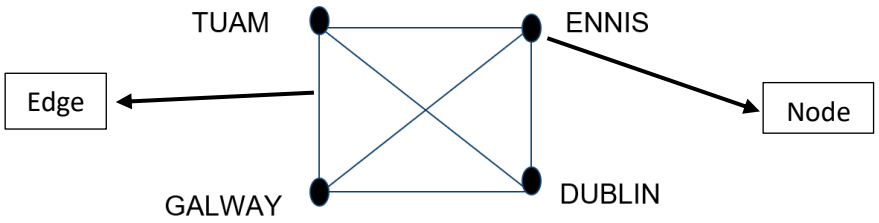
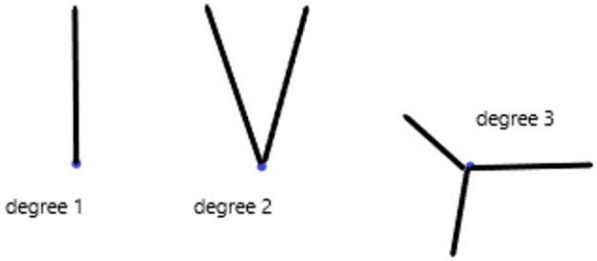
Networks and Graphs Terminology:

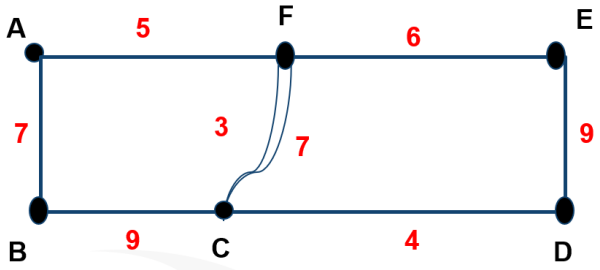
1) A graph is made up of points called nodes, or vertices, that are joined together with lines known as edges or arcs.



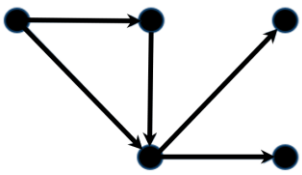
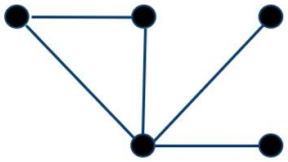
2) The degree, valency or order of a vertex is the number of edges meeting at that vertex.



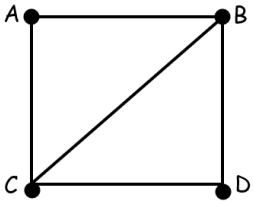
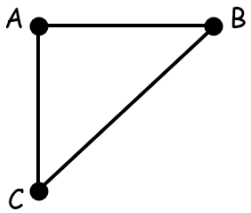
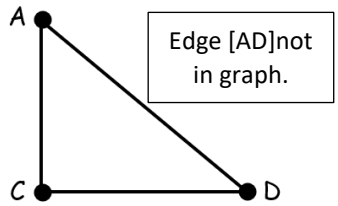
3) Sometimes edges can be assigned a value known as a weight. The weights could be distances or costs.



4) Sometimes the arcs can have a direction. If they do have arrows, then the graph is known as a directed graph, or digraph.

Directed Graph e.g. Twitter	Undirected Graph e.g. Facebook
	

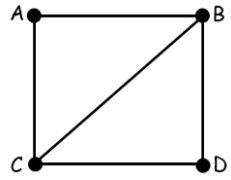
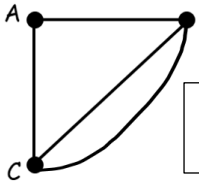
5) A graph P is a subgraph of Q if all the nodes in P are nodes of Q and all the arcs of P are arcs of Q.

Graph	Subgraph Example	Non-Subgraph Example
		

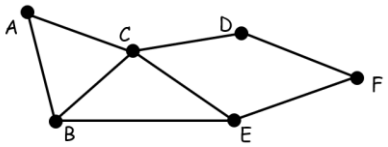
6) A loop is an arc from a node to itself.

7) Graphs that have the exact same nodes and node connections are called identical or isomorphic graphs.

