

Graph: definition

Drag and drop the given terms from the list below into the correct spaces to complete the text.

A graph is a data structure that consists of nodes (also known as) that are connected by edges (also known as arcs). Two nodes that are connected by an edge are called . A of distinct nodes that are connected by edges is called a path. A is a closed path: it is a path that starts and ends at the same node (and no node is visited more than once). This is not the same as a , which is when an edge starts and ends at the same node.

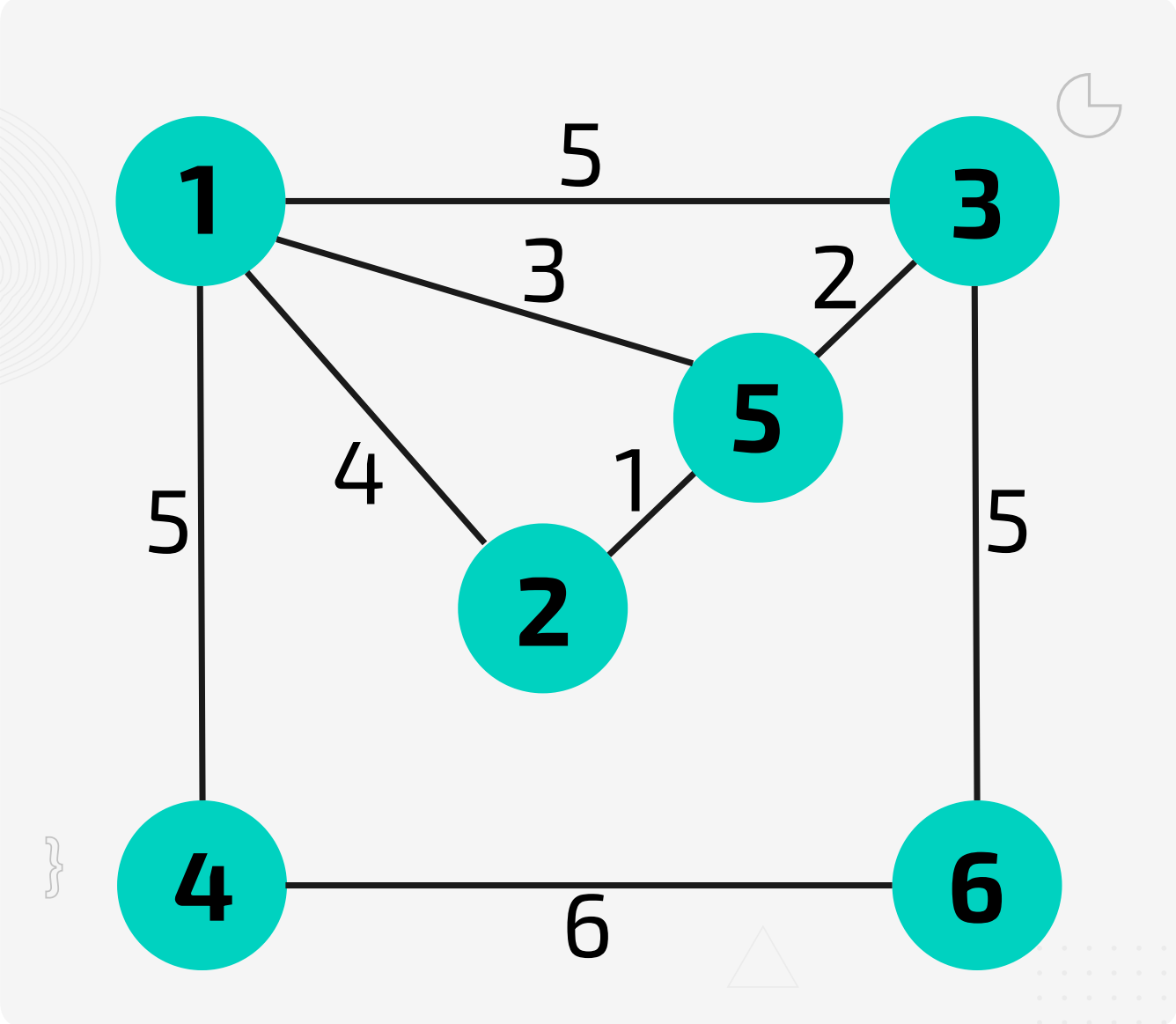
Many algorithms exist that a graph, which means that they visit each node of a graph to solve a problem.

