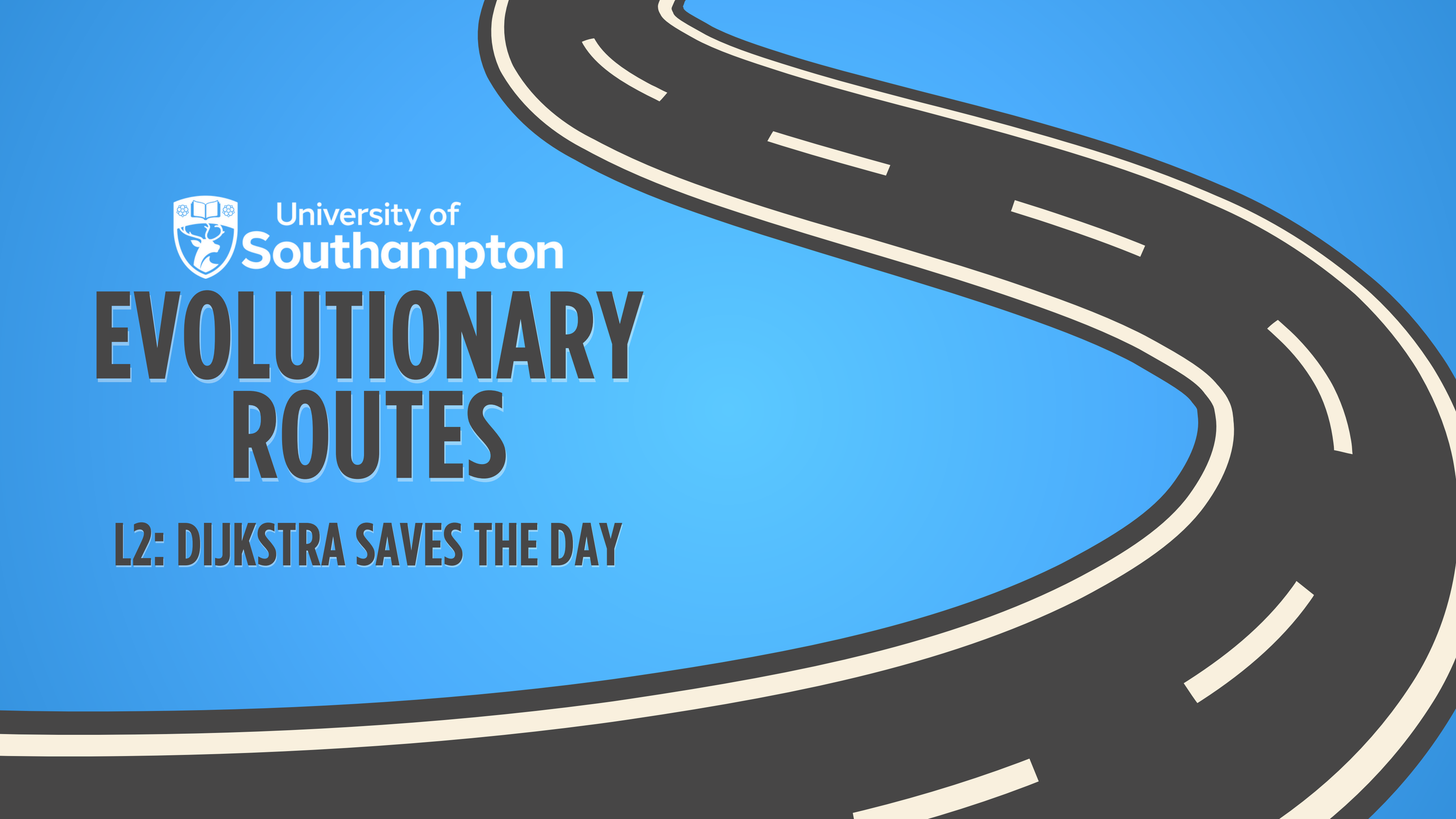
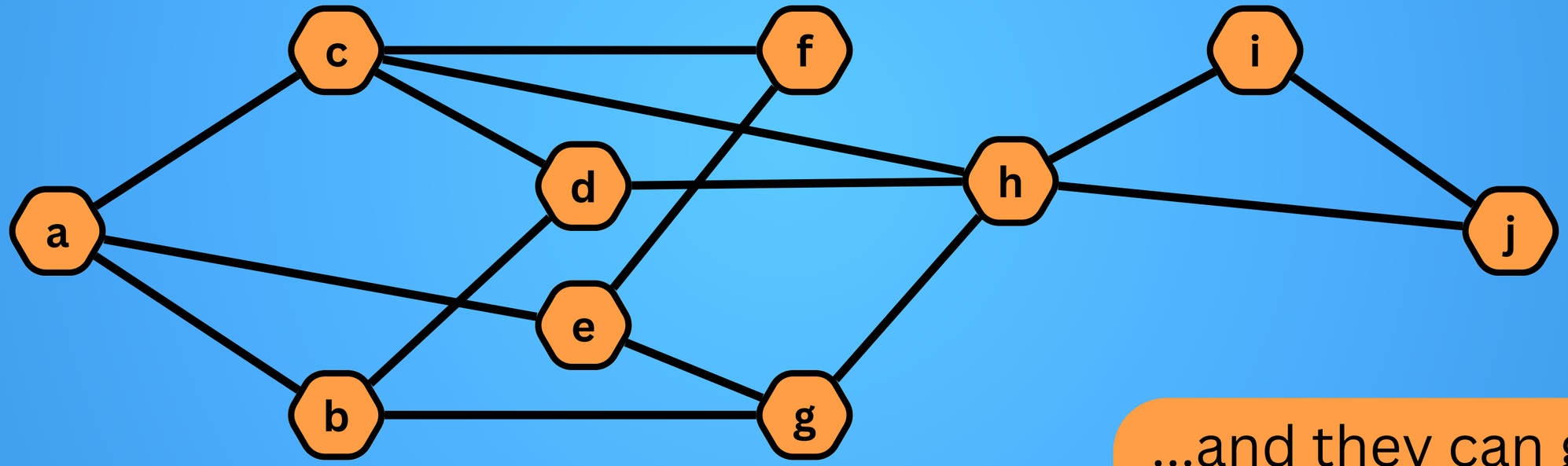