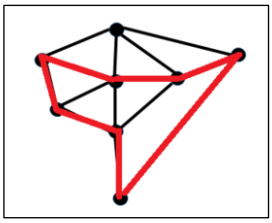
8) A graph is said to be simple if it doesn't have any loops and at most one edge connecting any two nodes.

Example of a Simple Graph	Example of a Graph that's not Simple
	 Two edges between B and C

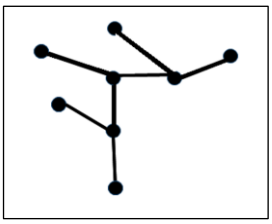
9) A walk of length n is a succession of n edges where the end of one is the start of the next. Examples in the diagram below would be ACDF (a walk of length 3) or ABCEF (a walk of length 4)



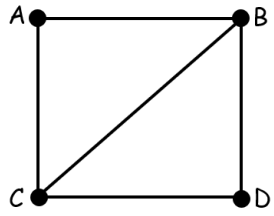
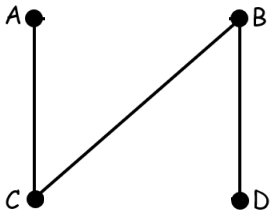
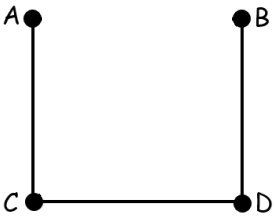
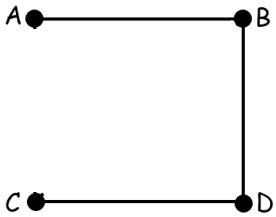
10) A walk in which all the nodes are different is known as a path. An example in the diagram above would be ACDF. An example of a walk that wouldn't be a path would be ACBECDF as node C is visited twice.
11) A graph is connected if there is a path between any pair of vertices. A graph which isn't connected is called disconnected.
12) If a walk starts and ends at the same vertex, then it is said to be closed. If it's not closed it's open.
13) A cycle is a path that starts and ends at the same vertex.



14) If two nodes are joined by an edge, they are said to be adjacent.
15) If an edge joins two nodes together, then we say that the two nodes are incident with the edge, and the edge is incident with the two nodes.
16) The Hand-shaking Lemma: The degree total of a graph is double the number of edges in the graph.
17) A tree is a connected graph with no cycles.



18) A spanning tree for a graph P is a subgraph of P, which contains all the vertices of P and is a tree. For example, a graph is shown below on the left with three possible spanning trees alongside.

Graph	Spanning Tree 1	Spanning Tree 2	Spanning Tree 3
			

19) A minimum spanning tree of a weighted graph is the spanning tree such that the total weight is a minimum.

Kruskal's Algorithm:

1) Pick the smallest edge.
2) Repeatedly look for smallest edge that does not create a cycle. If both vertices are already in the minimum spanning tree, then to not pick it – this will prevent cycles.
3) Keep adding edges until all nodes have been selected and are in the same tree.
4) When all the nodes have been selected and are in the same tree, we can re-draw the nodes and the edges that we selected – they should have no cycles visible.
5) If the edge weights are distinct the minimum spanning tree is unique. If we add up the weights of each of the edges selected, we will get the total edge weight of the minimum spanning tree.

Prim's Algorithm:

1) Create an empty list to keep track of the nodes we have touched.
2) Pick an arbitrary node, say A.
3) Add A to the visited list. Now look at all Nodes reachable from A. Prim is a greedy algorithm, which means it will select the smallest edge from A that connects to an unvisited node, say B.
4) Add B to the visited list.
5) Now look at all the nodes reachable from A and B, select the smallest edge that connects to an unvisited node.
6) Continue in this manner each time selecting the smallest edge connecting to an unvisited node.
7) If both vertices are already in the minimum spanning tree, then do not pick it – this will prevent cycles.
8) When all the nodes have been visited, we can re-draw the nodes and the edges that we selected – they should have no cycles visible.
9) If the edge weights are distinct the minimum spanning tree is unique. If we add up the weights of each of the edges selected we will get the total edge weight of the minimum spanning tree.