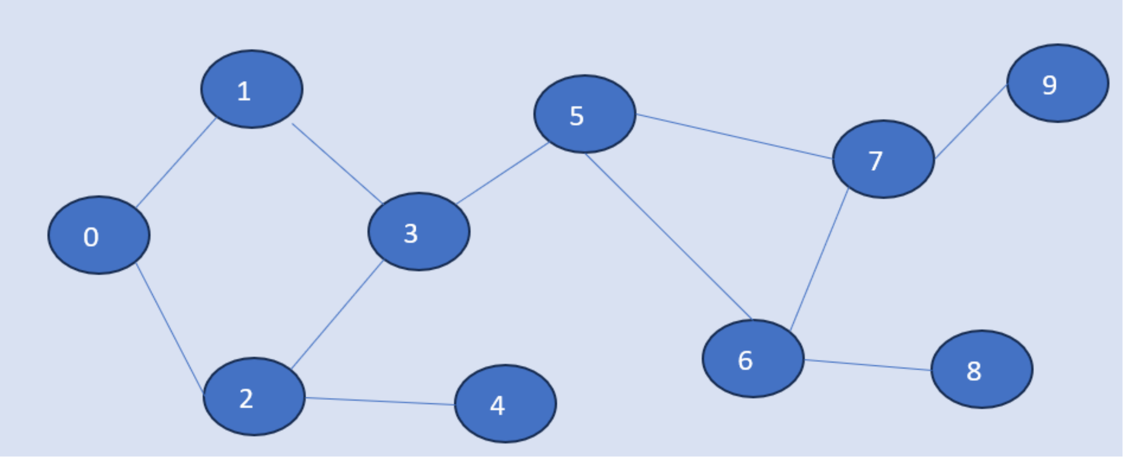
Playbook Notes: Breadth First Search (BFS)

A Breadth First Search will search for the shortest path to destination by visiting all the neighbors of a node before moving to the next node. Another way of saying this is, we will search one level at a time.

Given the following graph:



BFS Algorithm:

```
Every node will have a Boolean named visited with a false value.
Add the beginning node to the queue.
While the queue is not empty:
   Dequeue the queue (current)
   If current has not been visited
      Visit the node and set visited to true.
      For each neighbor
         If the node is not visited, place the node in the queue.
```

Algorithm Trace:

We will start at node 0 and place 0 into a queue.

Queue: **0**
Visited:

Next, we dequeue 0 and visit. Then enqueue any new neighbors (which are 1 and 2)
Queue: **1, 2**
Visited: **0**

Dequeue the queue (1), and visit. Enqueue the new neighbors (3) to the queue.
Queue: 2, **3**
Visited: 0, **1**

Dequeue the queue (2), and visit. Enqueue the new neighbors (3 and 4) to the queue.
Note: 3 has not been visited, so it is enqueued a second time.
Queue: 3, **3, 4**
Visited: 0, 1, **2**

Dequeue the queue (3), and visit. Enqueue the new neighbors (5) to the queue.
Queue: 3, **4, 5**
Visited: 0, 1, 2, **3**

Dequeue the queue (3), but the 3 has already been visited, so we move on.
Queue: 4, 5
Visited: 0, 1, 2, 3

Dequeue the queue (4), and visit. There are no new nodes to enqueue.
Queue: 5
Visited: 0, 1, 2, 3, **4**

Dequeue the queue (5), and visit. Enqueue the new neighbors (6 and 7) to the queue.
Queue: **6, 7**
Visited: 0, 1, 2, 3, 4, **5**

Dequeue the queue (6), and visit. Enqueue the new neighbors (7 and 8) to the queue.
Note: 7 has not been visited so it is added to the queue a second time.
Queue: 7, **7, 8**
Visited: 0, 1, 2, 3, 4, 5, **6**

Dequeue the queue (7), and visit. Enqueue the new neighbors (9) to the queue.
Queue: 7, 8, **9**
Visited: 0, 1, 2, 3, 4, 5, 6, **7**

Dequeue the queue (7), but the 7 has already been visited, so we move on.
Queue: 8, 9
Visited: 0, 1, 2, 3, 4, 5, 6, 7

Dequeue the queue (8), and visit. There are no new nodes to enqueue.
Queue: 9
Visited: 0, 1, 2, 3, 4, 5, 6, 7, **8**

Dequeue the queue (9), and visit. There are no new nodes to enqueue.
Queue:
Visited: 0, 1, 2, 3, 4, 5, 6, 7, 8, **9**

Reference Videos:

https://www.youtube.com/watch?v=xlVX7dXLS64