University of
Southampton
EVOLUTIONARY
ROUTES
L2: DIJKSTRA SAVES THE DAY

LESSON OUTCOMES

LO1: Perform Dijkstra’s Algorithm to find the shortest path.

IDEA

In the real world we use graphs to model transportation networks.

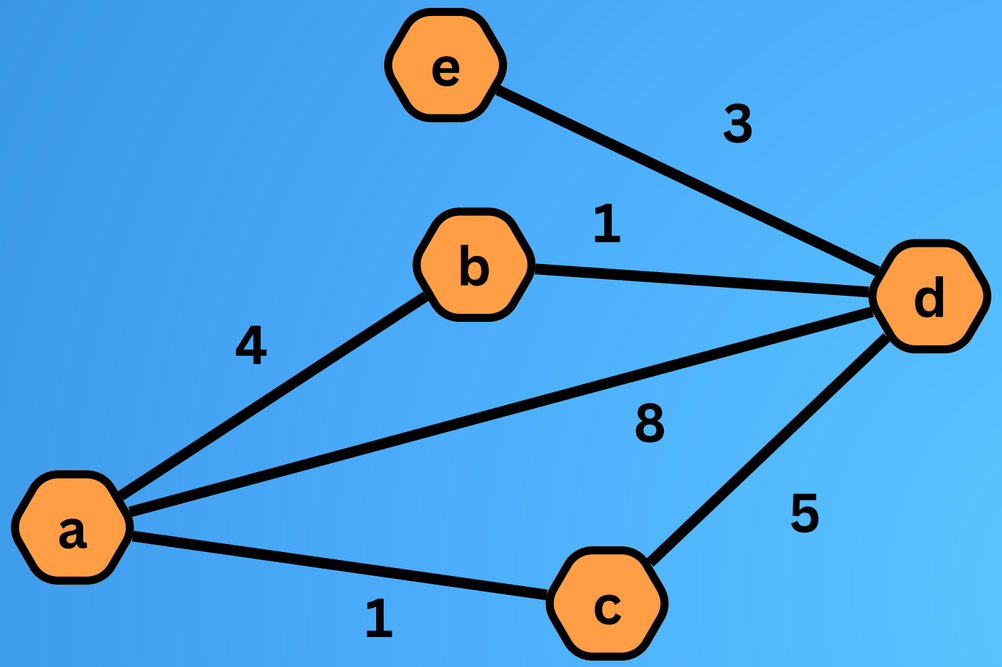


...and they can get messy **quickly!**

IDEA

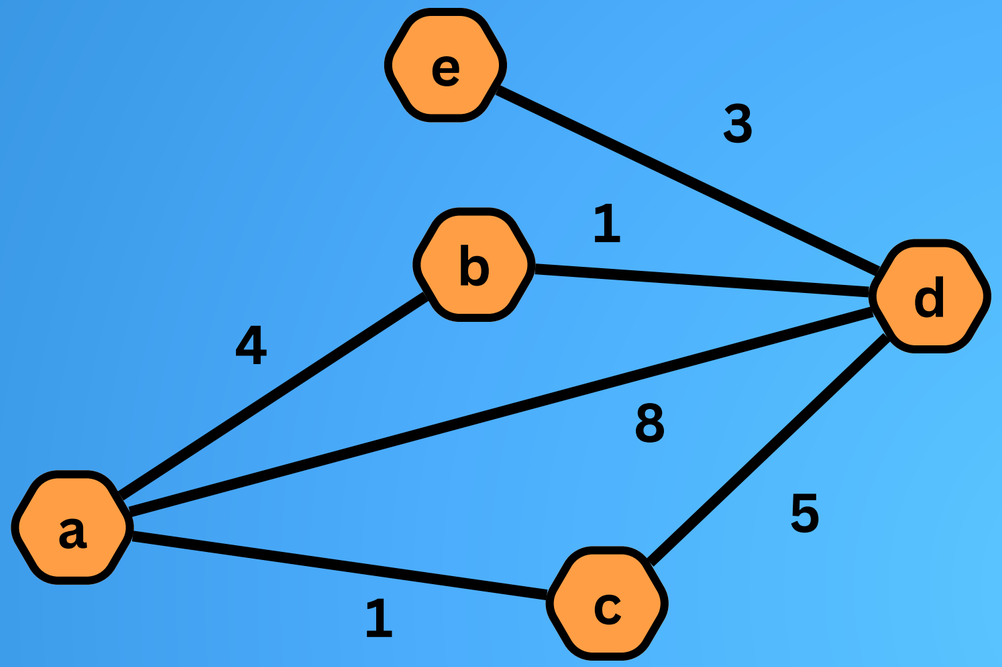
Imagine you were in charge of a bus company. It would be useful if you could find the shortest route to every stop in your transport network.

