Design and analysis of algorithm

prepared By:
13cse035:Hemanshi maheta
13cse038:Satya parsana
13cse047:Jignesh rathod

Topics

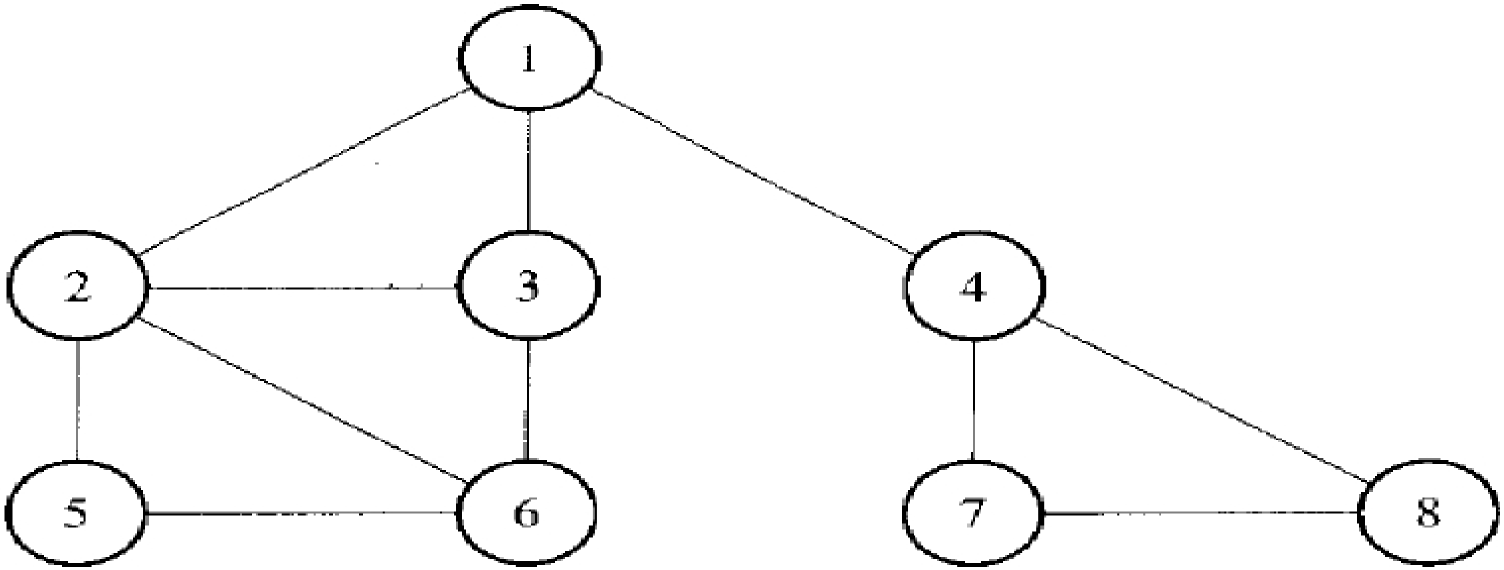
- Depth First Search (DFS)
- Breadth First Search (BFS)

DEPTH-FIRST SEARCH: UNDIRECTED GRAPHS

- Let **G = (N , A)** be an undirected graph all of whose nodes we wish to visit.
- Suppose it is somehow possible to mark a node to show it has already been visited.
- To carry out a depth-first traversal of the graph, choose any node **v** ϵ **N** as the starting point.
- Mark this node to show it has been visited. Next, if there is a node adjacent to **v** that has not yet been visited, choose this node as a new starting point and call the depth-first search procedure recursively.

- On return from the recursive call, if there is another node adjacent to **v** that has not been visited, choose this node as the next starting point, call the procedure recursively once again, and so on.
- When all the nodes adjacent to **v** are marked, the search starting at **v** is finished.
- If there remain any nodes of G that have not been visited,choose any one of them as a new starting point, and call the procedure yet again.
- Continue thus until all the nodes of G are marked. Here is the recursive algorithm

EXAMPLE:



1.	*dfs*(1)	initial call
2.	*dfs*(2)	recursive call
3.	*dfs*(3)	recursive call
4.	*dfs*(6)	recursive call
5.	*dfs*(5)	recursive call; progress is blocked
6.	*dfs*(4)	a neighbour of node 1 has not been visited
7.	*dfs*(7)	recursive call
8.	*dfs*(8)	recursive call; progress is blocked
9.	there are no more nodes to visit	

procedure $dfsearch(G)$

    for each $v \in N$ **do** $mark[v] \leftarrow$ *not-visited*

    for each $v \in N$ **do**

        if $mark[v] \neq visited$ **then** $dfs(v)$

procedure $dfs(v)$

    {Node v has not previously been visited}

    $mark[v] \leftarrow visited$

    for each node w adjacent to v **do**

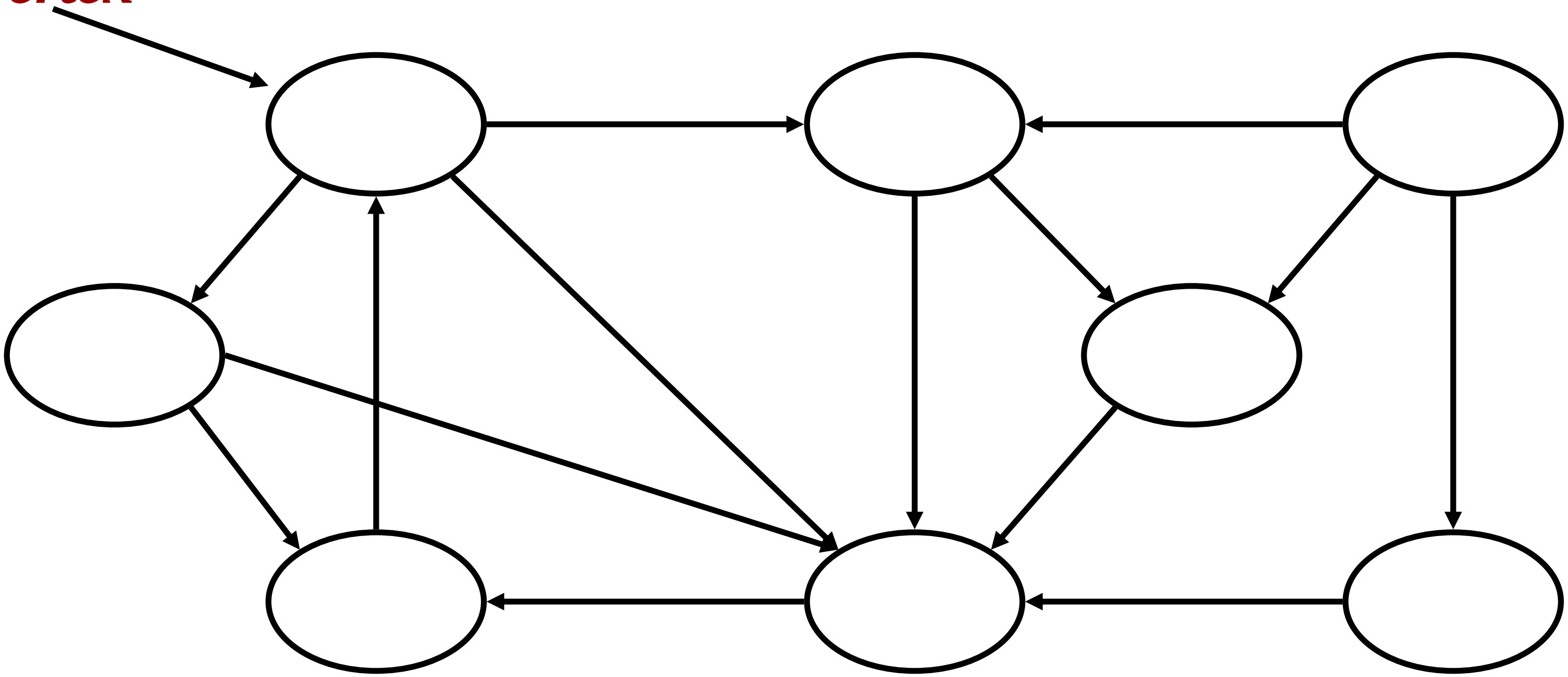
        if $mark[w] \neq visited$ **then** $dfs(w)$

Depth-first search: Directed graphs

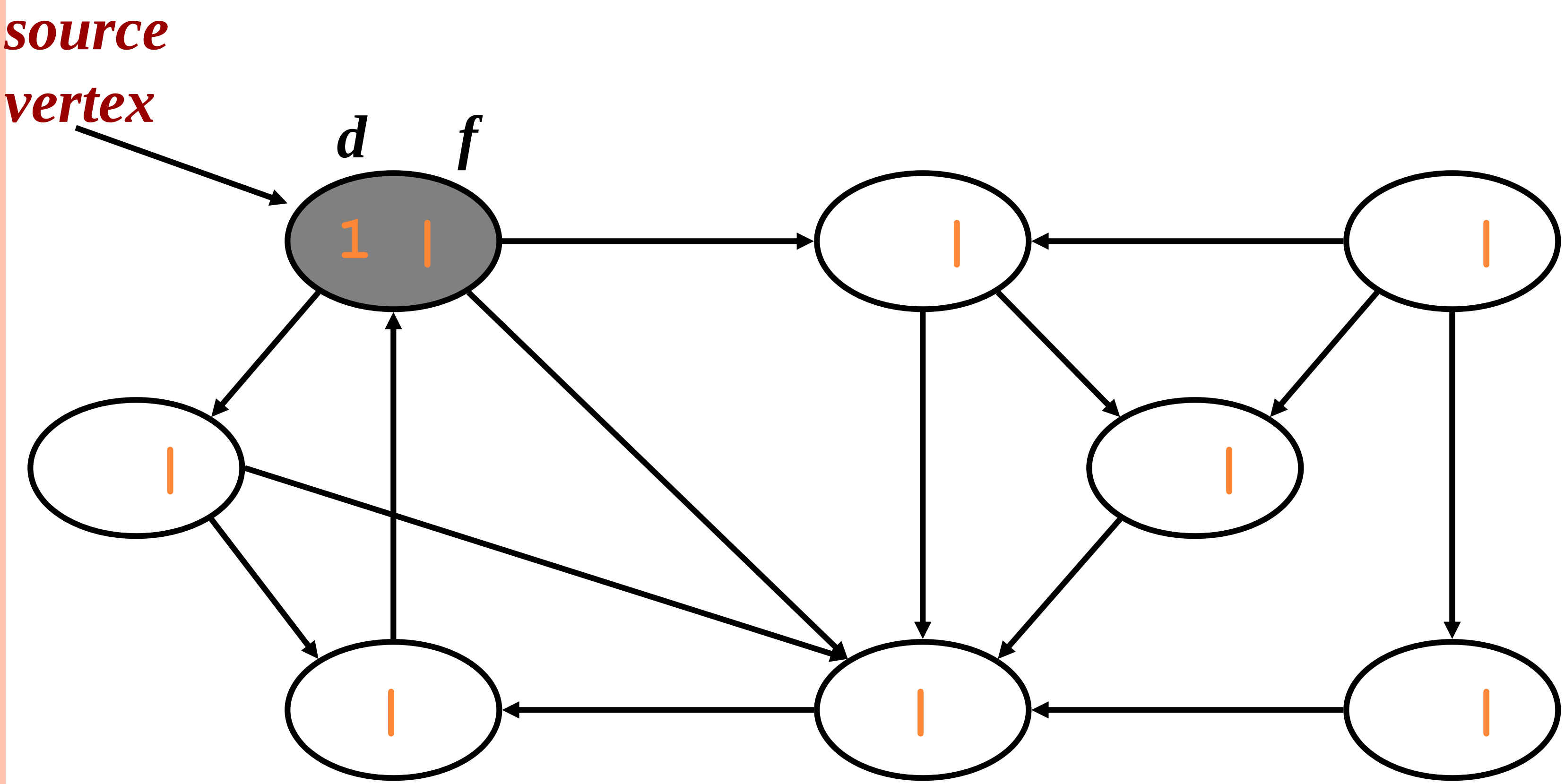
- The algorithm is essentially the same as for undirected graphs, the difference residing in the interpretation of the word "adjacent".
- In a directed graph, node **w** is adjacent to node v if the directed edge (v, w) exists.
- If **(v, w)** exists but **(w, v)** does not, then **w** is adjacent to **v** but **v** is not adjacent to **w**.
- With this change of interpretation the procedures **dfs** and **search** apply equally well in the case of a directed graph.