Items:

- loop sequence traverse vertices cycle neighbours

Graph: representation 1

The figure below is a weighted graph that represents the distance between the locations of six rental properties. The six properties have been labelled with the numbers 1–6. When there is no edge between two nodes, this means that it is not possible to travel directly between those two properties. When there is an edge between two nodes, the edge is labelled with the distance (miles) to travel between the two properties.



Graph representing the location of six rental properties

An adjacency matrix is used to store the data. Which of the tables represents the graph data shown in figure 1?

☐

Node	1	2	3	4	5	6
1		4	5	5	3	
2	3				5	
3	5				5	6

○

4	5					6
5	4	2			5	
6	∞	∞	3	4	∞	∞
Node	1	2	3	4	5	6
1	2	3	4	5		
2	1	5				
3	1	5	6			
4	1	6				
5	1	2	3			
6	3	4				

○

Node	1	2	3	4	5	6
1	0	1	1	1	1	0
2	1	0	0	0	1	0
3	1	0	0	0	1	1
4	1	0	0	0	0	1
5	1	1	0	0	1	0
6	0	0	1	1	0	0

○

Node	1	2	3	4	5	6
1		4	5	5	3	
2	4				1	
3	5				2	5
4	5					6
5	3	1	2			
6			5	6		

Graph: representation 2

Every morning, the drivers for a delivery company receive a route for collecting and dropping off deliveries. Some items are collected at one location and dropped off at another, so these locations must be visited in the right order.

The graph shown in **Figure 1** represents the locations for a small number of customers. The graph is directed to show that the locations must be visited in a particular order. This shows that a route from 2 to 6 could be made via 3 or 5, but location 6 could not be visited ahead of location 2. The delivery company's scheduling system uses the graph data to produce a suitable route for each of the drivers.