We can use **Dijkstra’s Algorithm** to do that!



Let’s imagine this is our transport network.

The bus station is vertex **a**, and all other vertices are bus stops.



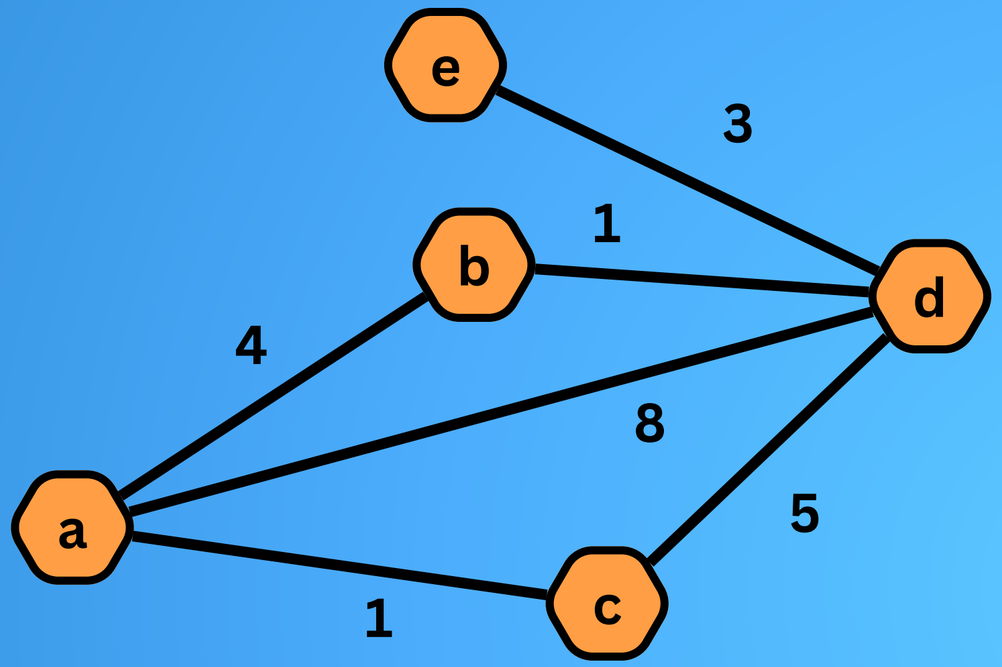
STEP 1

Make two lists.

1) A list of all **visited** vertices.

2) A list of all **unvisited** vertices.

Visited: [], Unvisited: [a, b, c, d, e]

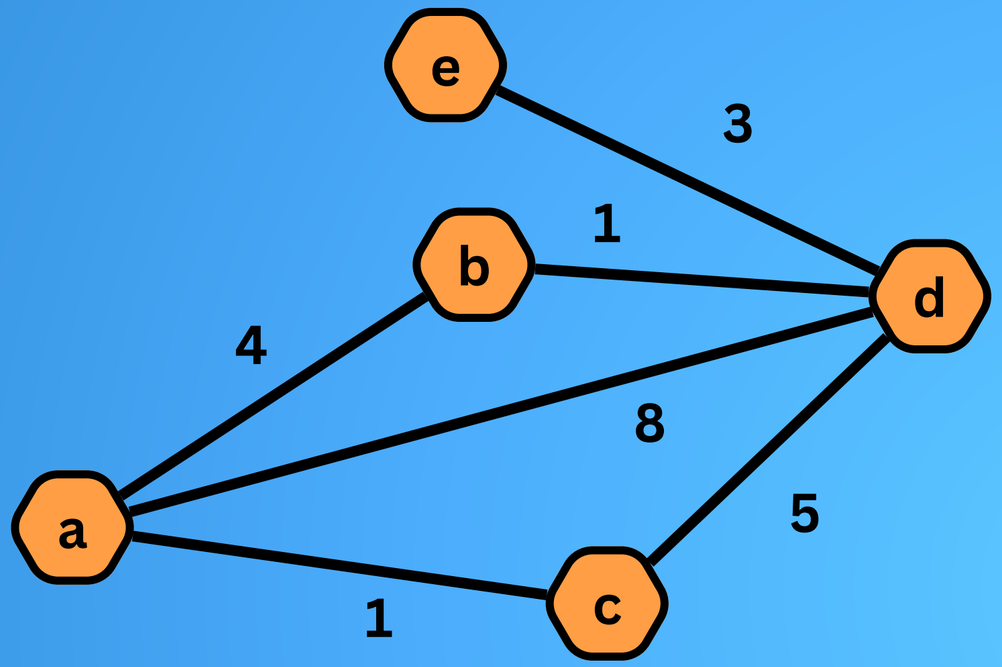


STEP 2

Make a table of vertices

Vertex	Shortest Distance	From
a	∞	
b	∞	
c	∞	
d	∞	
e	∞	

Visited: [], Unvisited: [a, b, c, d, e]

