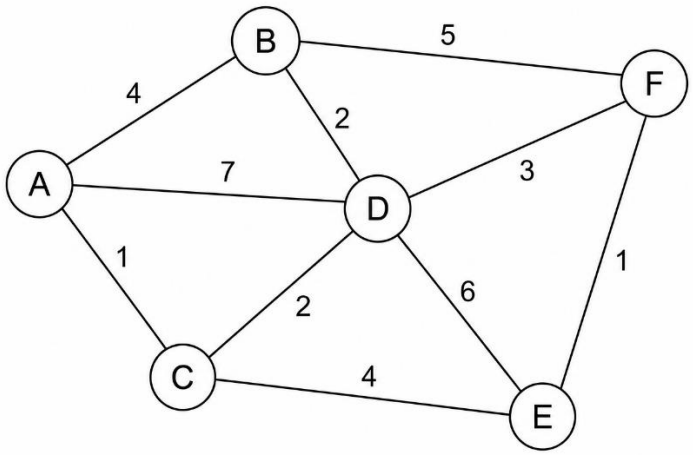
4.2.4 Graphs & Trees

1) **Figure 1** is a graph that shows the time it takes to travel between six locations in a warehouse. The six locations have been labelled with the letters A - F. When there is no edge between two nodes in the graph this means that it is not possible to travel directly between those two locations. When there is an edge between two nodes in the graph the edge is labelled with the time (in minutes) it takes to travel between the two locations represented by the nodes.

Figure 1



a) The graph is represented using an adjacency matrix, with the value 0 being used to indicate that there is no edge between two nodes in the graph. A value should be written in every cell.

Complete the unshaded cells in **Table 1** so that it shows the adjacency matrix for **Figure 1**.

Table 1

	A	B	C	D	E	F
A	0	4	1	7	0	0
B	4	0	0	2	0	5
C	1	0	0	2	4	0
D	7	2	2	0	6	3
E	0	0	4	6	0	1
F	0	5	0	3	1	0

[2 marks]

b) Instead of using an adjacency matrix, an adjacency list could be used to represent the graph. Explain the circumstances in which it would be more appropriate to use an adjacency list instead of an adjacency matrix.

[2 marks]

- **Adjacency list is appropriate when there are few edges between vertices // when graph/matrix is sparse; NE. few edges**
- **Adjacency list is appropriate when edges rarely changed;**
- **Adjacency list is appropriate when presence/absence of specific edges does not need to be tested frequently;**

c) State one reason why the graph shown in **Figure 1** is not a tree.

[1 mark]

- **It contains a cycle;**

d) The graph in **Figure 1** is a weighted graph. Explain what is meant by a weighted graph.

[1 mark]

- **A graph where each edge has a weight/value associated with it;**

e) Only the top half of the matrix in **Figure 1** was needed to represent this graph. For which type of graph wound the bottom half also be needed?

[1 mark]

- **A directed graph;**

f) Represent the graph shown in **Figure 1** as an adjacency list by completing **Table 2**.

Show the vertices and weight in this format: (vertex, weight)

Table 2

Vertex	Adjacent vertices
A	(B,4), (C,1), (D,7)
B	(A,4), (D,2), (F,5)
C	(A,1), (D,2), (E,4)
D	(A,7), (B,2), (C,2), (E,6), (F,3)
E	(C,4), (D,6), (F,1)
F	(B,5), (D,3), (E,1)

[3 marks]

2) Give **two** similarities and **two** differences between a tree and a graph data structure.

[4 marks]

Similarity (max 2)

- **Both consists of nodes;**
- **Both are connected by edges/links;**
- **Both are non-linear data structures;**
- **Both are dynamic data structures;**

Differences (max 2)

- **A tree is 1-directional whereas a graph is 2-directional;**
- **A tree has a root node whereas a graph does not**
- **A tree can not have cycles whereas a graph can;**
- **A tree will not be weighted whereas a graph may be weighted;**