DFS Example

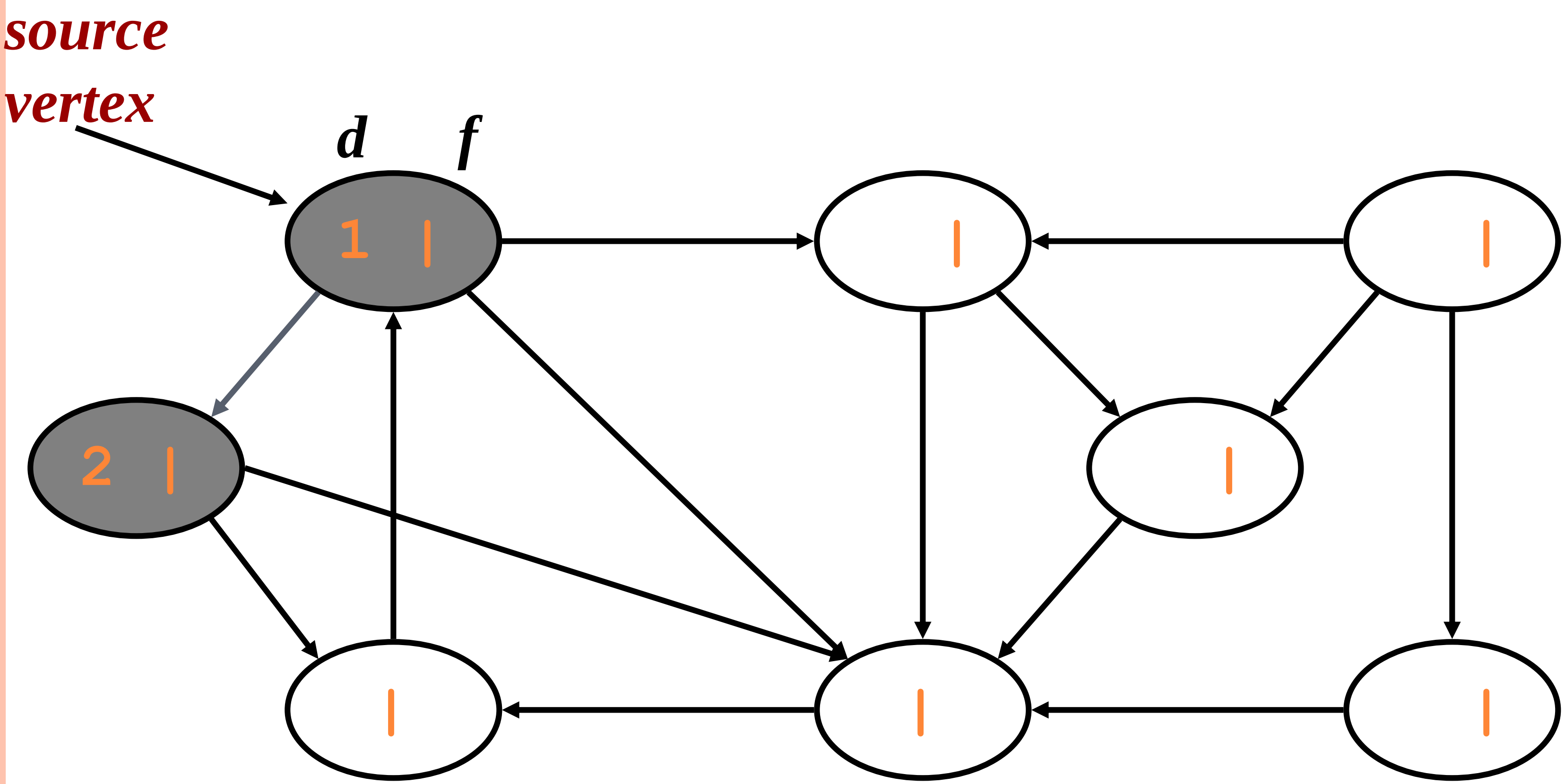
source vertex



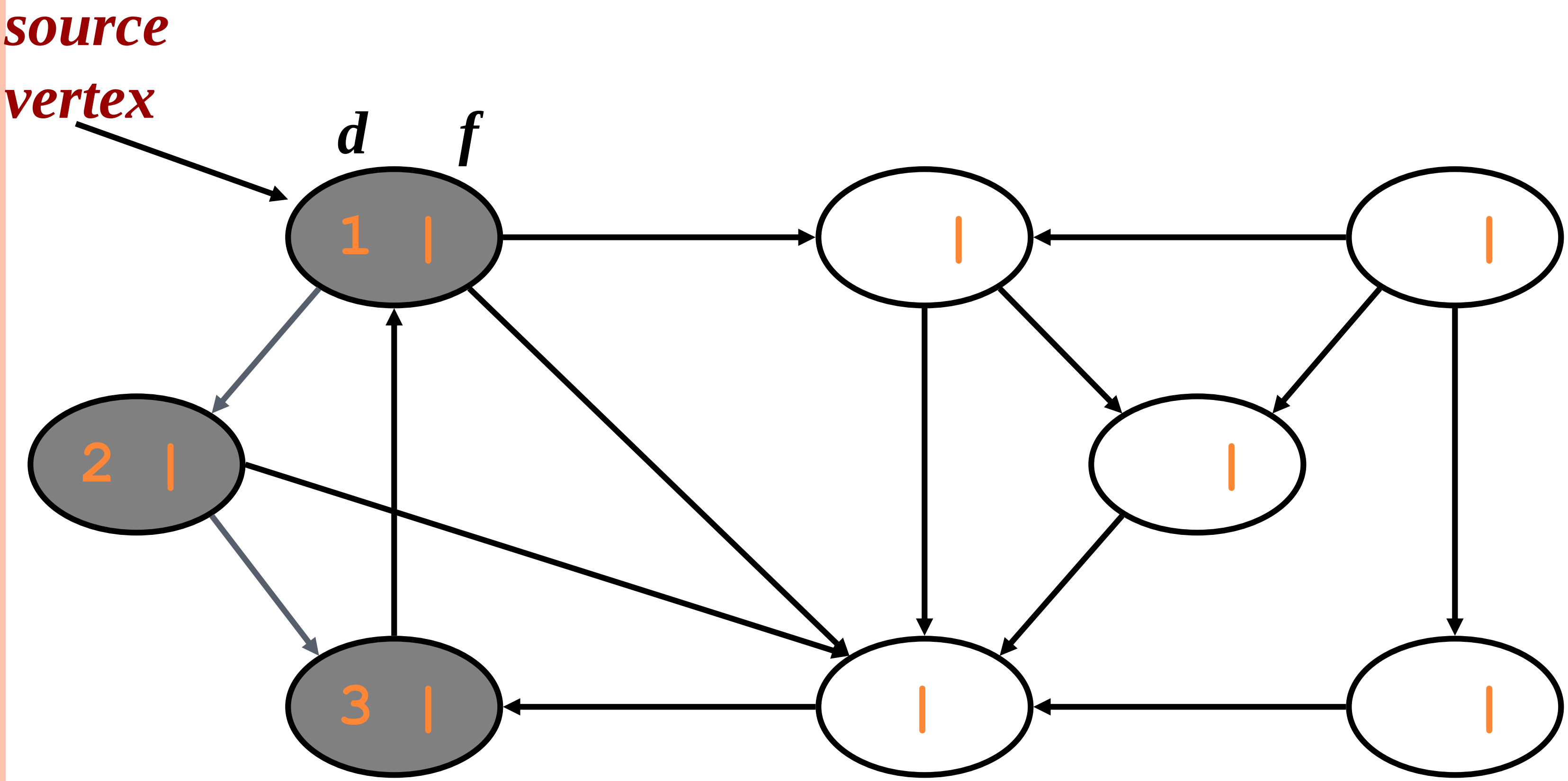
DFS Example



DFS Example



DFS EXAMPLE



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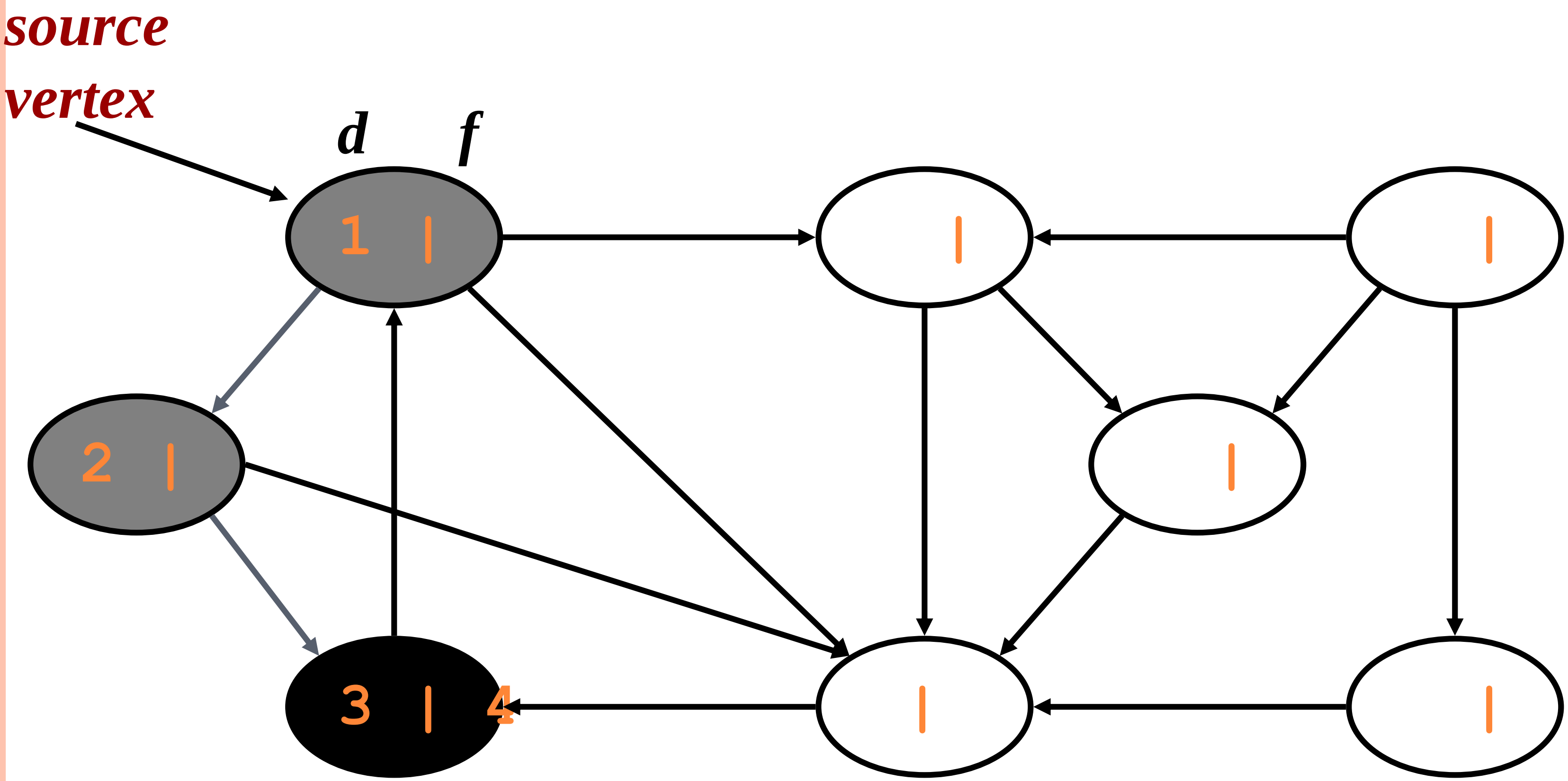
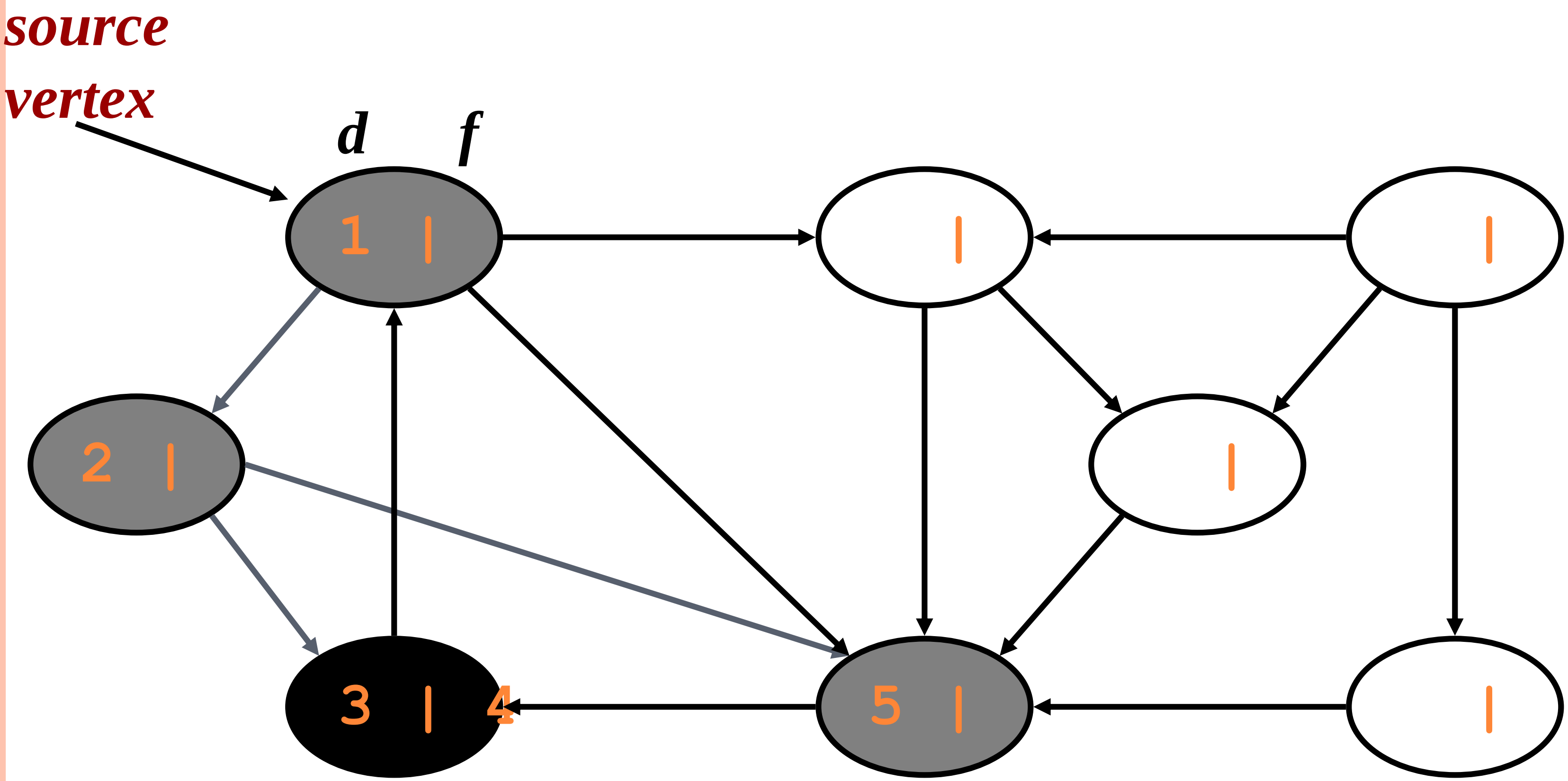