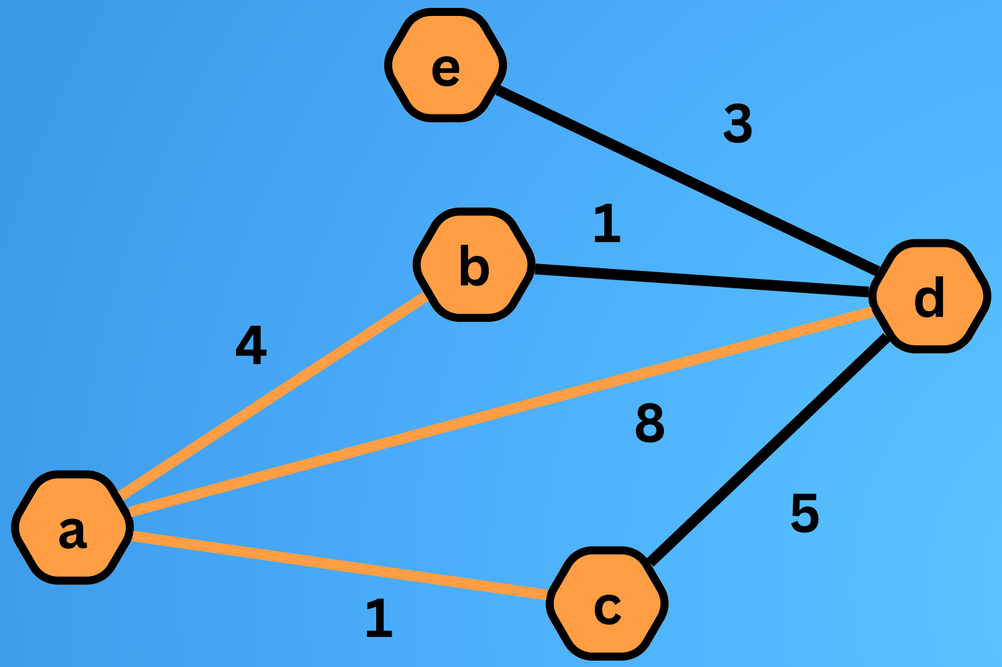


STEP 3

Start with **a**. Add it to the visited and write 0 in the shortest distance.

Vertex	Shortest Distance	From
a	0	
b	∞	
c	∞	
d	∞	
e	∞	

Visited: [a], Unvisited: [b, c, d, e]

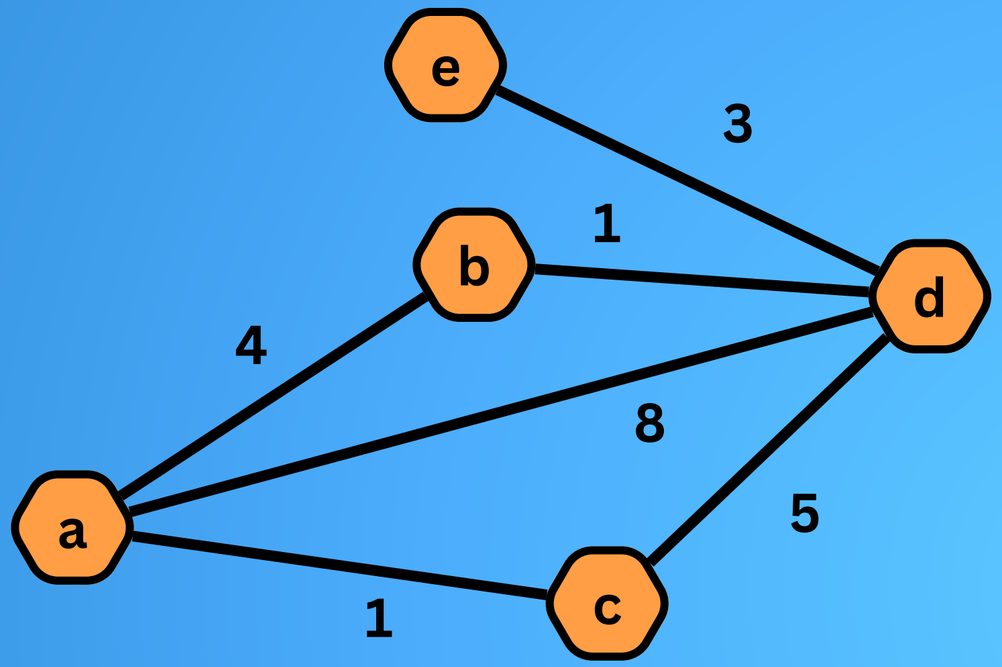


Vertex	Shortest Distance	From
a	0	
b	4	a
c	1	a
d	8	a
e	∞	

Look at all edges adjacent to **a**. Write their distances in the table.

