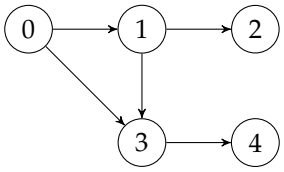
1. Tracing DFS

The following code implements depth-first search:

```
def dfs(G, node, visited):
    visited[node] = True
    print(node)
    for neighbor in G[node]:
        if not visited[neighbor]:
            dfs(G, neighbor, visited)
```

Consider the graph below:



The neighbors of each node are explored in the order shown below:

```
0: [1, 3], 1: [2, 3], 2: [], 3: [4], 4: []
```

a. When DFS reaches node 1, which neighbor does it explore first? _____

Solution: 2

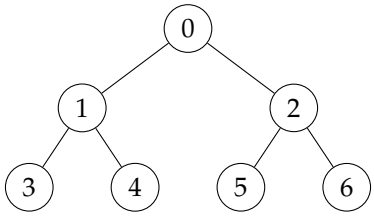
b. Write the order in which the nodes are printed using the function above given that we start our dfs at node 0.

[DFS order: _____ → _____ → _____ → _____ → _____]

Solution: 0 → 1 → 2 → 3 → 4

2. DFS on a Tree

Consider the following tree:



Suppose we run DFS starting at node 0. When a node has multiple children, we always explore the **left child first**.

a. Which node does DFS visit immediately after node 0? _____

Solution: 1

b. Write the order in which DFS visits the nodes.

[DFS order: _____ → _____ → _____ → _____ → _____ → _____ → _____]

Solution: 0 1 3 4 2 5 6

3. Tracing DFS Without a `visited` Array

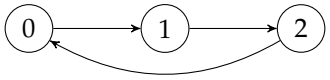
The following code implements depth-first search without keeping track of visited nodes:

```
def dfs(G, node):
    print(node)
    for neighbor in G[node]:
        dfs(G, neighbor)
```

Consider the graph represent by this adjacency list:

```
0: [1], 1: [2], 2: [0]
```

The graph is drawn on the next page.



a. Write the first several nodes that are printed given that we start our dfs at node 0 in the function above.

[DFS order: _____ → _____ → _____ → _____ → _____ → · · ·]

Solution: 0 → 1 → 2 → 0 → 1...

b. What happens after DFS reaches node 2?

(A) DFS stops.

(B) DFS returns to node 1.

(C) DFS goes back to node 0 and continues.

(D) DFS skips node 0 because it was already visited.

Solution: C) DFS goes back to node 0 and continues

c. The DFS never finishes. Why does this happen?

Solution: Multiple solutions. There is a cycle of nodes and no visited array to keep track of things already visited.