DFS Example



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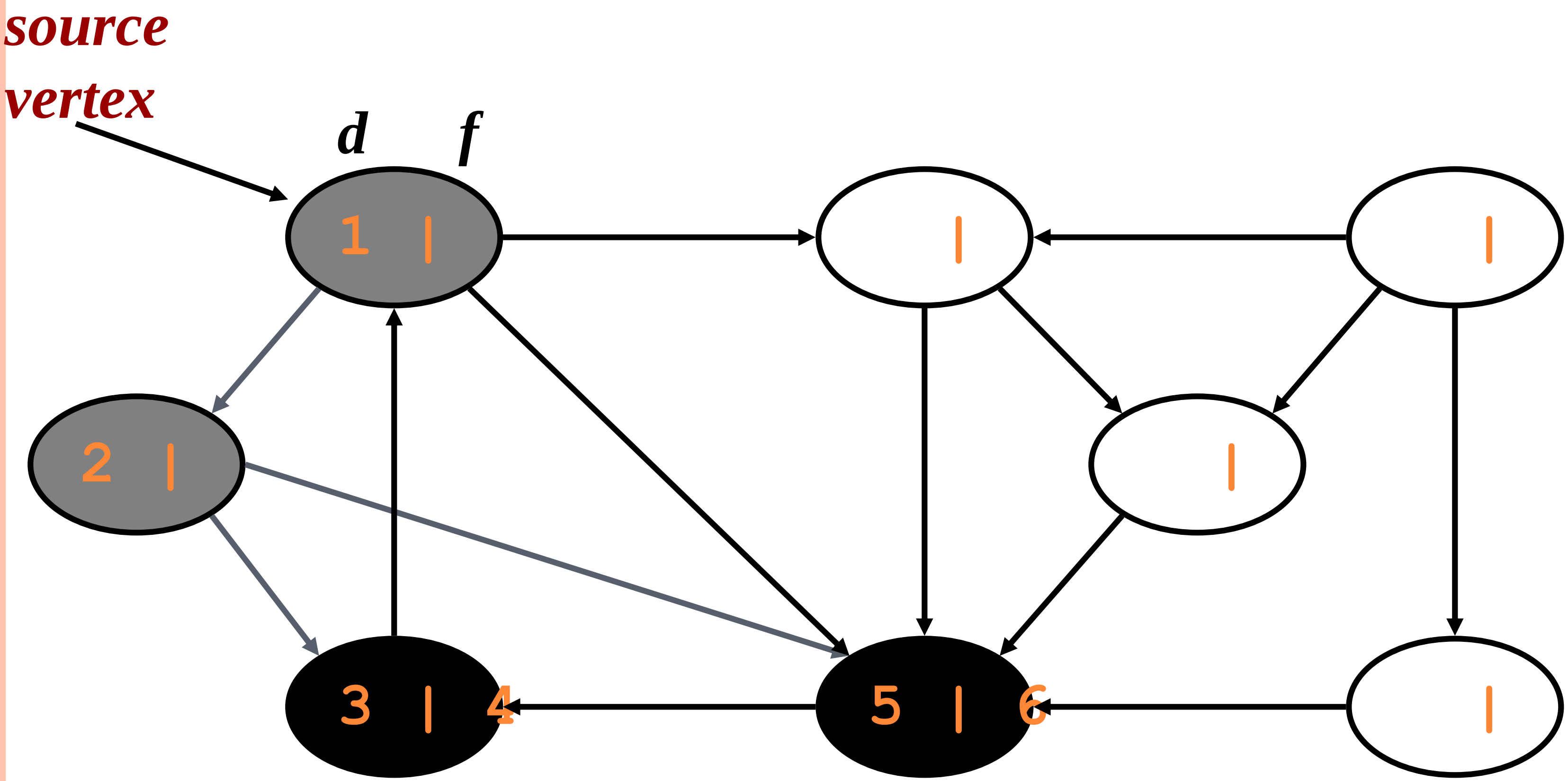
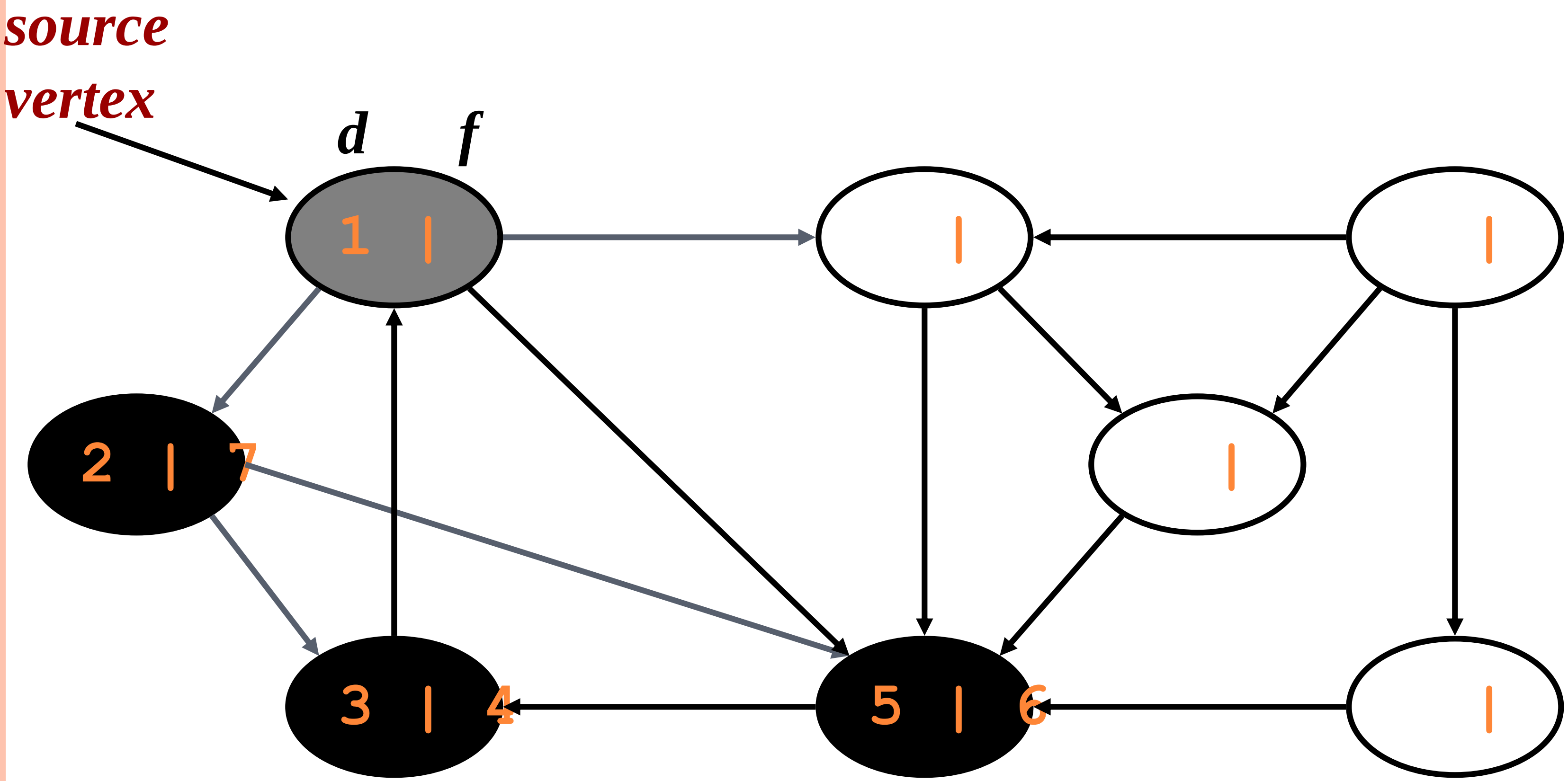
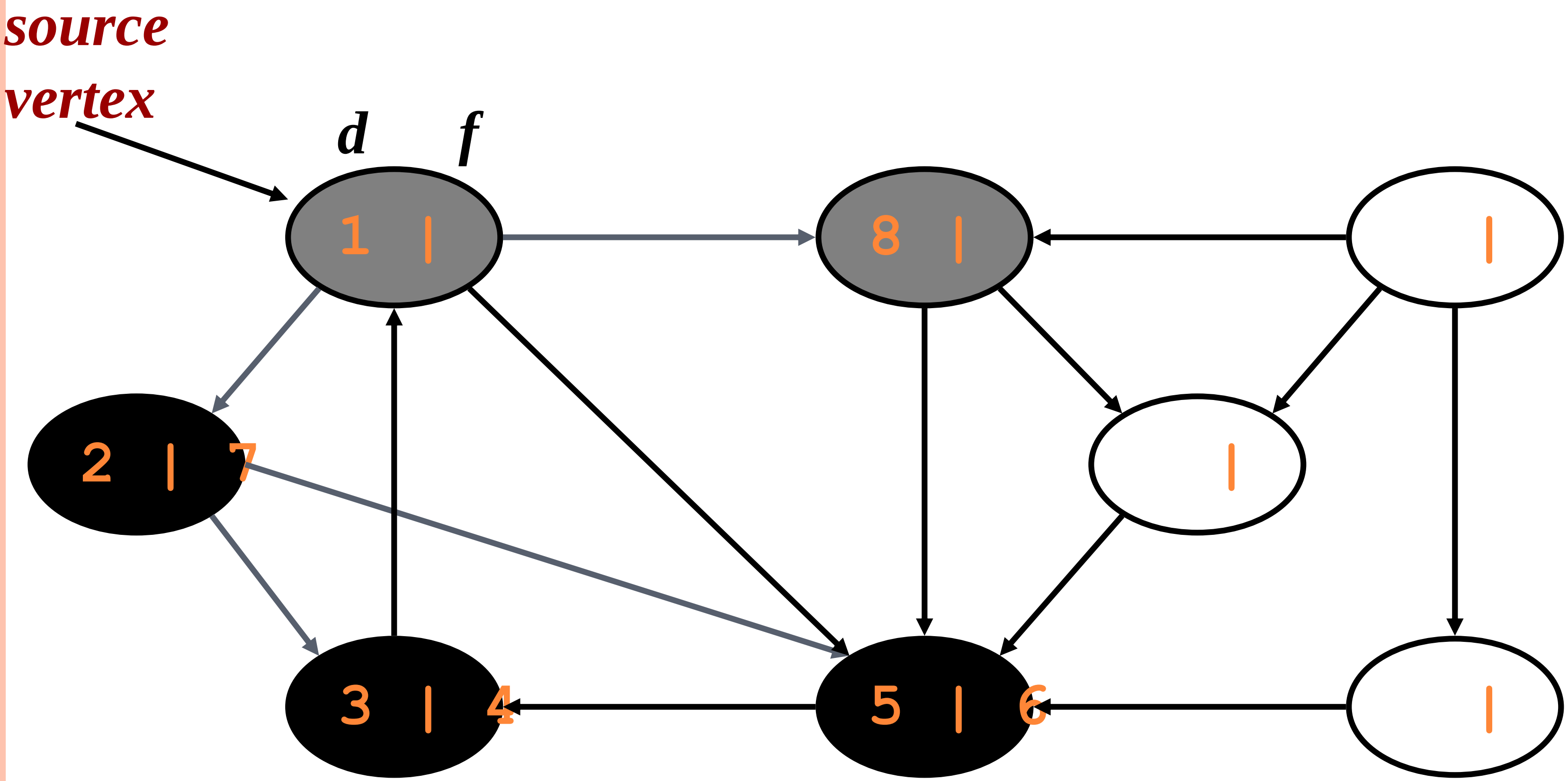


