Dennis Kuzminer
CSCI-UA 310-001 PS3a

7.

a. It is important to note that a path in G is called k-alternating if it changes color ***at least*** k times (not necessarily exactly k).
   i. Run a topological sorting algorithm such that the runtime is O(|V| + |E|) (Kahn)
   ii. Run DFS starting on the first node with in-degree = 0
   During DFS: If a node in the path changes the color from the starting color, increment a counter variable associated with that particular tree branch. (Cross edges will already be accounted for)
   iii. Suppose i is the number of tree branches
   If i > 1
   For 0 to i-1
   m[v] = max(counter at branch i, counter at branch i+1)
   Return m[v] >= k //boolean

b. An arbitrary graph implies that there could a cycle(s) in the graph.
   i. Therefore, run the SCC algorithm
   ii. If a particular SCC contains 2 or more nodes with different colors, then return true. This is because we know that there a cycle in each SCC, and we can achieve at least k by just remaining in the loop. Once k is achieved, we continue to our path.
   iii. Else if all of the nodes in the SCC have the same color, check for a k-alternating path the same way we did in part a.