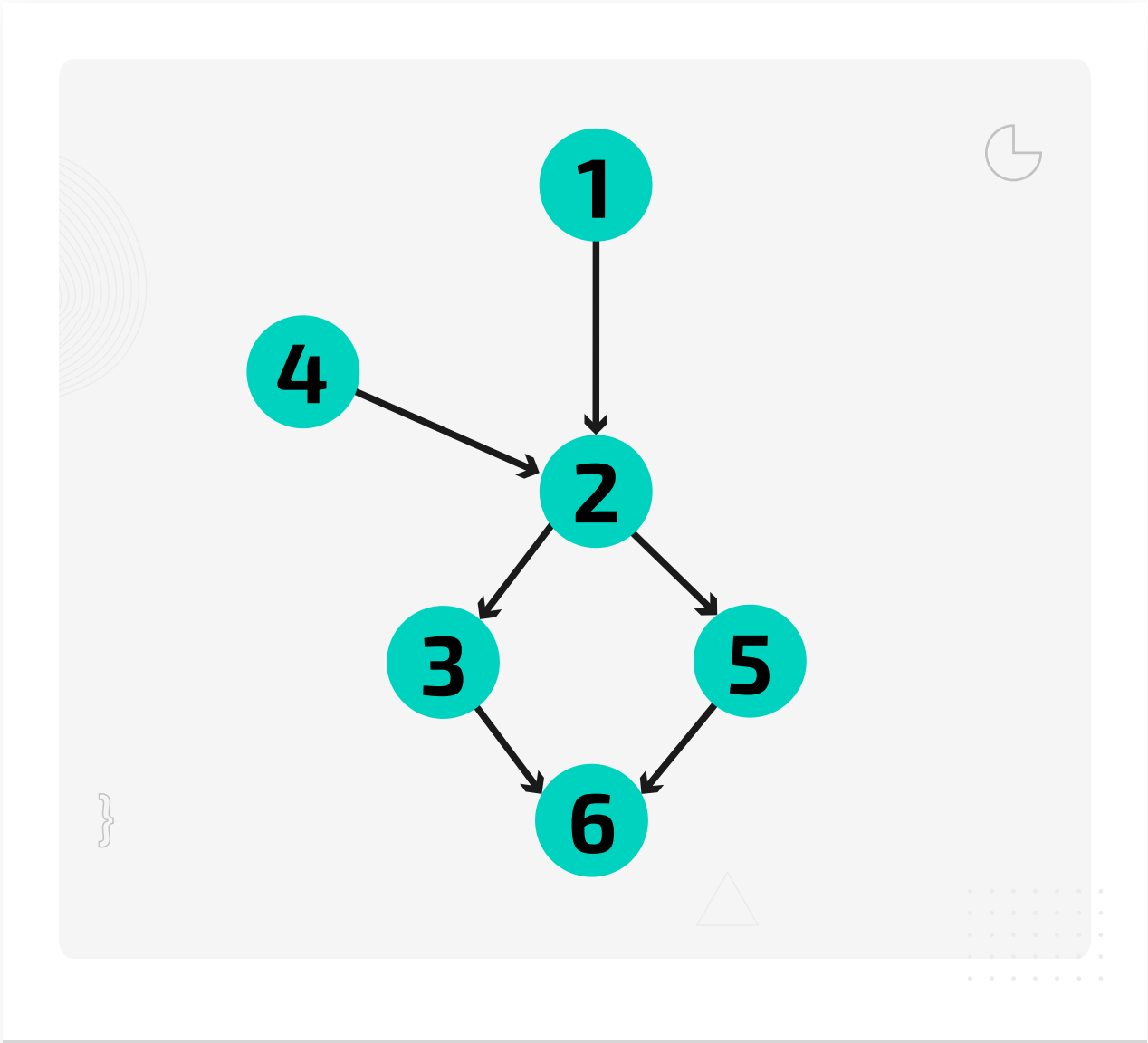


Figure 1: Directed graph

Option A

Vertex	1	2	3	4	5	6
1		1				
2			1		1	
3						1

4		1				
5						1
6						

Option C

Vertex	1	2	3	4	5	6
1	0	1	0	0	0	0
2	0	0	1	0	1	0
3	0	0	0	0	0	1
4	0	1	0	0	0	0
5	0	0	0	0	0	1
6	0	0	0	0	0	0

Option B

Vertex	1	2	3	4	5	6
1	0	1	0	0	0	0
2	1	0	1	1	1	0
3	0	1	0	0	0	1
4	0	1	0	0	0	0
5	0	1	0	0	0	1
6	0	0	1	0	1	0