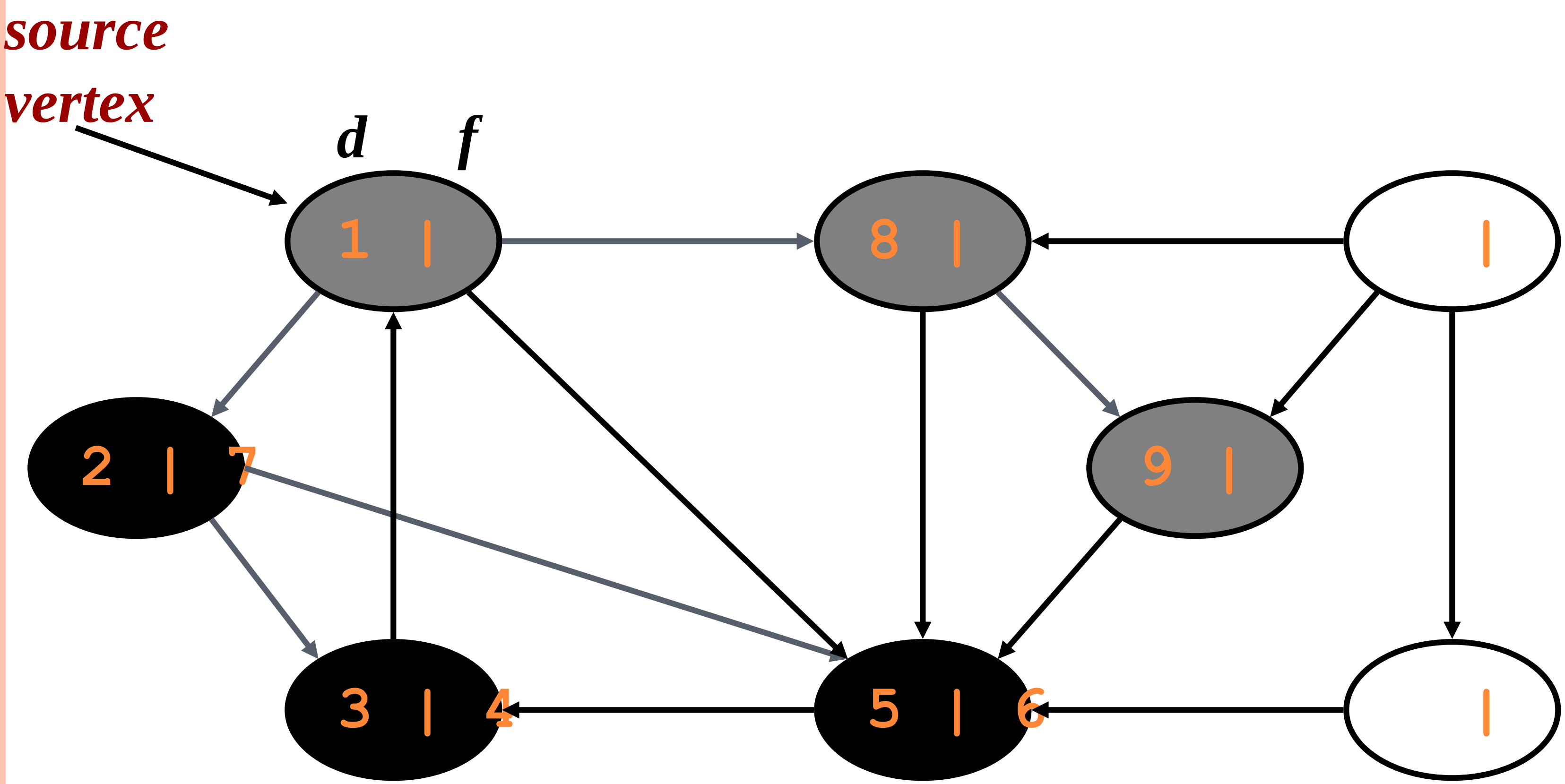
DFS Example



DFS Example



DFS Example



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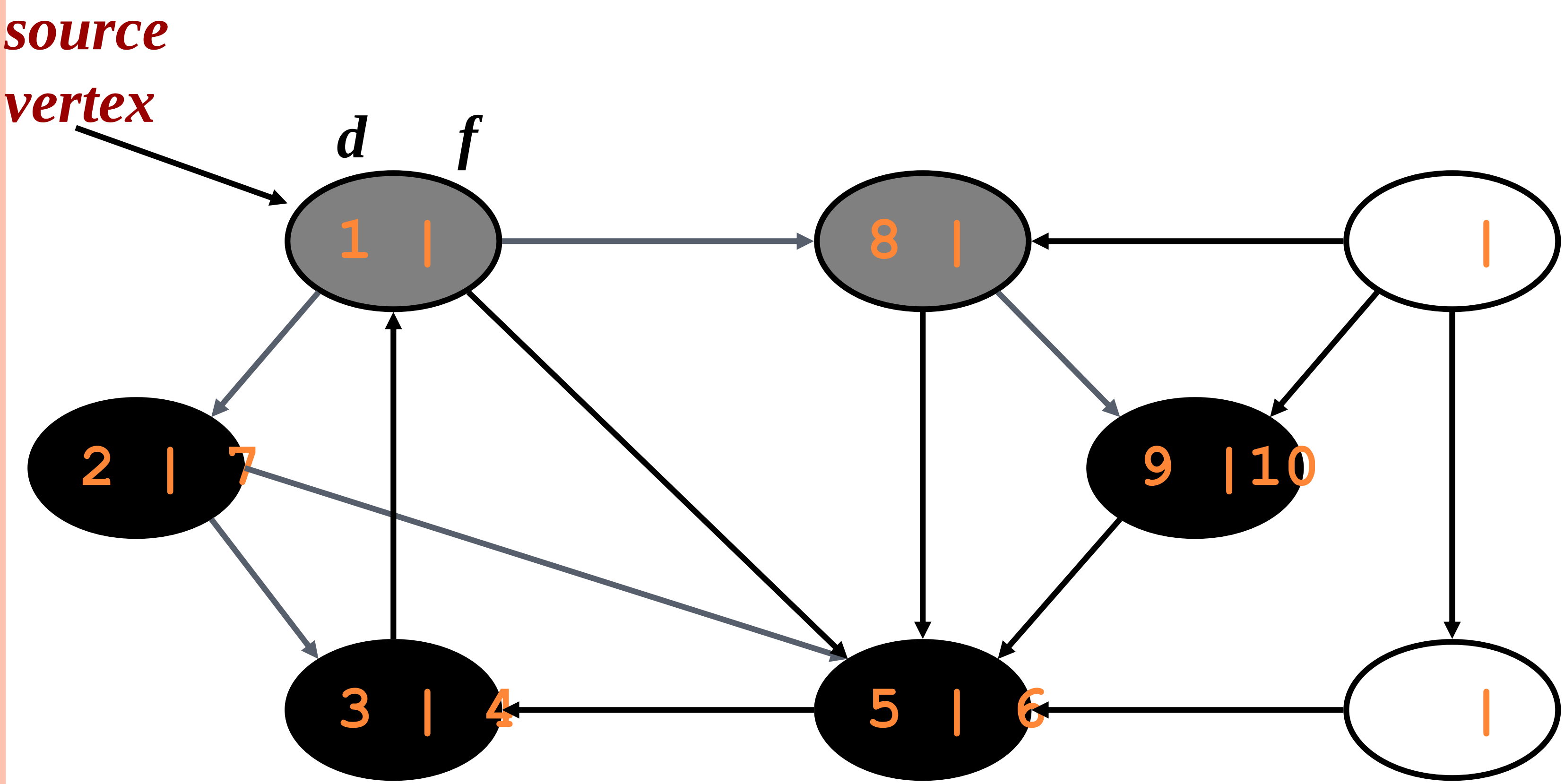

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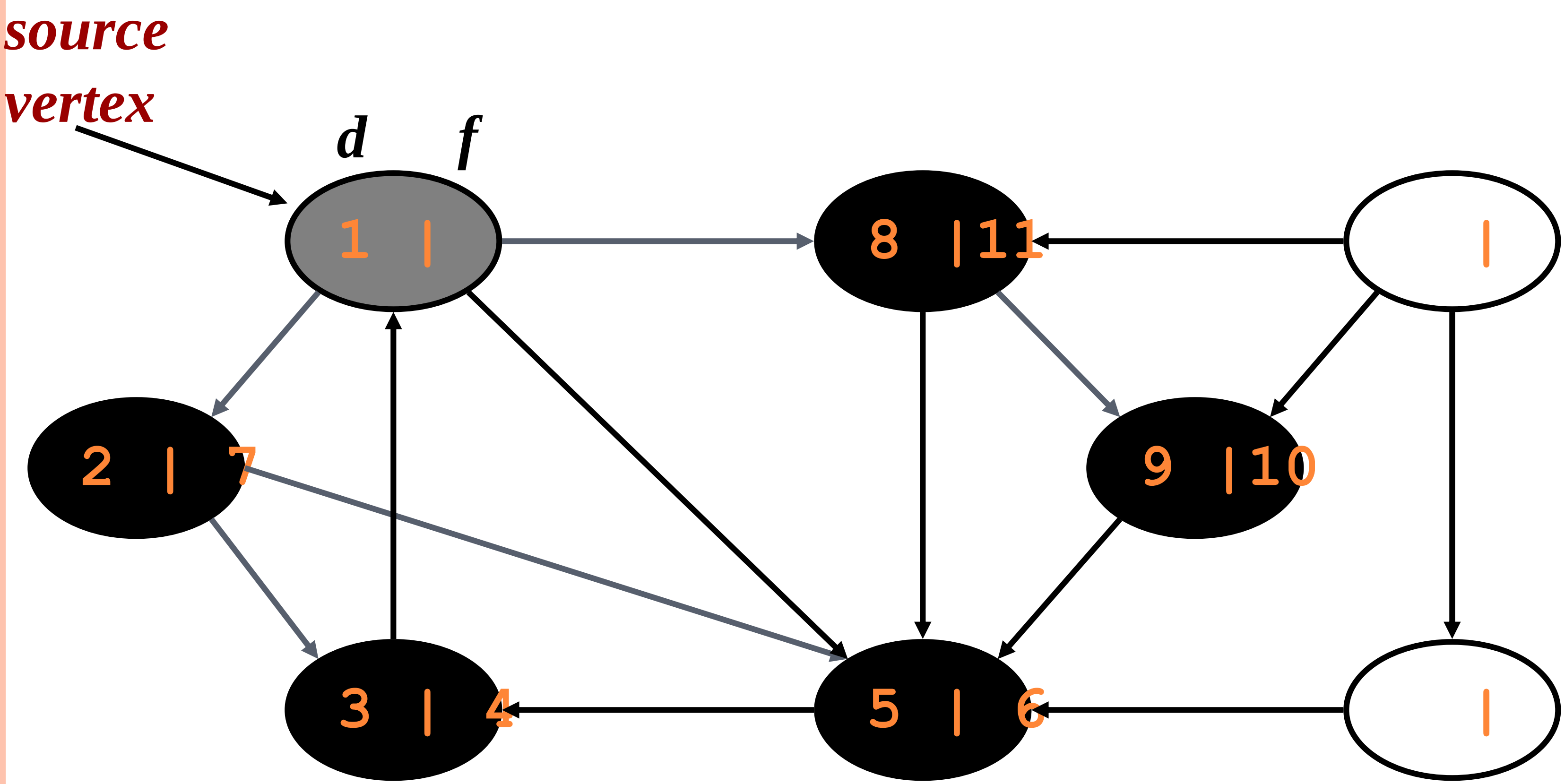
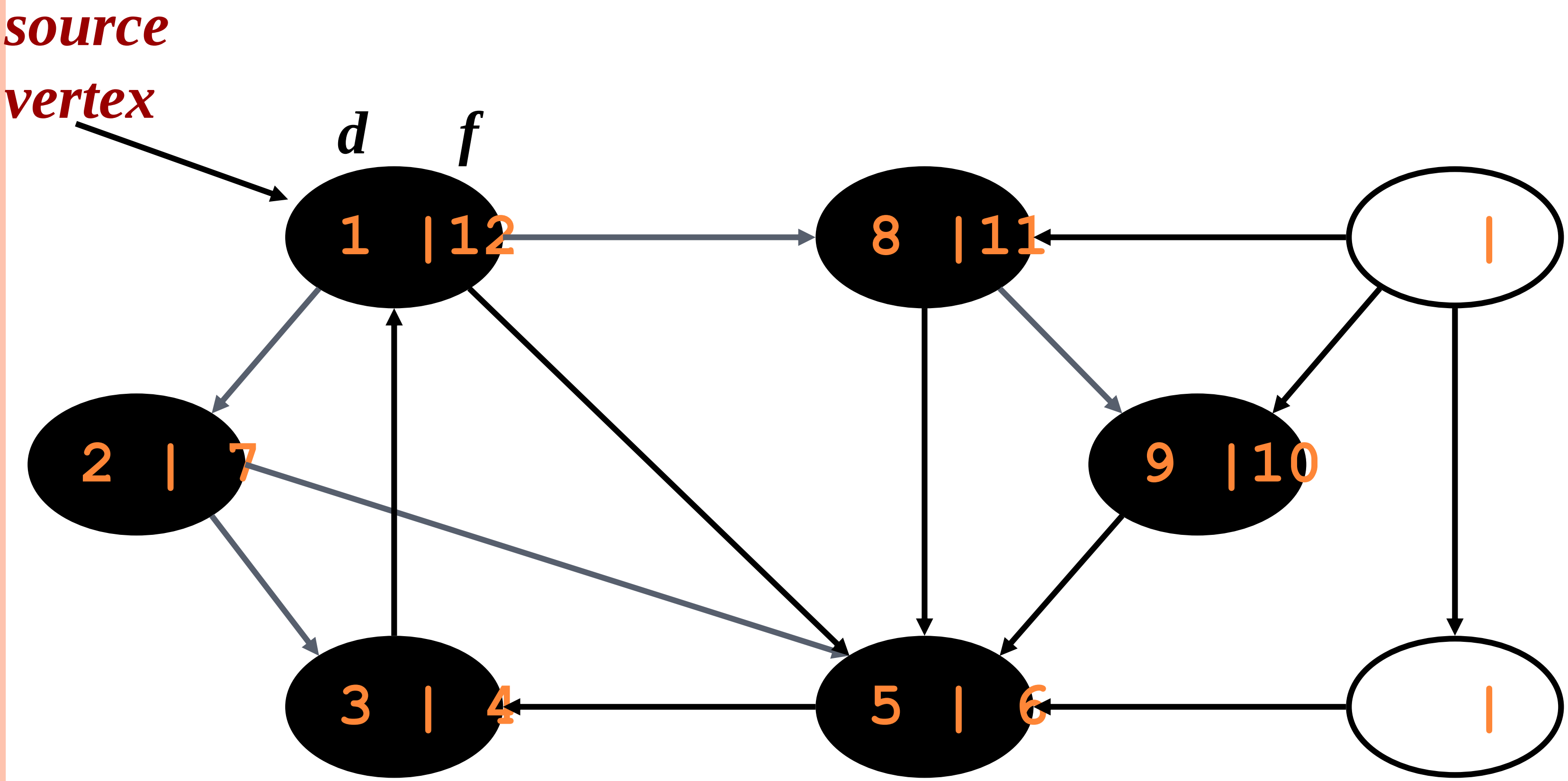
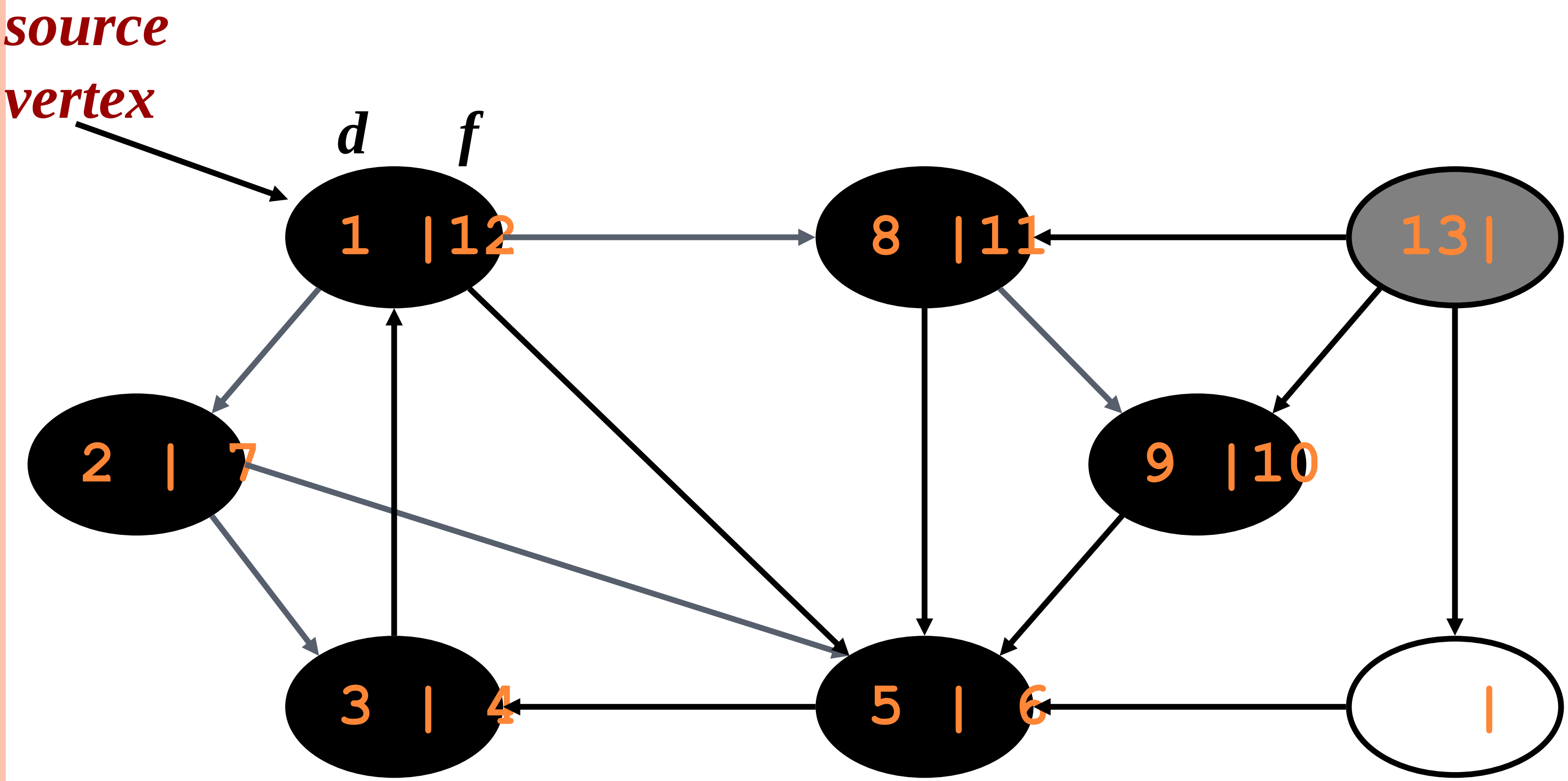


