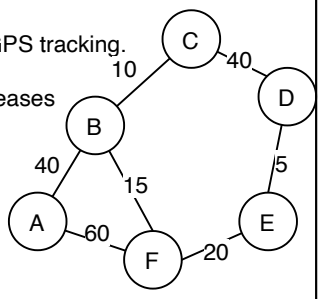
ALevel CS C21 Artificial Intelligence(AI)

Graphic: a collection of nodes or vertices between which there can be edges. Each **node** has a name. An **edge** can have an associated label which is a numerical value.
Dijkstra's algorithm:finds the shortest path to each of the other nodes starting from one of the nodes.
Structure English:
Identify the source node (S) where the path starts.
Create an empty set called the ShortestPath set.
Create another set called RemainingNodes and put all of the nodes into this including the source node (S).
Create a record that stores:
node names
calculated values for the distance to the node from the source node
the sequence of nodes in the route to the node.
Set the distance value for the source node S to be 0.
Set the distance value for all other nodes to be INFINITY where this is to be set as a large value greater than any value that will be calculated.
While the ShortestPath set does not include all of the nodes do the following:
Pick the node (N) from the RemainingNodes set that has the lowest distance value.
Move this node into the ShortestPath set.
For each node in the RemainingNodes set that is adjacent to N:
Calculate a new distance value by adding the value given by the label of the edge connecting the two nodes to the already stored distance for N.
If this value is less than the value currently stored replace this stored value by the new one that has been calculated.
If a new value has been stored enter the sequence of nodes used to obtain this value.
Usage:
1. It is the basis of technology such as GPS tracking.
2. Google Maps
3. modelling the spread of infectious diseases
4. IP routing



Content of the ShortestPath set	Content of the record					
{}	A	B	C	D	E	F
	0	∞	∞	∞	∞	∞
{A}	A	B	C	D	E	F
	0	40	∞	∞	∞	60
	A	A-B				A-F
{A,B}	A	B	C	D	E	F
	0	40	50	∞	∞	55
	A	A-B	A-B-C			A-B-F
{A,B,C}	A	B	C	D	E	F
	0	40	50	90	∞	55
	A	A-B	A-B-C	A-B-C-D		A-B-F
{A,B,C,F}	A	B	C	D	E	F
	0	40	50	90	75	55
	A	A-B	A-B-C	A-B-C-D	A-B-F-E	A-B-F
{A,B,C,E,F}	A	B	C	D	E	F
	0	40	50	80	75	55
	A	A-B	A-B-C	A-B-F-E-D	A-B-F-E	A-B-F
{A,B,C,D,E,F}	A	B	C	D	E	F
	0	40	50	80	75	55
	A	A-B	A-B-C	A-B-F-E-D	A-B-F-E	A-B-F

Artificial neural network: based on the interconnections between neurons in the human brain. The system is able to think like a human using these neural networks, and its performance improves with more data.
Artificial neural networks are excellent at identifying patterns which would be too complex or time consuming for humans to carry out.
Back propagation of errors: An algorithm for machine learning that optimises the values for parameters which are adjustable. It is applied first to the nodes in the output layer and then works backward through the nodes in hidden layers until finally the input nodes are considered.
Deep Learning systems: structures algorithms in layers(input layout, out layout, hidden layout) to create an artificial neural network that can learn and make intelligent decisions on its own.

A* algorithm: find the best route from one node to just one other node A* algorithm is a modification of the Dijkstra algorithm designed to improve matters.
different between dijkstra and A*
 # Dijkstra
Calculate a new distance value by adding the value given by the label of the edge
connecting the two nodes to the already stored distance for N.
 # A*
Calculate a new distance value by adding the value given by the label of the edge
connecting the two nodes to the already stored distance for N.
Calculate an estimated value for the distance of N from the destination node and
add this to the new distance value.

Machine learning: where a system improves its performance through analysis of previous performance
1. a computer-based system has a defined task or tasks to perform
2. **knowledge is acquired** through the experience of performing the tasks
3. as a result of this experience and the knowledge gained the performance of future tasks is improved.
Unsupervised learning: where the machine learning takes place entirely through the system analysing and categorising the available data
1. In unsupervised learning the system has to draw its own conclusions from its experience of the results of the tasks it has performed.
2. Powerful computer systems having access to massive data banks are regularly used to make decisions based on previous actions recorded.
Unsupervised learning usage:
1. density estimation
2. k-mean clustering
Supervised learning: where sample data is supplied to the system with associated data relating to the outcome of its use.
1. require both input and output to be given to the model so ti can be trained.
2. The model uses labelled data, so the desired output for a given input is known.
2. Algorithms receive a set of inputs and the correct outputs to permit the learning process.
3. Once trained, the model is run using labelled data.
4. The results are compared with the expected output; if there are any errors, the model needs further refinement.
5. The model is run with unlabelled data to predict the outcome.
Supervised learning usage:
1. regression analysis
2. classification analysis
Reinforcement learning: where an agent learns by receiving graded rewards for actions taken
Reinforcement learning has some features similar to unsupervised learning and other features similar to supervised learning.
1. An agent is learning how best to perform in an environment.
2. The environment has many defined states.
3. At each step the agent takes an action.
4. An agent has a policy that guides its actions.
5. The policy is influenced by the recorded history and the knowledge of the current state of the environment.
6. An action changes the environment to a new state.
7. The agent receives a reward following an action which is a measure of how effective the action was in relation to the achievement of the overall goal.
8. The policy will guide the agent in deciding whether the next action should be exploiting knowledge already known or exploring a new avenue.
In summary, the aim is to maximise the reward values by improving the quality of the policy. It is a trial-and-error search for optimum performance. It requires many repeated attempts at the same problem.
Regression analysis: finding a mathematical function that provides the best fit to the actual outcomes when outcomes are calculated from previous inputs