STEP 4

Visited: [a], Unvisited: [b, c, d, e]

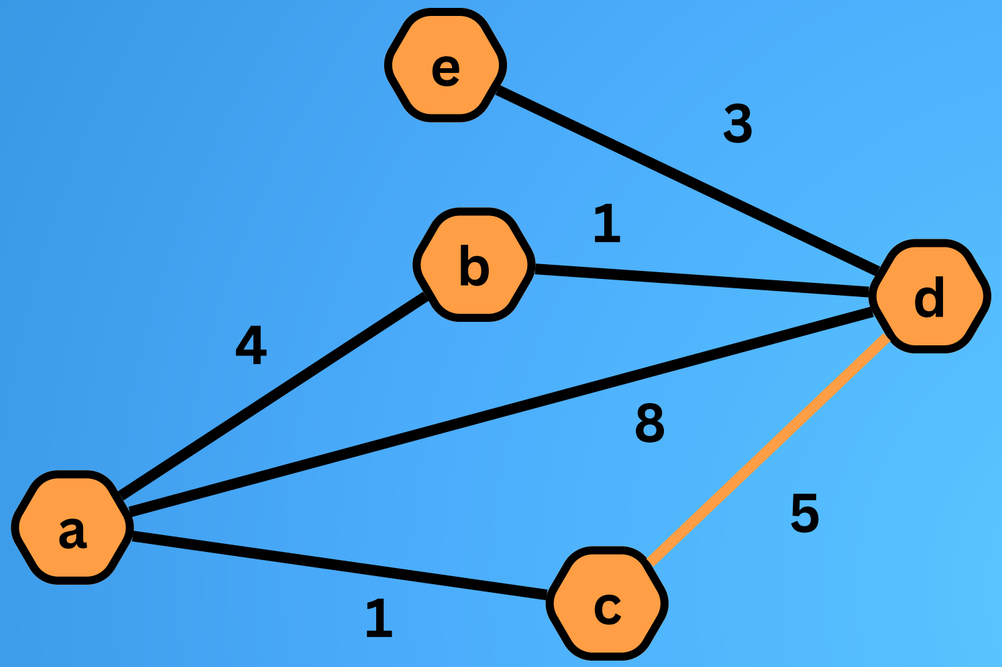


STEP 5

Pick the unvisited vertex with the shortest distance and add it to the visted list.

Visited: [a, c], Unvisited: [b, d, e]

Vertex	Shortest Distance	From
a	0	
b	4	a
c	1	a
d	8	a
e	∞	

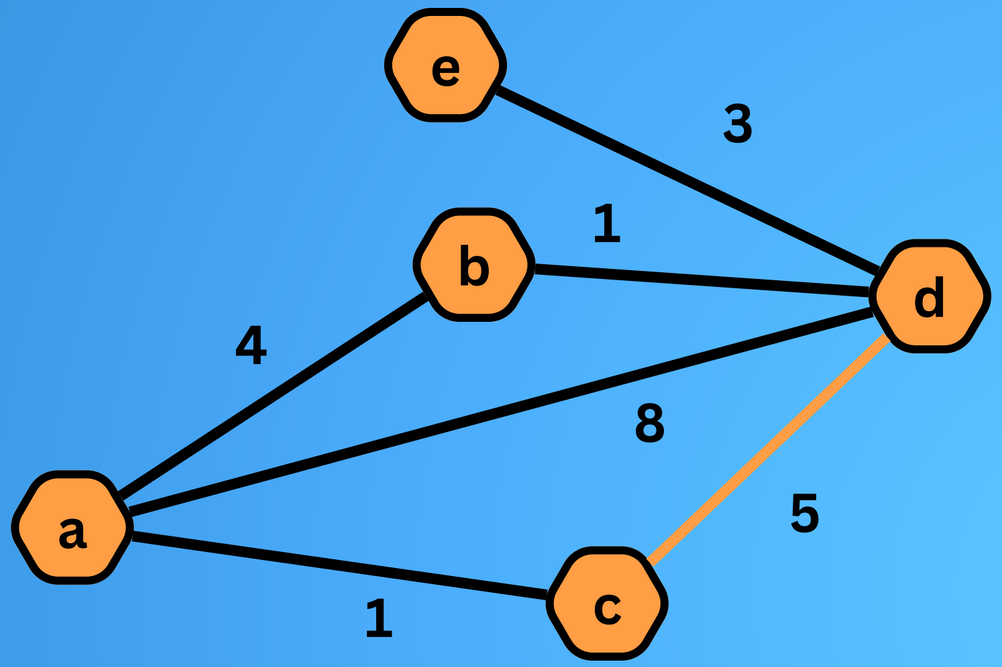


Vertex	Shortest Distance	From
a	0	
b	4	a
c	1	a
d	8	a
e	∞	

STEP 6

Check all the unvisited vertices connected with the newest visited vertex.