Option D

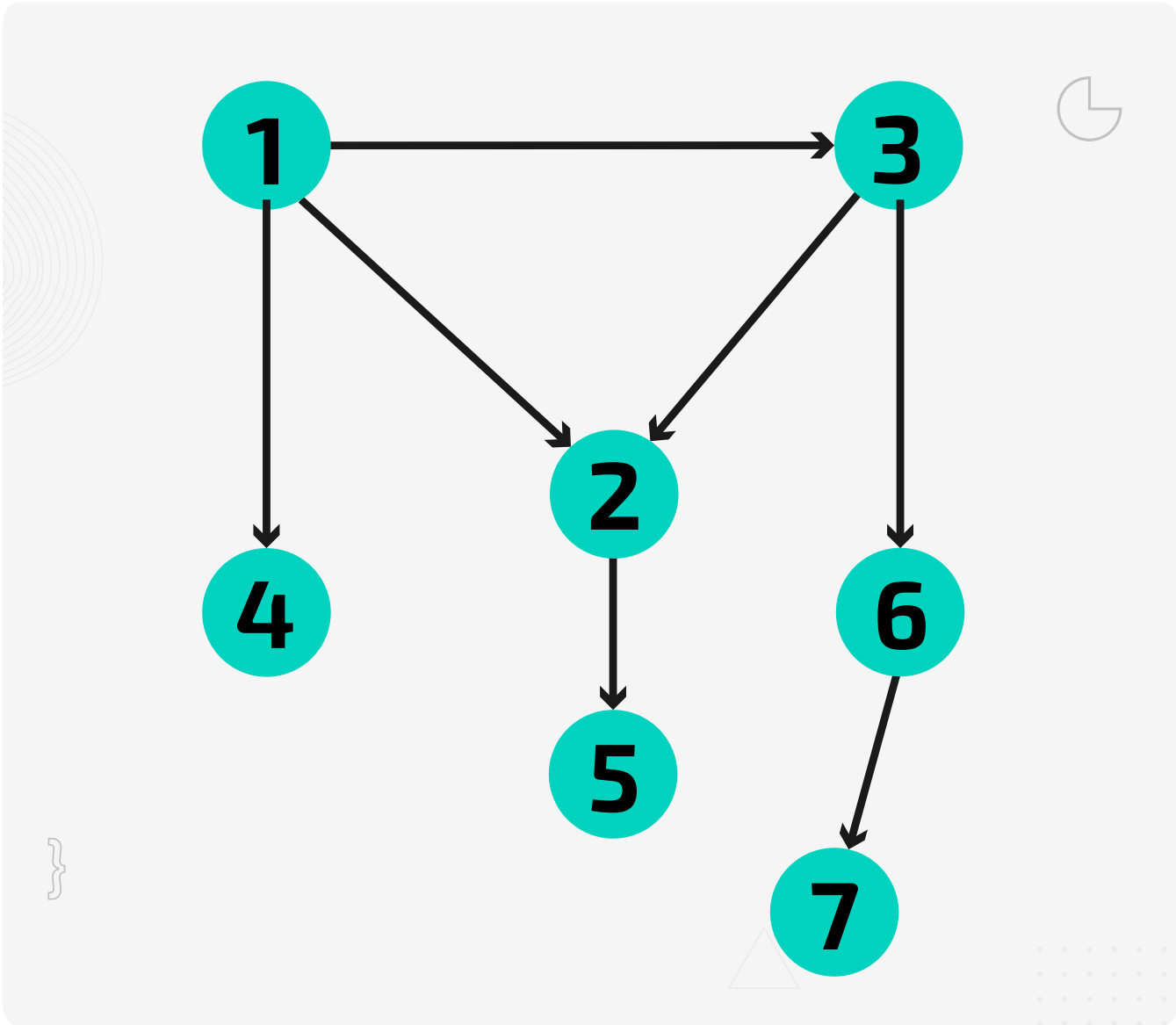
Vertex	1	2	3	4	5	6
1	2					
2	3	5				
3	6					
4	2					
5	6					
6						

Which adjacency matrix represents the data for the given graph?

- ☐ A
- ☐ B
- ☐ C
- ☐ D

Graph: representation 3

A graph can be directed or undirected. It can also be weighted or unweighted. Below is an example of a directed, unweighted graph used to represent the connections between seven nodes.



A directed, unweighted graph

Which of the following options represents an **adjacency list** for the given graph?

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Nodes	Adjacency list
1	2; 3; 4
2	5
3	2; 6
4	
5	
6	7

7	
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Nodes	Adjacency list
1	1; 2; 3; 4
2	2; 5
3	2; 3; 6
4	
5	
6	6; 7
7	

Nodes	Adjacency list
1	0; 1; 1; 1; 0; 0; 0
2	0; 0; 0; 0; 1; 0; 0
3	0; 1; 0; 0; 0; 1; 0
4	0; 0; 0; 0; 0; 0; 0
5	0; 0; 0; 0; 0; 0; 0
6	0; 0; 0; 0; 0; 0; 1
7	0; 0; 0; 0; 0; 0; 0