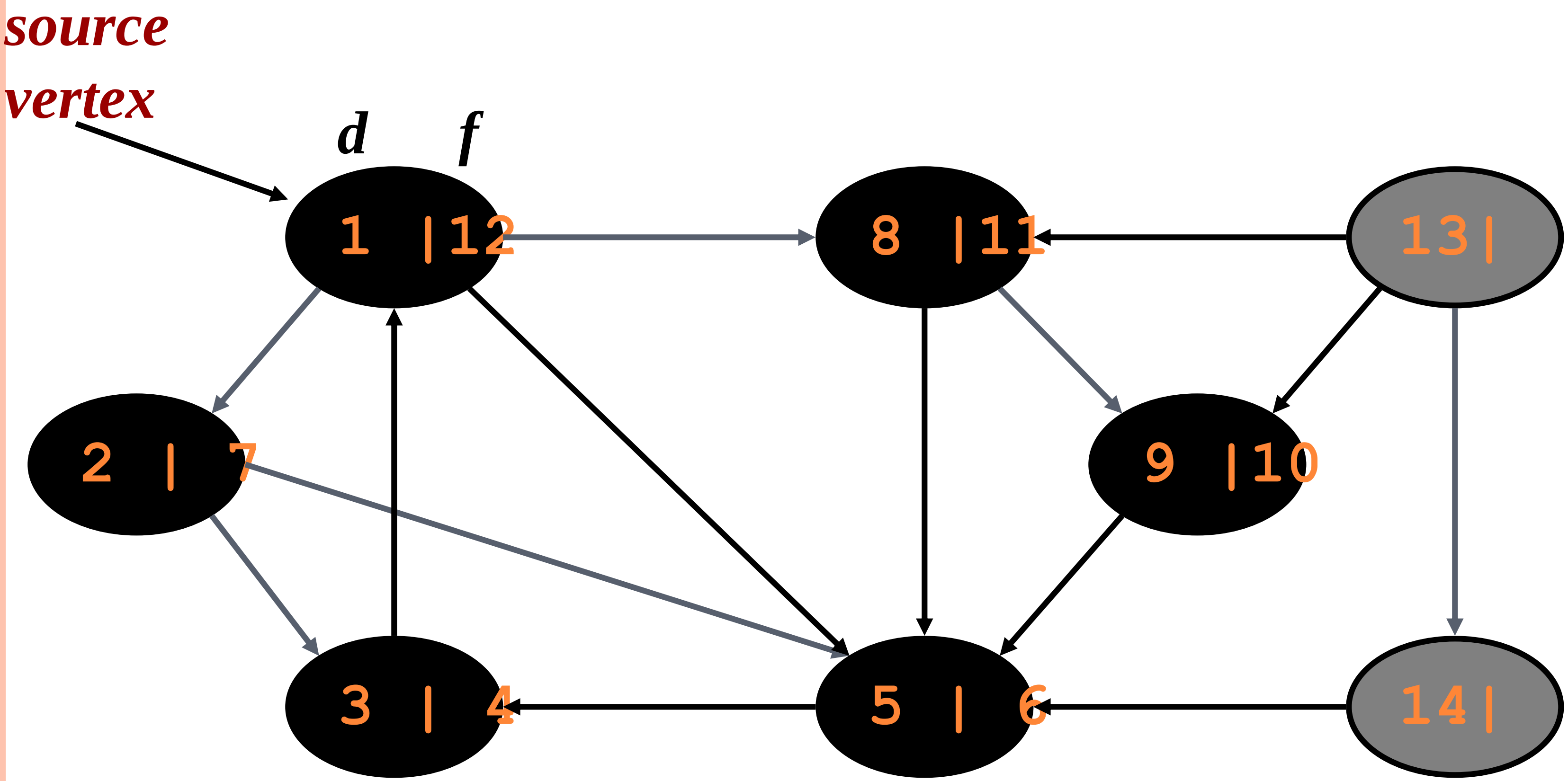
DFS Example



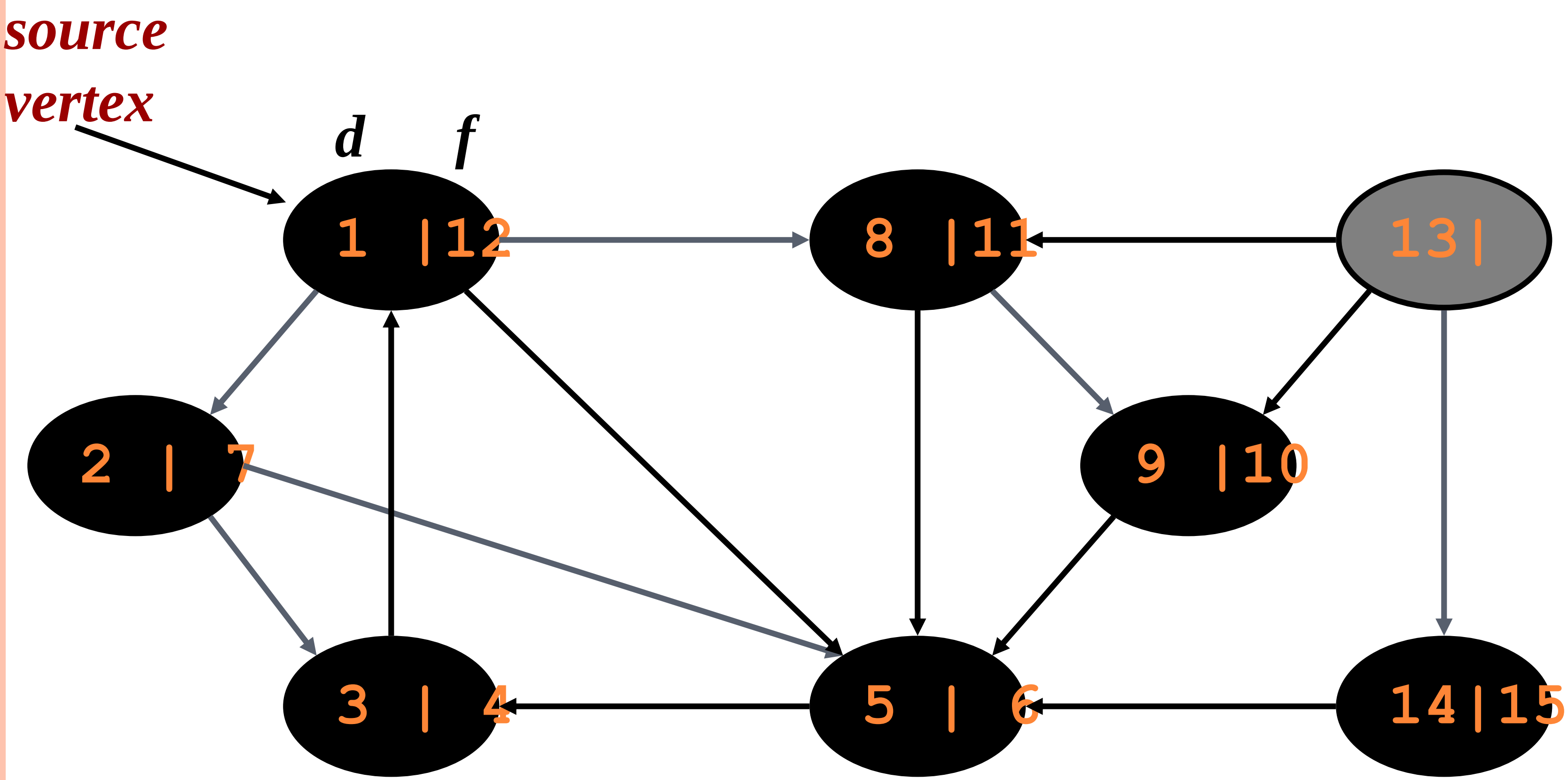
DFS Example



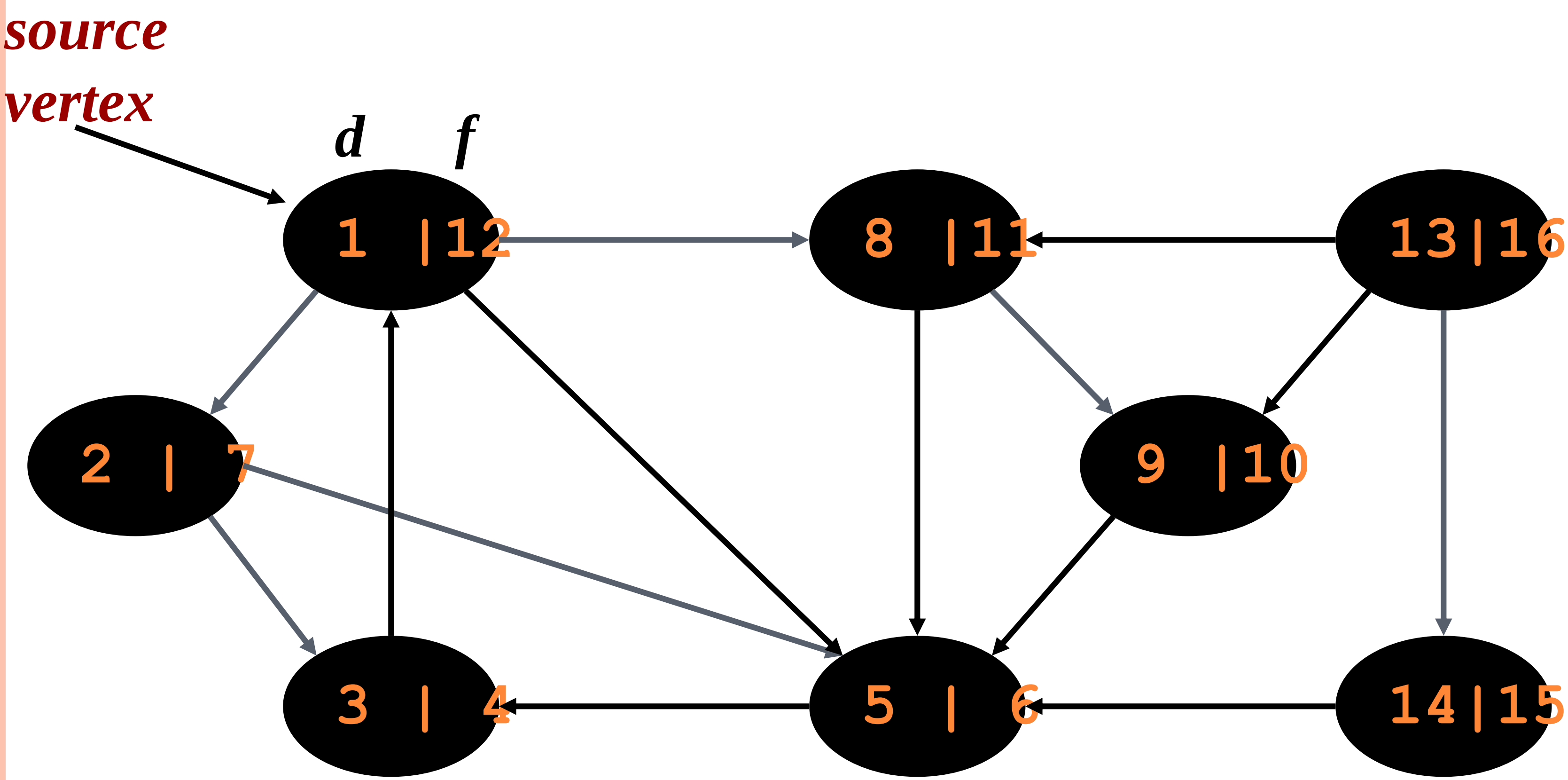
DFS Example



DFS Example



DFS EXAMPLE



Breadth-first Search (BFS)

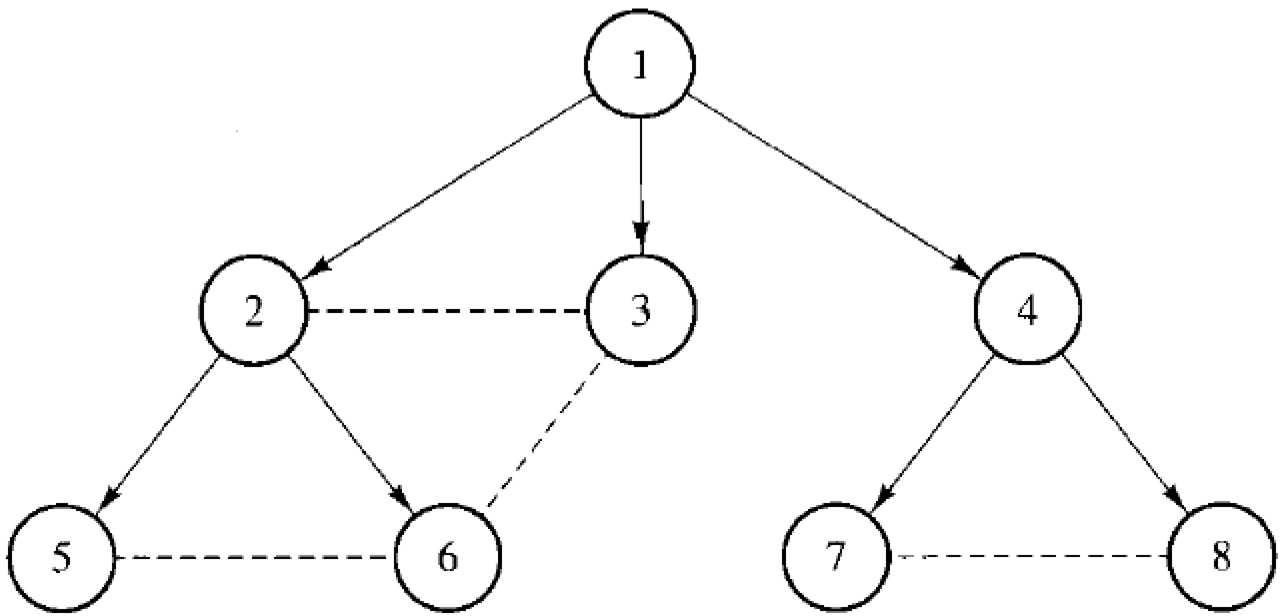
- Search for all vertices that are directly reachable from the root (called level 1 vertices)
- After mark all these vertices, visit all vertices that are directly reachable from any level 1 vertices (called level 2 vertices), and so on.
- In general, level k vertices are directly reachable from a level k – 1 vertices

```
procedure bfs(v)
    Q ← empty-queue
    mark[v] ← visited
