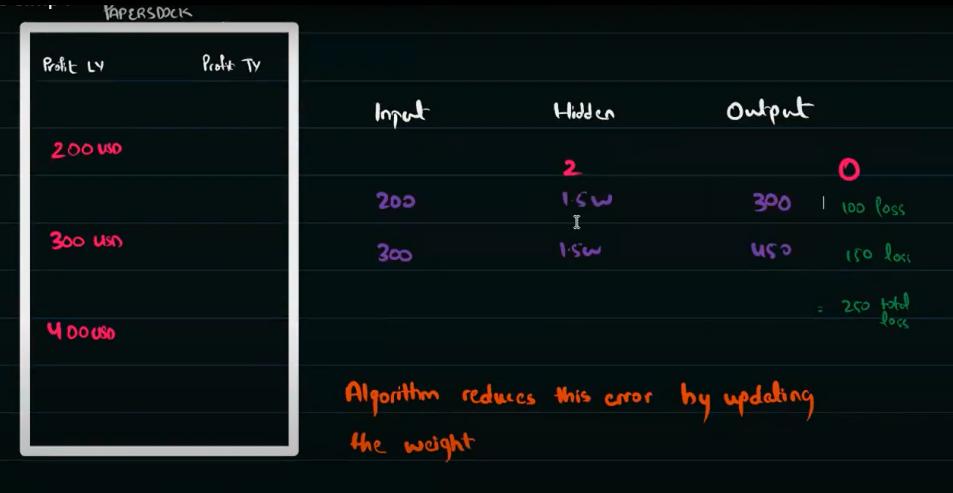


Q- State the reason for having multiple hidden layers in an artificial neural network

- Enables deep Learning to take place
- Where the problems you are trying to solve have a higher level of complexity which requires more layer to solve. (Hidden Layers ↑ , processing ↑)
- To enable the neural network to learn and make decisions on its own.
- To improve accuracy of results.

machine learning	deep learning
enables machines to make decisions on their own based on past data	enables machines to make decisions using an artificial neural network
needs only a small amount of data to carry out the training	the system needs large amounts of data during the training stages
most of the features in the data need to be identified in advance and then manually coded into the System	deep learning machine learns the features of the data from the data itself and it does not need to be identified in advance
a modular approach is taken to solve a given problem/task: each module is then combined to produce the final model	the problem is solved from beginning to end as a single entity
testing of the system takes a long time to carry out	testing of the system takes much less time to carry out
there are clear rules which explain why each stage in the model was made	since the system makes decisions based on its own logic, the reasoning behind those decisions may be very difficult to understand (they are often referred to as a <b>black box</b> )

# Back Propagation And Regression



- Training program is iterative
- The errors are propagated back into the neural networks in order to update the initial networking weightings.
- This training process is repeated until the desired outputs are eventually obtained

Q- Describe the back propagation process

- The initial outputs from the system are compared to the expected output
- The system weightings are adjusted to minimise the difference b/w the actual and

expected result.

- Once the errors in the output have been eliminated, the neural network functions correctly
- If the errors are still too large, the weightings are altered.

## Regression

- Regression is one of the ways of analysing data before it is input to a system
- It is used to make predictions from the given data by learning some relationship b/w the input and output

Q- Explain how artificial neural networks enable machine learning?

- Artificial neural networks are intended to replicate the way human brains work.
- Weights are assigned for each connection b/w nodes
- The data is input at the input layer and are passed into the system.
- They are analysed at each subsequent hidden layer where outputs are calculated

- This process of learning is repeated many times to analyse optimum outputs
- Decisions can be made without being specifically programmed
- The deep learning net will have created complex feature detectors
- The output layer provides the results
- Back propagation of errors will be used to correct any errors that have been made.