Visited: [a, c], Unvisited: [b, d, e]

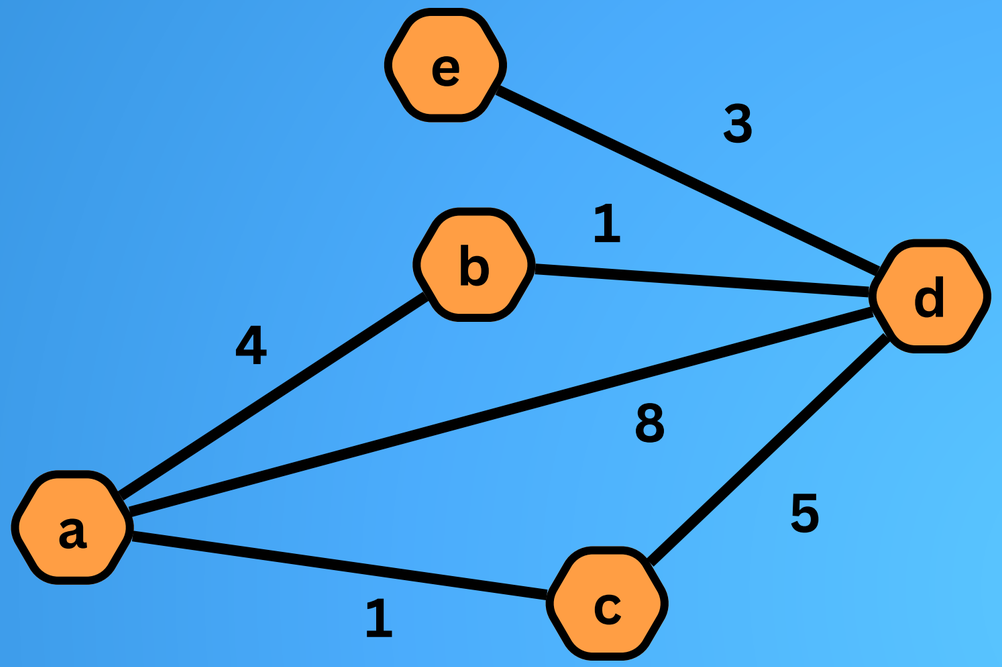


STEP 7

If the visited vertex distance plus this distance is smaller, update the table.

Vertex	Shortest Distance	From
a	0	
b	4	a
c	1	a
d	(1 + 5) vs. 8	c vs.a
e	∞	

Visited: [a, c], Unvisited: [b, d, e]

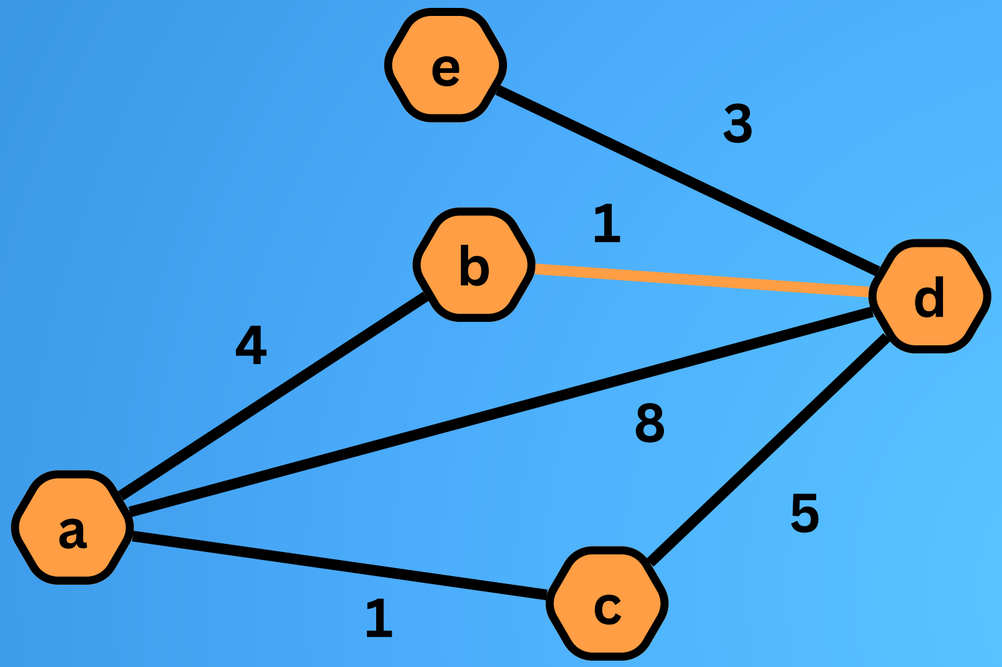


Vertex	Shortest Distance	From
a	0	
b	4	a
c	1	a
d	6	c
e	∞	

STEP 8

Continue these steps all vertices have been visited.

Visited: [a, c], Unvisited: [b, d, e]