    enqueue v into Q
    while Q is not empty do
        u ← first(Q)
        dequeue u from Q
        for each node w adjacent to u do
            if mark[w] ≠ visited then mark[w] ← visited
                enqueue w into Q
```

In both cases we need a main program to start the search.

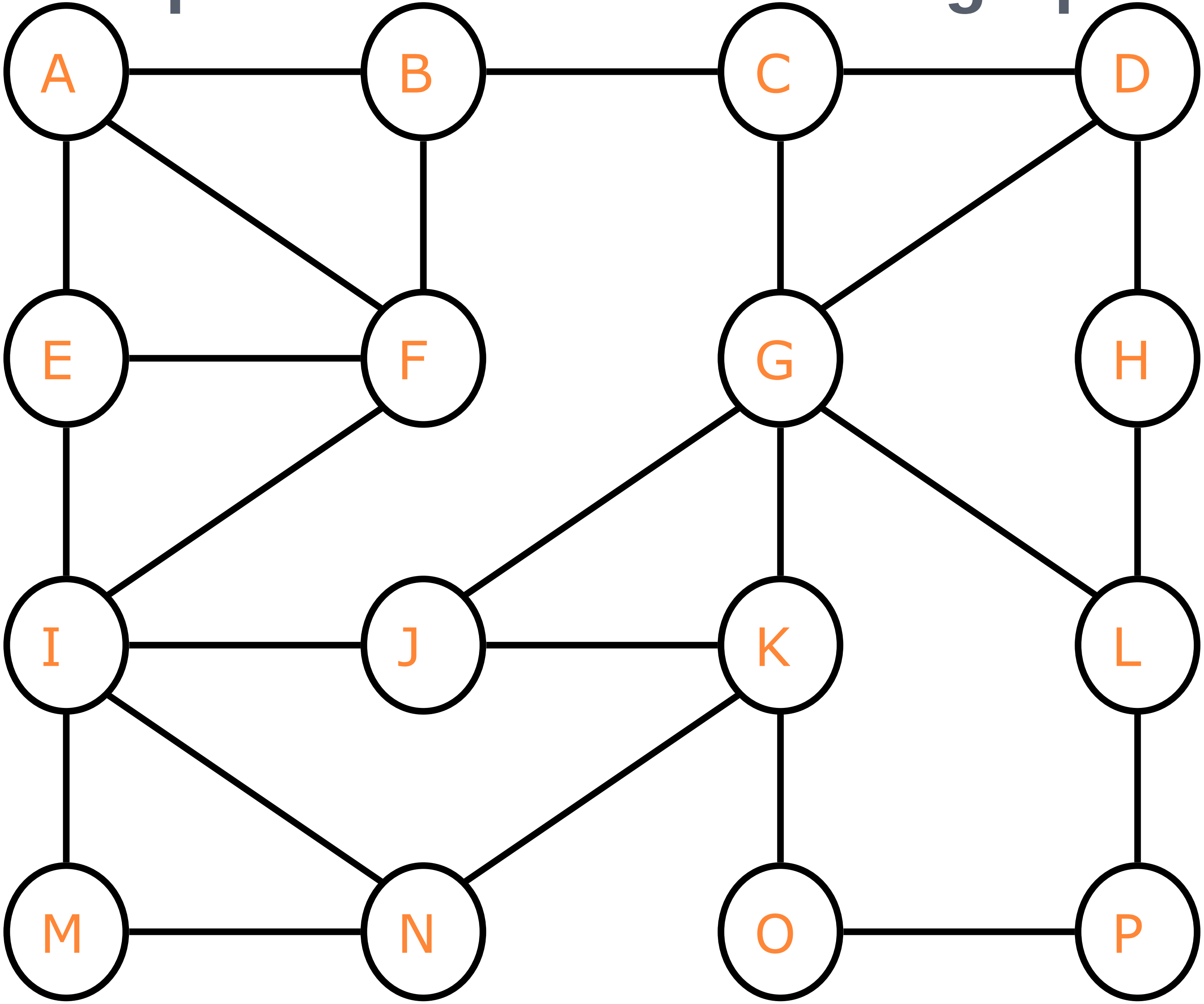
```
procedure search(G)
    for each v ∈ N do mark[v] ← not-visited
    for each v ∈ N do
        if mark[v] ≠ visited then {dfs2 or bfs} (v)
```

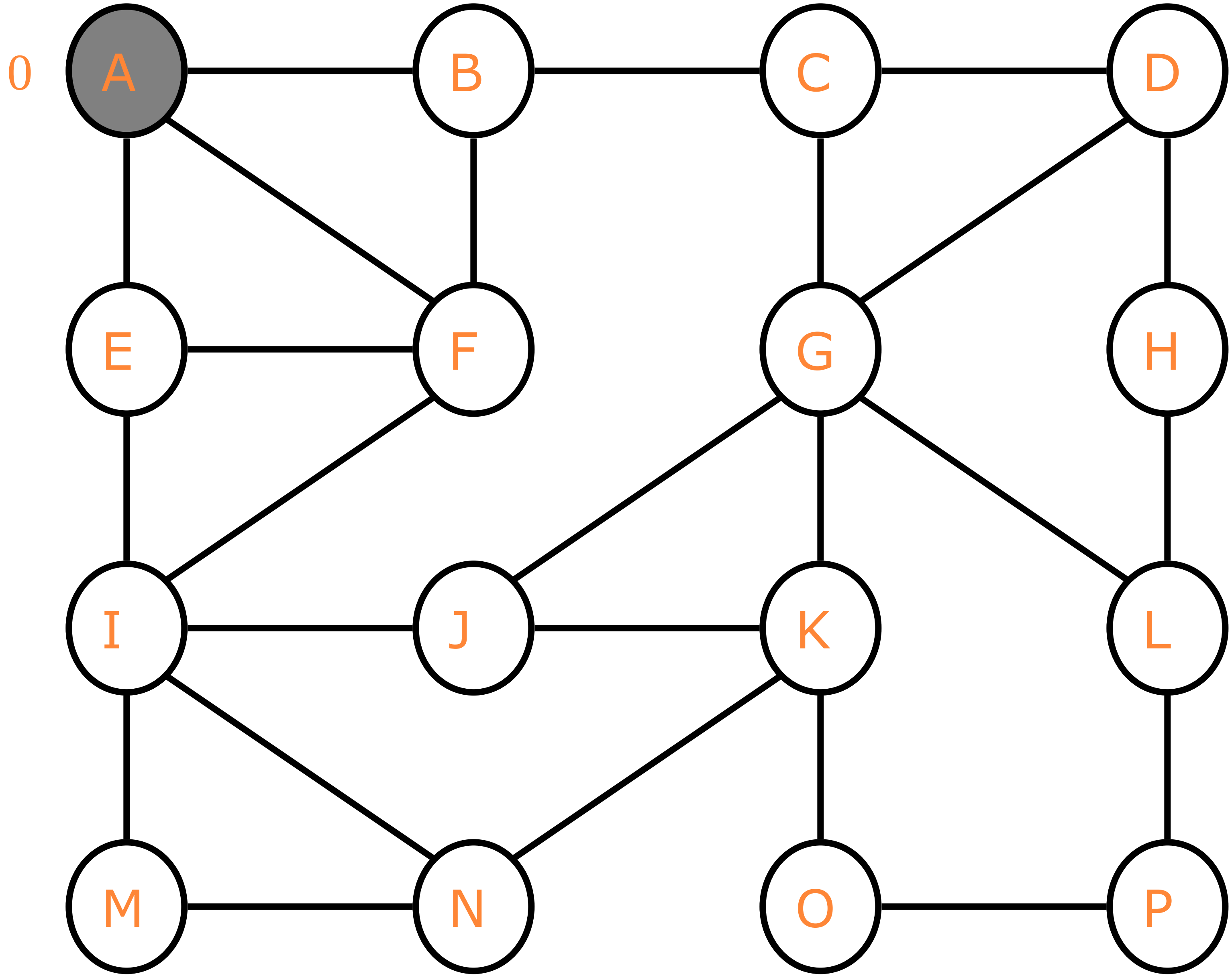
EXAMPLE:BFS FOR DIRECTED GRAPH



	Node visited	Q
1.	1	2,3,4
2.	2	3,4,5,6
3.	3	4,5,6
4.	4	5,6,7,8
5.	5	6,7,8
6.	6	7,8
7.	7	8
8.	8	—