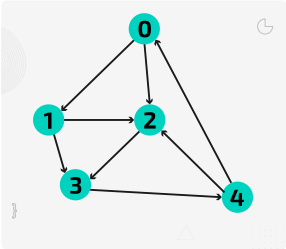
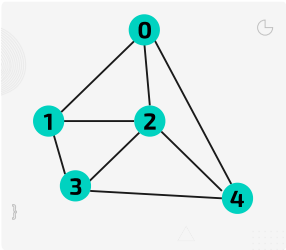
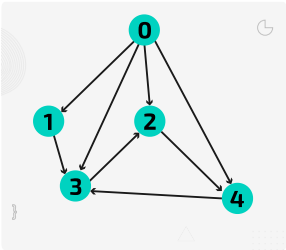
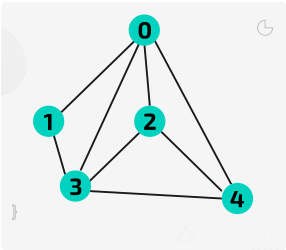
Nodes	Adjacency list
1	1; 0; 0; 0; 1; 1; 1
2	1; 1; 1; 1; 0; 1; 1
3	1; 0; 1; 1; 1; 0; 1
4	1; 1; 1; 1; 1; 1; 1
5	1; 1; 1; 1; 1; 1; 1
6	1; 1; 1; 1; 1; 1; 0
7	1; 1; 1; 1; 1; 1; 1

Graph: representation 4

A group of students have decided to create a list of their respective friends within the group. Each student has been allocated a number, and the friendship connections between five members of the group can be represented with the adjacency list shown below:

Members	Friends with
0	1, 2, 3, 4
1	0, 3
2	0, 3, 4
3	0, 1, 2, 4
4	0, 2, 3

Which of the following graphs illustrates the data stored in the adjacency list?

☐☐☐☐

Graph: representation 5

A graph can be represented using an adjacency matrix or an adjacency list. Under which circumstances would it be more appropriate to use an adjacency list (instead of an adjacency matrix)? Select **three** correct statements.

- ☐ When nodes will be removed frequently
- ☐ When new edges will be added frequently
- ☐ When there are relatively few edges compared to the number of nodes in the graph and the amount of memory space is a potential issue
- ☐ When the presence or absence of edges will be tested frequently
- ☐ When new nodes will be added frequently
- ☐ When edges will be removed frequently

A graph can be represented using an adjacency matrix or an adjacency list. Under which circumstances would it be more appropriate to use an adjacency matrix (instead of an adjacency list)? Select **two** correct statements.

☐

When there are relatively few edges compared to the number of nodes in the graph and the amount of memory space is a potential issue

☐

When edges will be removed frequently

☐

When new edges will be added frequently

☐

When new nodes will be added frequently

☐

When the presence or absence of edges will be tested frequently

☐

When nodes will be removed frequently

DFS and BFS order visited

A graph problem often requires you to traverse every edge between the nodes in the graph in a systematic way. This process helps identify the connected components of the graph and find paths between nodes. Over the course of a traversal, the state of each node progresses from **unvisited** to **visited** to **completely explored**.