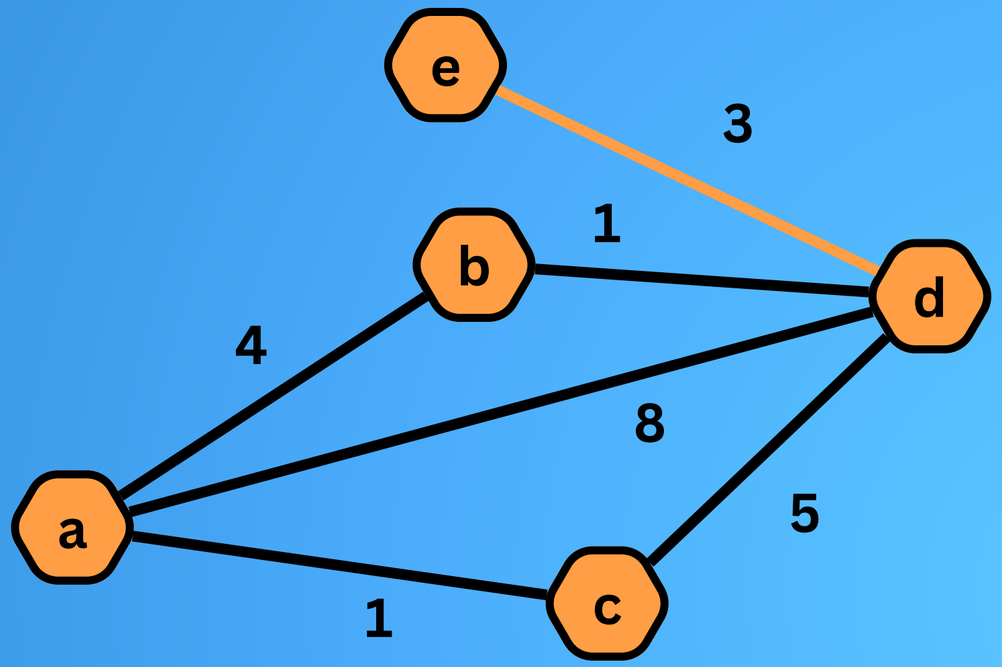


STEP 8

Continue these steps all vertices have been visited.

Visited: [a, b, c], Unvisited: [d, e]

Vertex	Shortest Distance	From
a	0	
b	4	a
c	1	a
d	(4 + 1) vs. 6	b vs. c
e	∞	

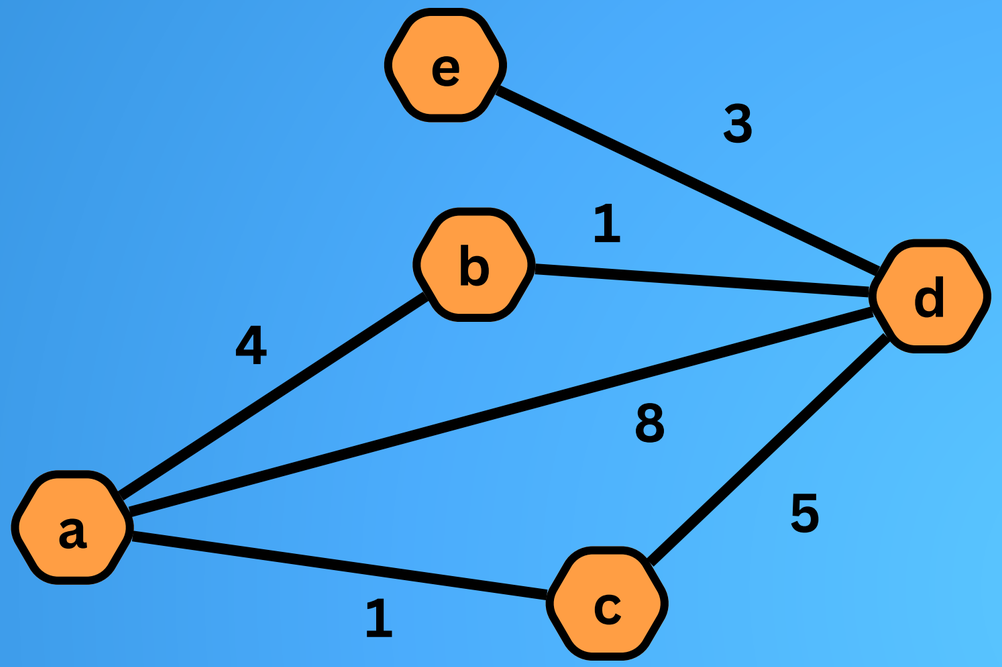


STEP 8

Continue these steps all vertices have been visited.

Vertex	Shortest Distance	From
a	0	
b	4	a
c	1	a
d	5	b
e	(5 + 3)	d

Visited: [a, b, c, d], Unvisited: [e]