An Example:BFS for undirected graph

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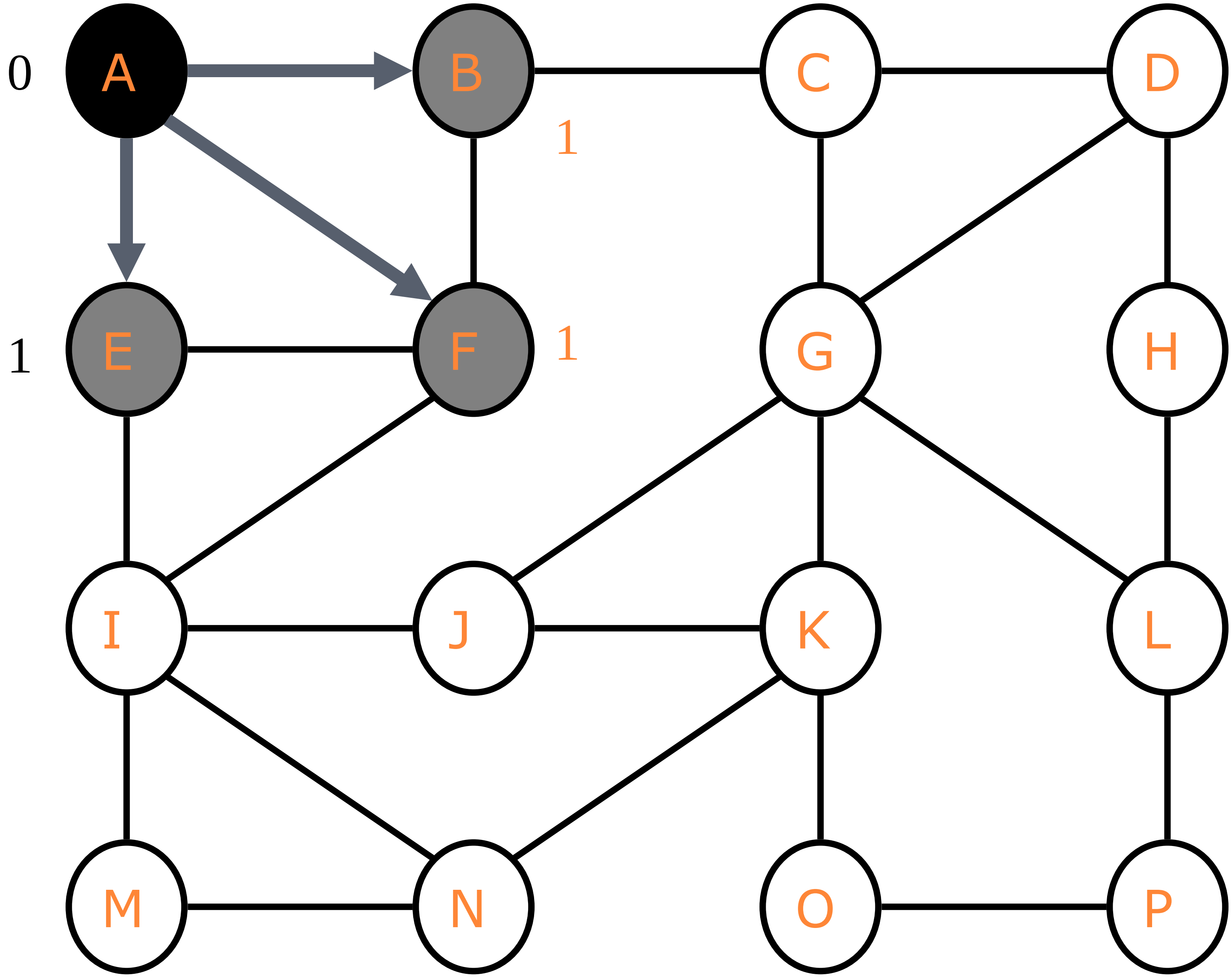
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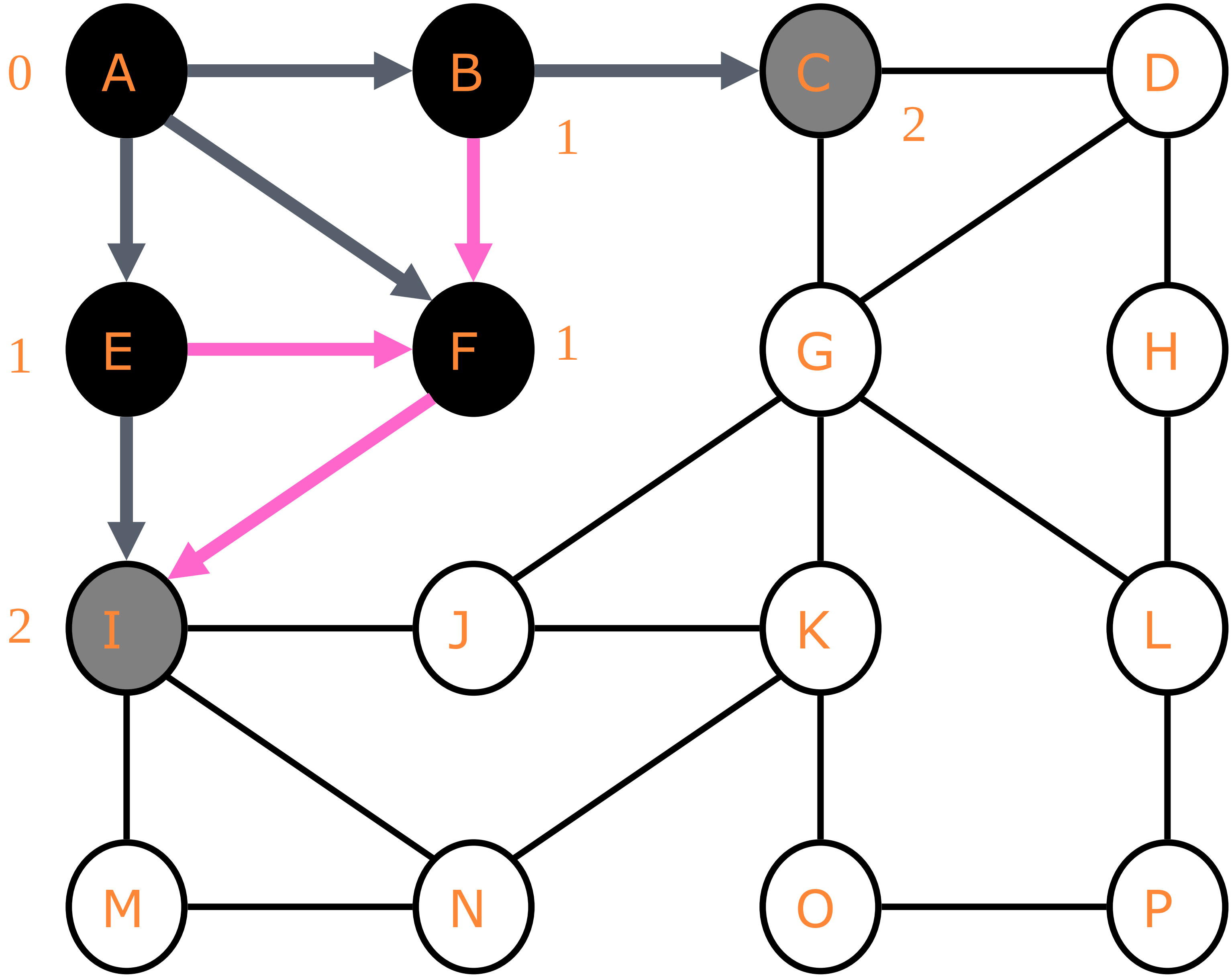
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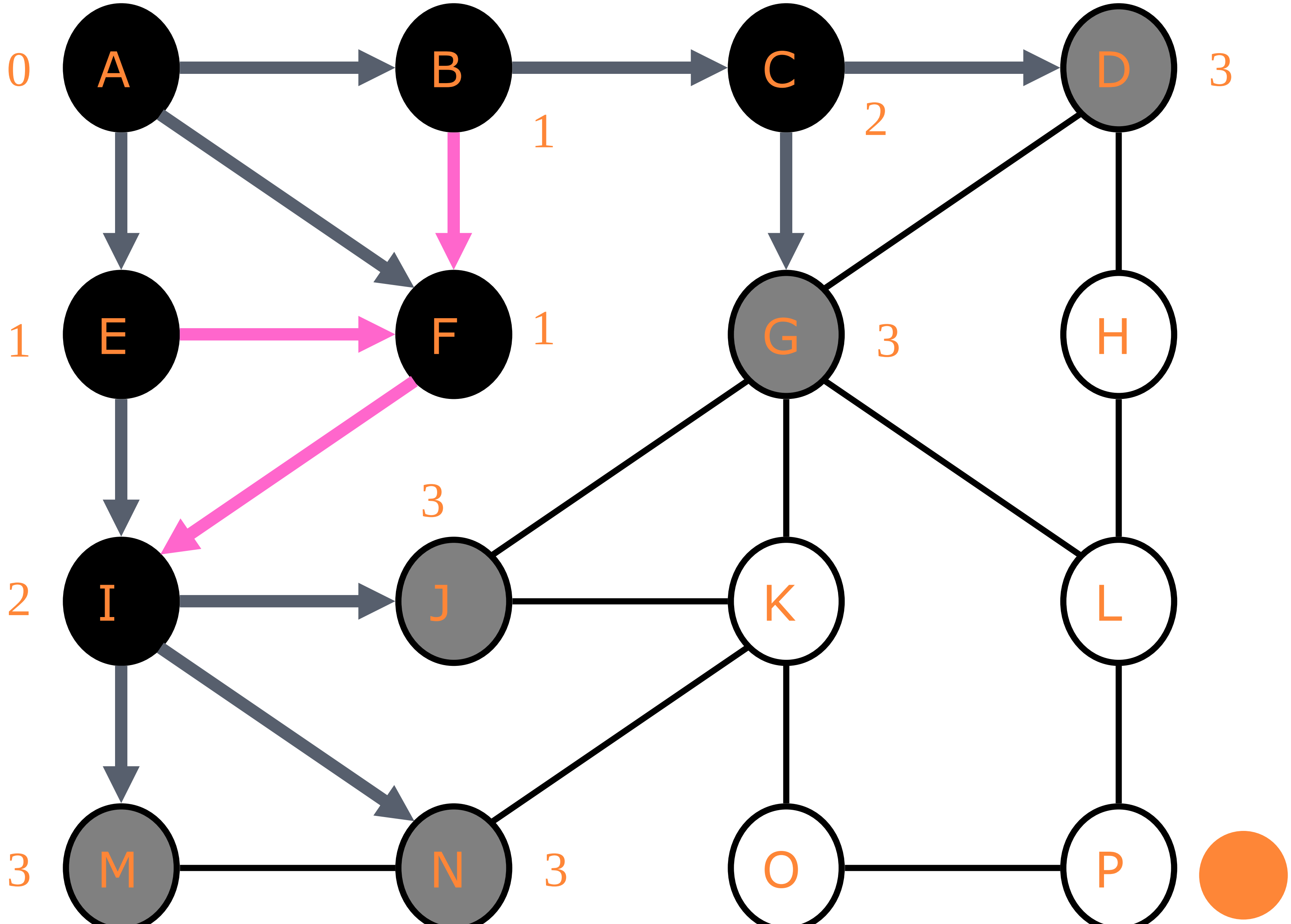
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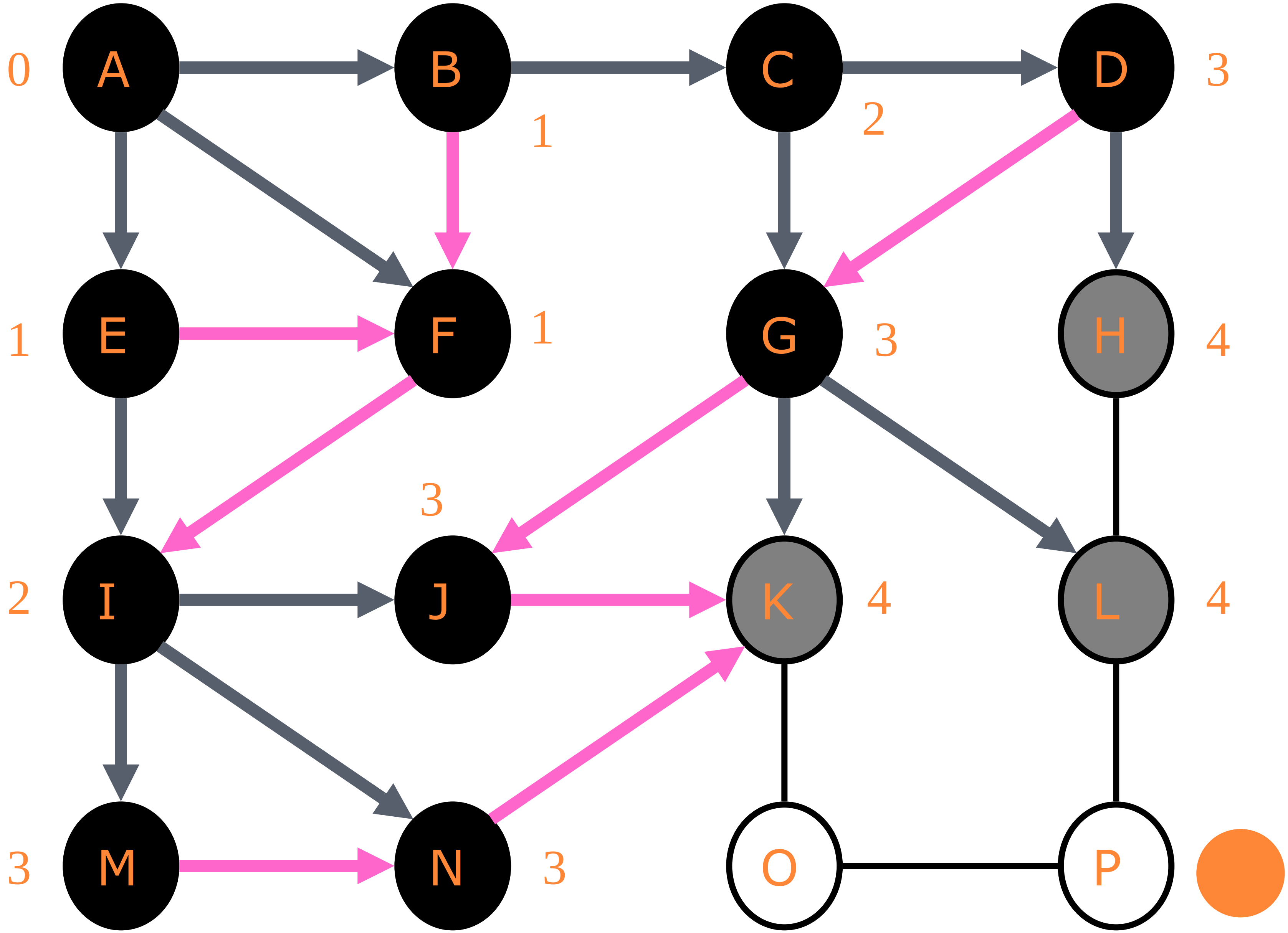