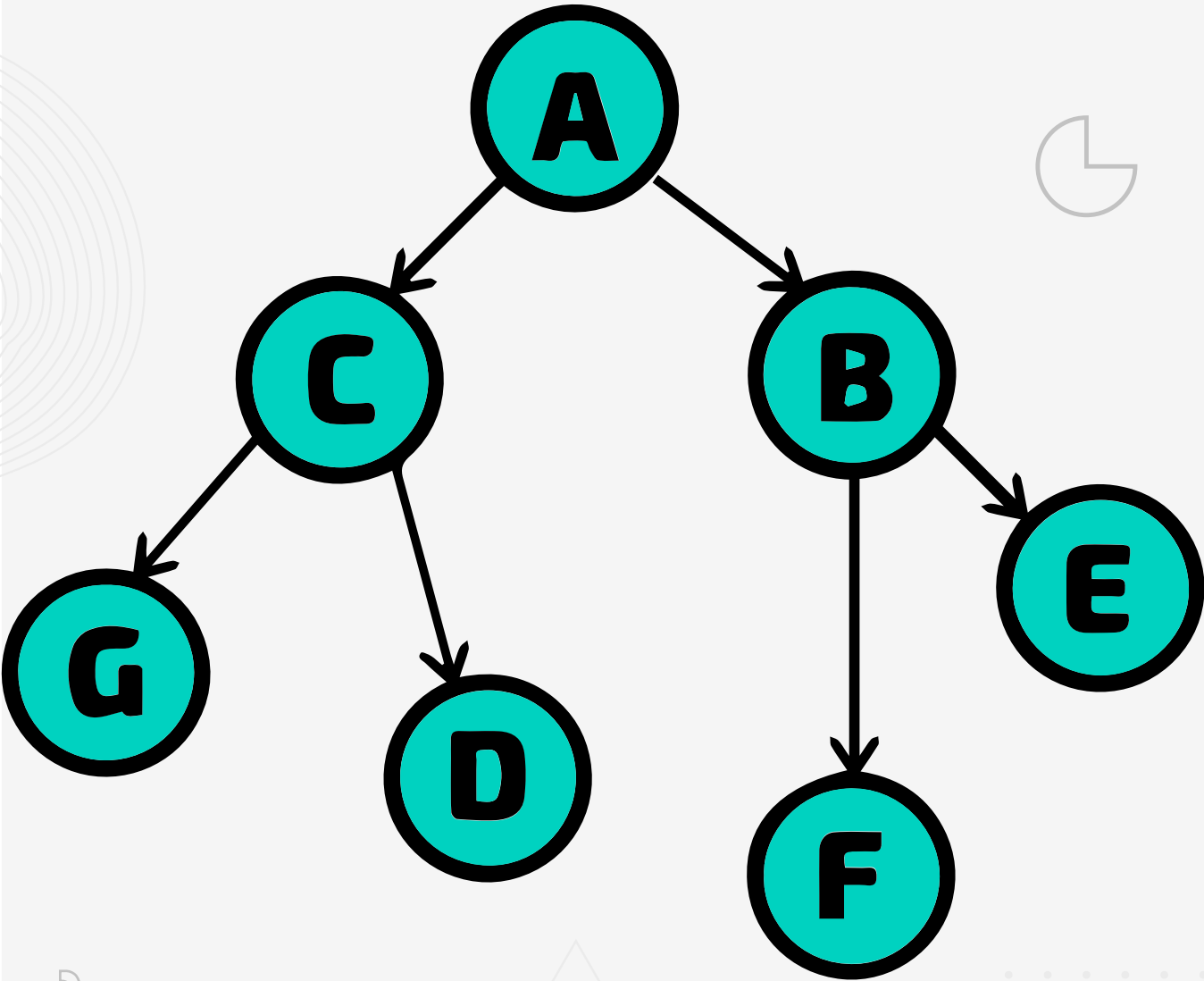


Figure 1: Directed, unweighted graph

Consider a **breadth-first** and a **depth-first** traversal of the graph shown in **Figure 1**, starting from the node labelled **A**. In what order will the nodes be visited? When you trace each traversal and need to make a decision between neighbouring nodes, choose the node with the letter value closest to the beginning of the alphabet.

- ☐
- For BFS : A, C, B, G, D, F, E

For DFS : A, B, C, D, E, F, G

- ☐
 - For BFS : A, B, C, D, E, F, G
 - For DFS : A, C, G, D, B, F, E
- ☐
 - For BFS : A, C, G, D, B, F, E
 - For DFS : A, C, B, G, D, F, E
- ☐
 - For BFS : A, B, C, E, F, D, G
 - For DFS : A, B, E, F, C, D, G