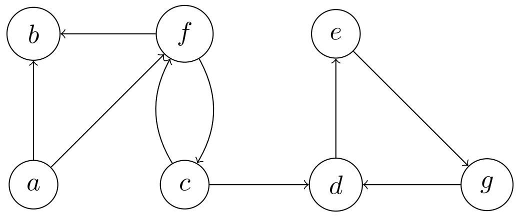
DSC 40B - Discussion 07

Problem 1.

Consider a *breadth*-first search on the graph shown in the figure, starting with node c.



a) Suppose you call bfs_shortest_paths(graph, 'c') on the graph above. This function returns dictionaries distance and predecessor. Write down the contents of these dictionaries as they are when the function exits.

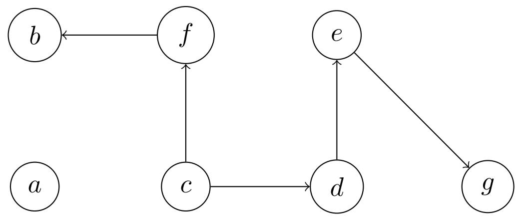
```
def bfs_shortest_paths(graph, source):
    status = {node:'undiscovered' for node in graph.nodes}
    distance= {node:float('inf') for node in graph.nodes}
    predecessor = {node: None for node in graph.nodes}
    status[source] = 'pending'
    distance[source]=0
    pending = deque([source])
    # while there are still pending nodes
    while pending:
        u = pending.popleft()
        for v in graph.neighbors(u):
            # explore edge (u,v)
            if status[v] == 'undiscovered':
                status[v]='pending'
                distance[v]=distance[u]+1
                predecessor[v]=u
                # append to right
                pending.append(v)
        status[u]='visited'
    return predecessor, distance
```

Solution:
distance: {
'a':∞,
'b':2,
'c':0,
'd':1,
'e':2,
'f':1,
'g':3
}
predecessor:{
'a':None,

'b':'f',
'c':None,
'd':'c',
'e':'d',
'f':'c',
'g':'e'
}

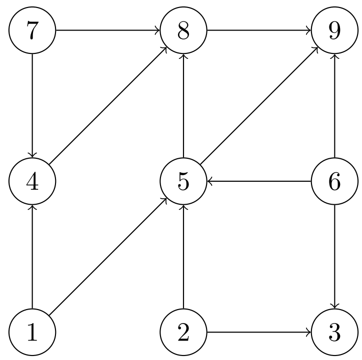
b) Mark the BFS trees produced on executing BFS on this graph.

Solution:



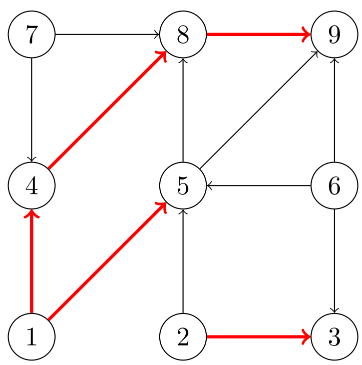
Problem 2.

Consider the following directed graph.



a) Run Full_DFS on the graph above. Make a bold arrow from node u to node v if u is the predecessor of node v in DFS. Use the convention that nodes are processed in ascending order by label.

Solution:



b) Fill in the table below so that it contains the start and finish times of each node after a Full_DFS is performed on the above graph. Assume node 1 as the source for the first DFS call. Begin your start times with 1.

Node	Start	Finish
1	1	10
2	11	14
3	12	13
4	2	7
5	8	9

Node	Start	Finish
6	15	16
7	17	18
8	3	6
9	4	5

Problem 3.

Given an undirected graph G=(V,E), give an algorithm to find if the graph is disconnected.

Solution: A connected graph is a graph with one connected component, this means the only CC must have $|V|$ nodes.

Note that running BFS or DFS on a node in an undirected graph will visit all nodes in the connected component containing that node.

Thus, we can run BFS or DFS on a node in G (since G is undirected, any node will do). If the size of the set of visited nodes does not equal $|V|$, then the graph is disconnected.