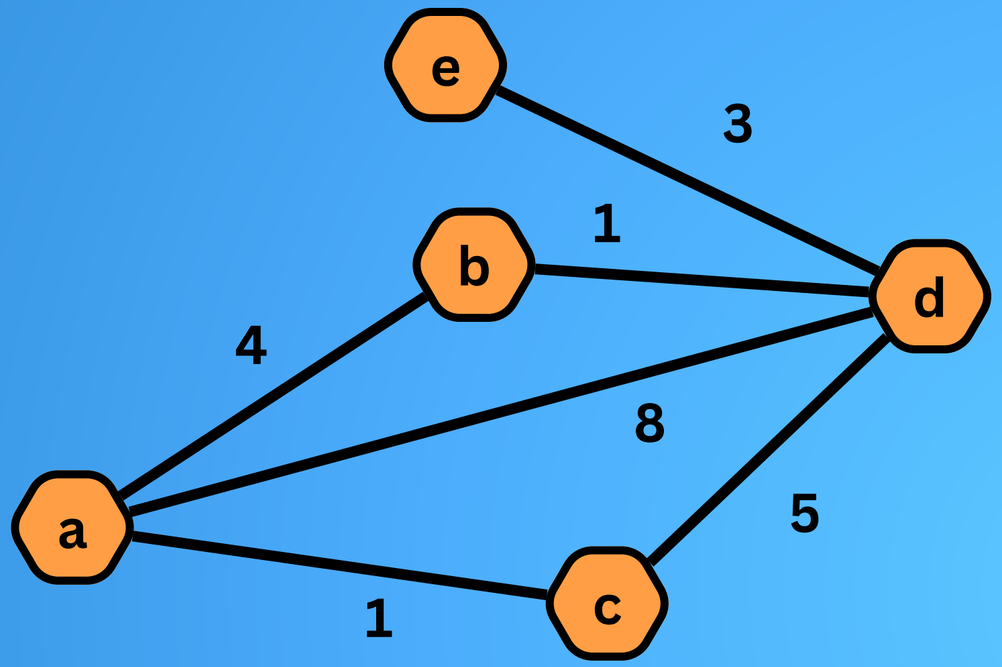


Vertex	Shortest Distance	From
a	0	
b	4	a
c	1	a
d	5	b
e	8	d

STEP 8

Continue these steps all vertices have been visited.

Visited: [a, b, c, d, e], Unvisited: []



We now have all the shortest distances from vertex **a** to any other vertex.

Vertex	Shortest Distance	From
a	0	
b	4	a
c	1	a
d	5	b
e	8	d

IDEA

To get the path from any vertex to **a**, we simply follow the **from** column.

For example:

a > b > d > e

represents the shortest path from **a** to **e**.

Vertex	Shortest Distance	From
a	0	
b	4	a
c	1	a
d	5	b
e	8	d

1) Make an empty **visited** list and add all vertices in the graph to an **unvisited** list.

2) Make a table with the vertex name, smallest distance, and from vertex column. Write all distances as infinity to begin.

2) Choose a vertex to begin with and mark its distance as 0. This is the **current** vertex.

3) Look at each unvisited vertex adjacent to the **current vertex**, and write down their distances from the current vertex plus the **current vertex distance**. Also note the current vertex in the from column.

4) If the new distance is smaller, update the table.

5) Pick the unvisited vertex with the smallest distance to be the new current vertex. Add it to the visited list.

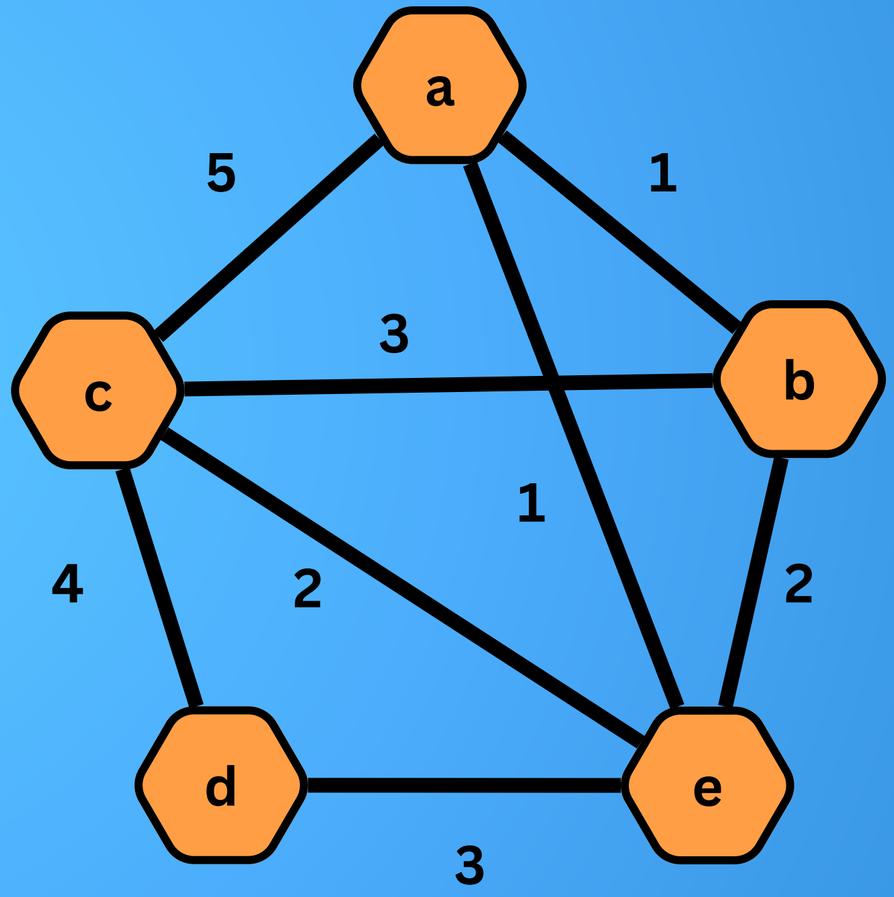
6) Repeat the process until all unvisited vertices are visited.

DIJKSTRA

ACTIVITY

Perform Dijkstra's Algorithm starting from **a**

Vertex	Shortest Distance	From
a	0	
b	∞	
c	∞	
d	∞	
e	∞	



ANSWER

Perform Dijkstra's Algorithm starting from **a**

Vertex	Shortest Distance	From
a	0	
b	1	a
c	3	e
d	4	e
e	1	a