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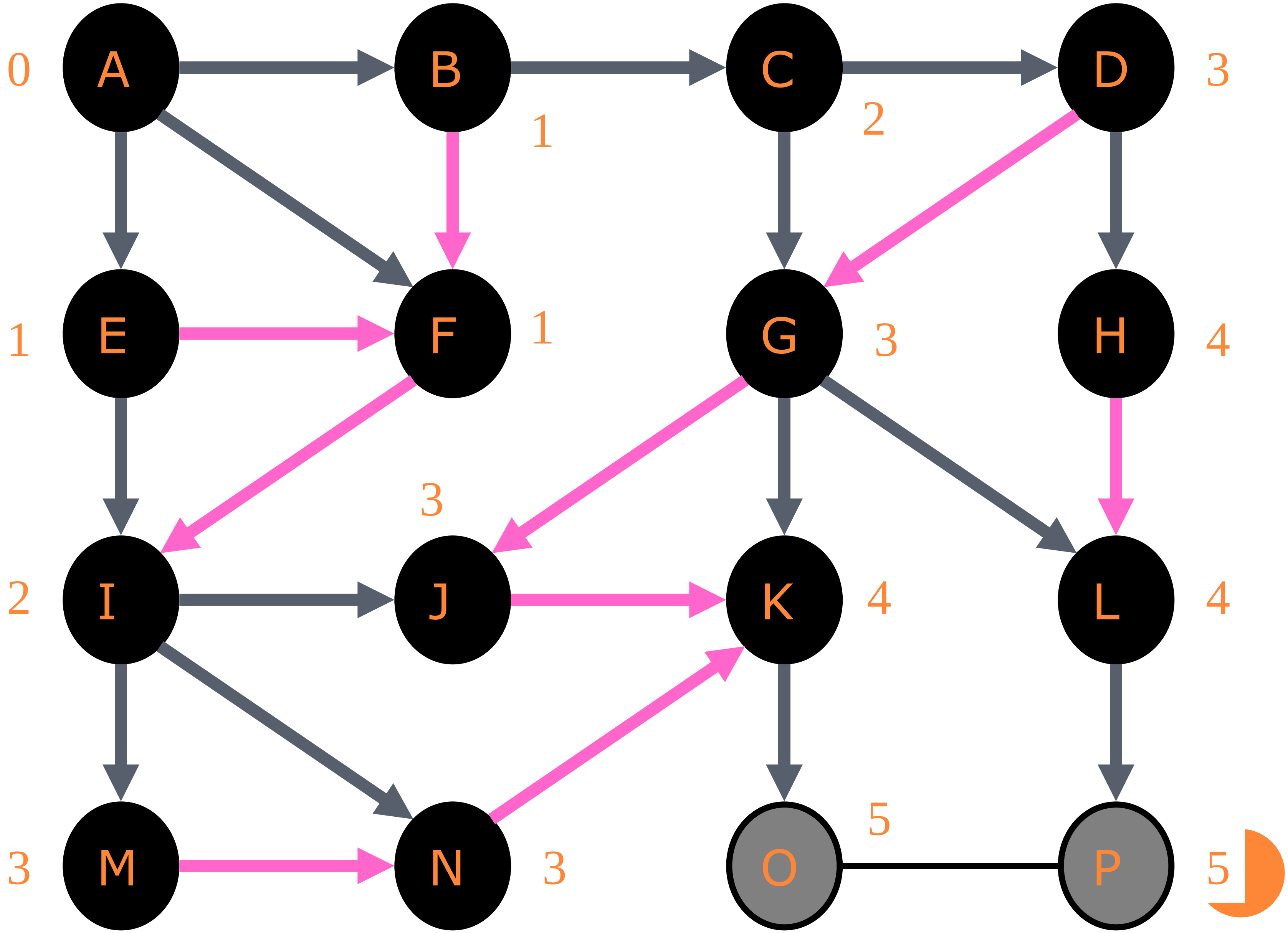
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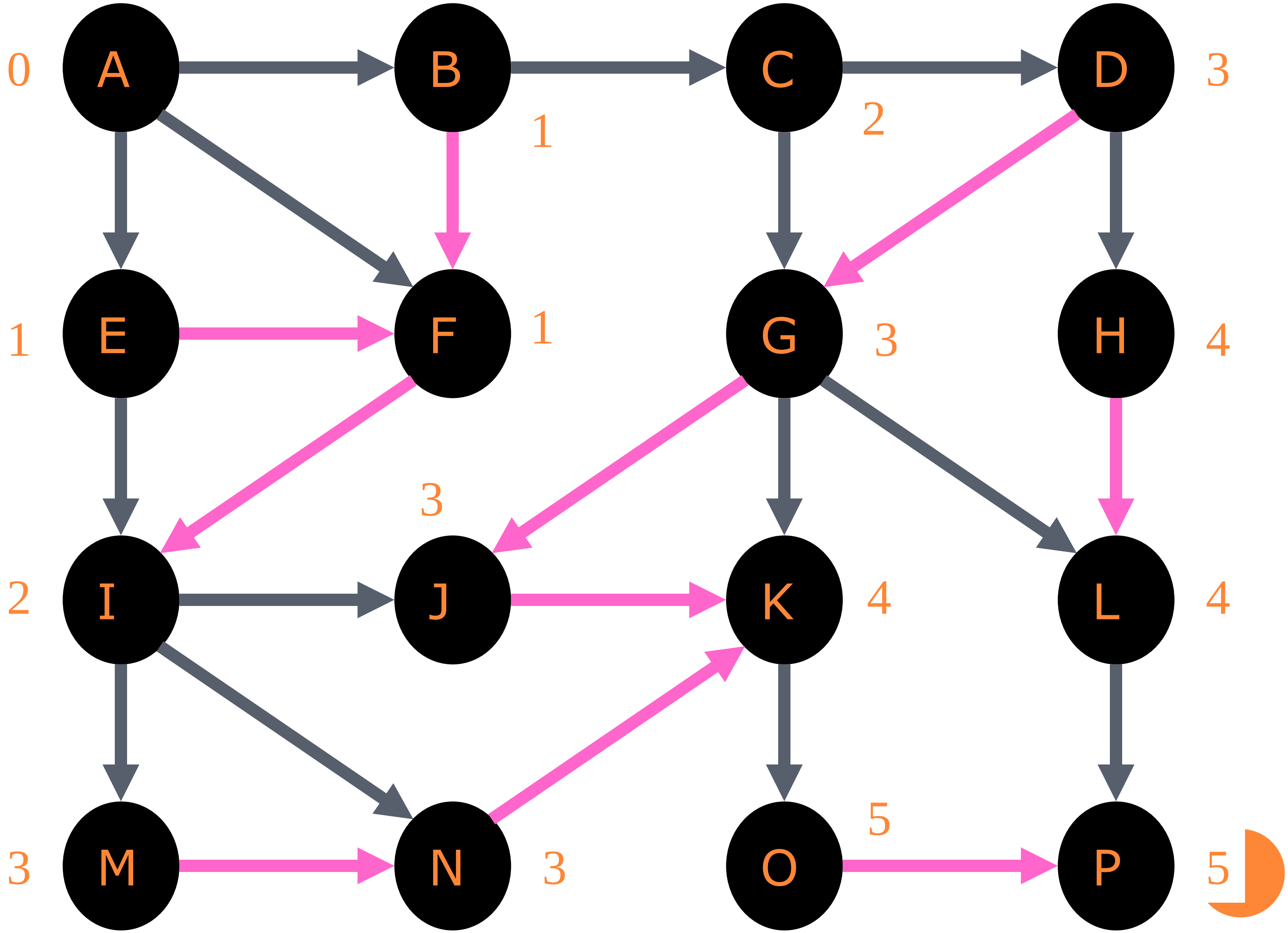
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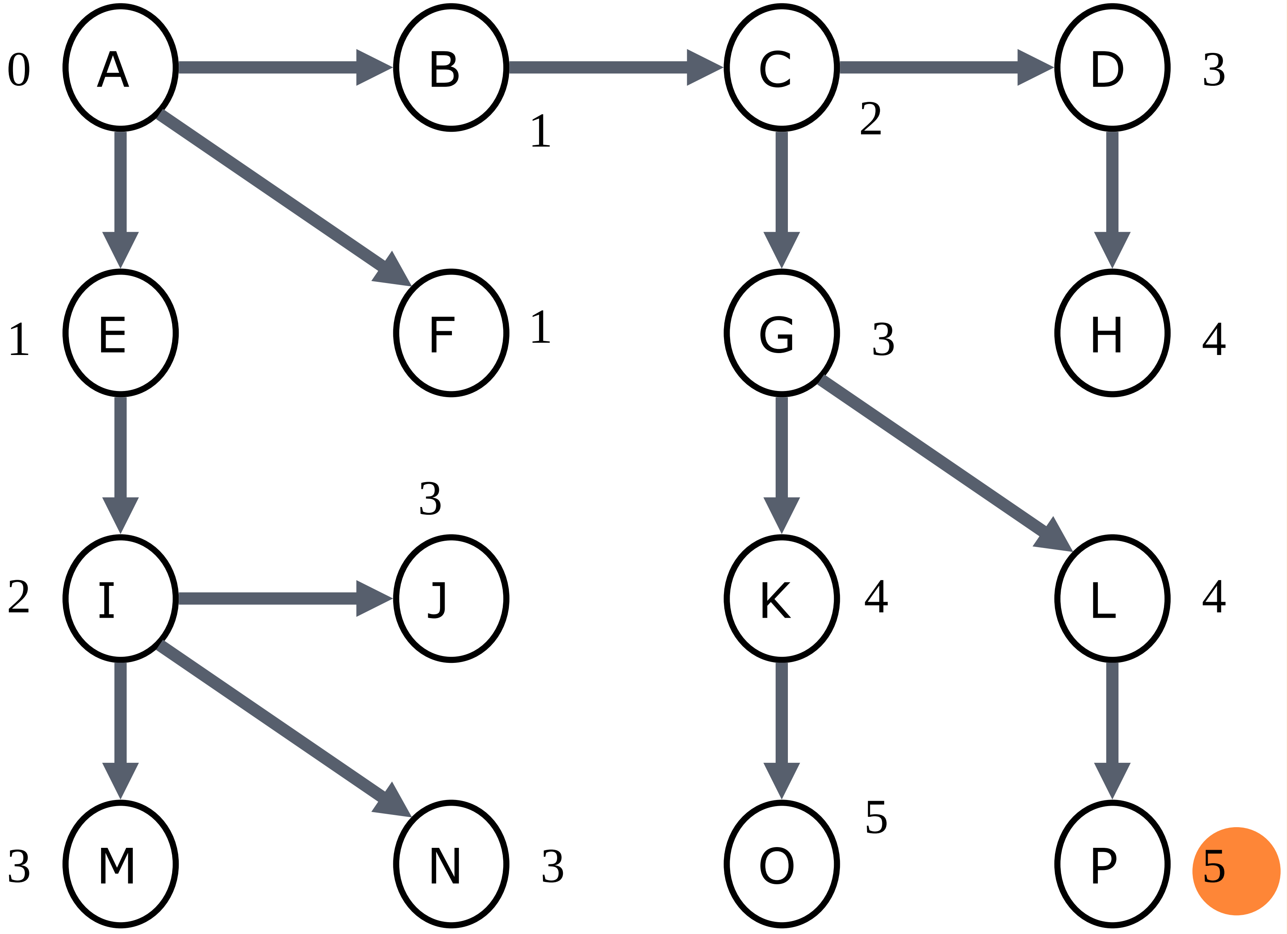
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Thnk u…very much..