

18.5 Depth first search

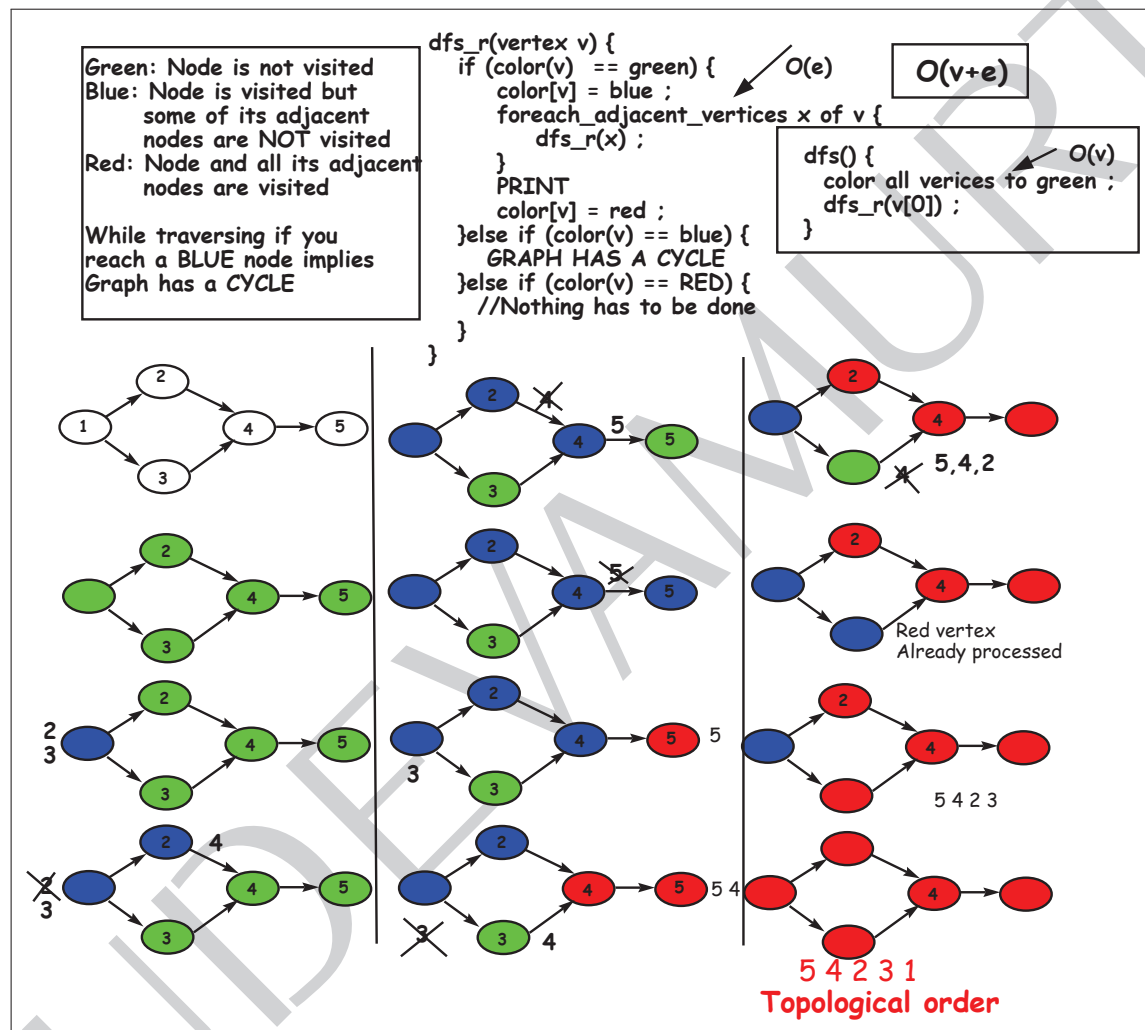


Figure 18.17: Depth first search on a graph that has no loop

18.5. DEPTH FIRST SEARCH

Green: Node is not visited
 Blue: Node is visited but some of its adjacent nodes are NOT visited
 Red: Node and all its adjacent nodes are visited

While traversing if you reach a BLUE node implies Graph has a CYCLE

```

dfs_r(vertex v) {
  if (color(v) == green) {
    color[v] = blue ;
    foreach_adjacent_vertices x of v {
      dfs_r(x) ;
    }
    PRINT
    color[v] = red ;
  } else if (color(v) == blue) {
    GRAPH HAS A CYCLE
  } else if (color(v) == RED) {
    //Nothing has to be done
  }
}
            
```

$O(v+e)$

$O(e)$

$O(v)$

```

dfs() {
  color all verices to green
  dfs_r(v[0]) ;
}
            
```

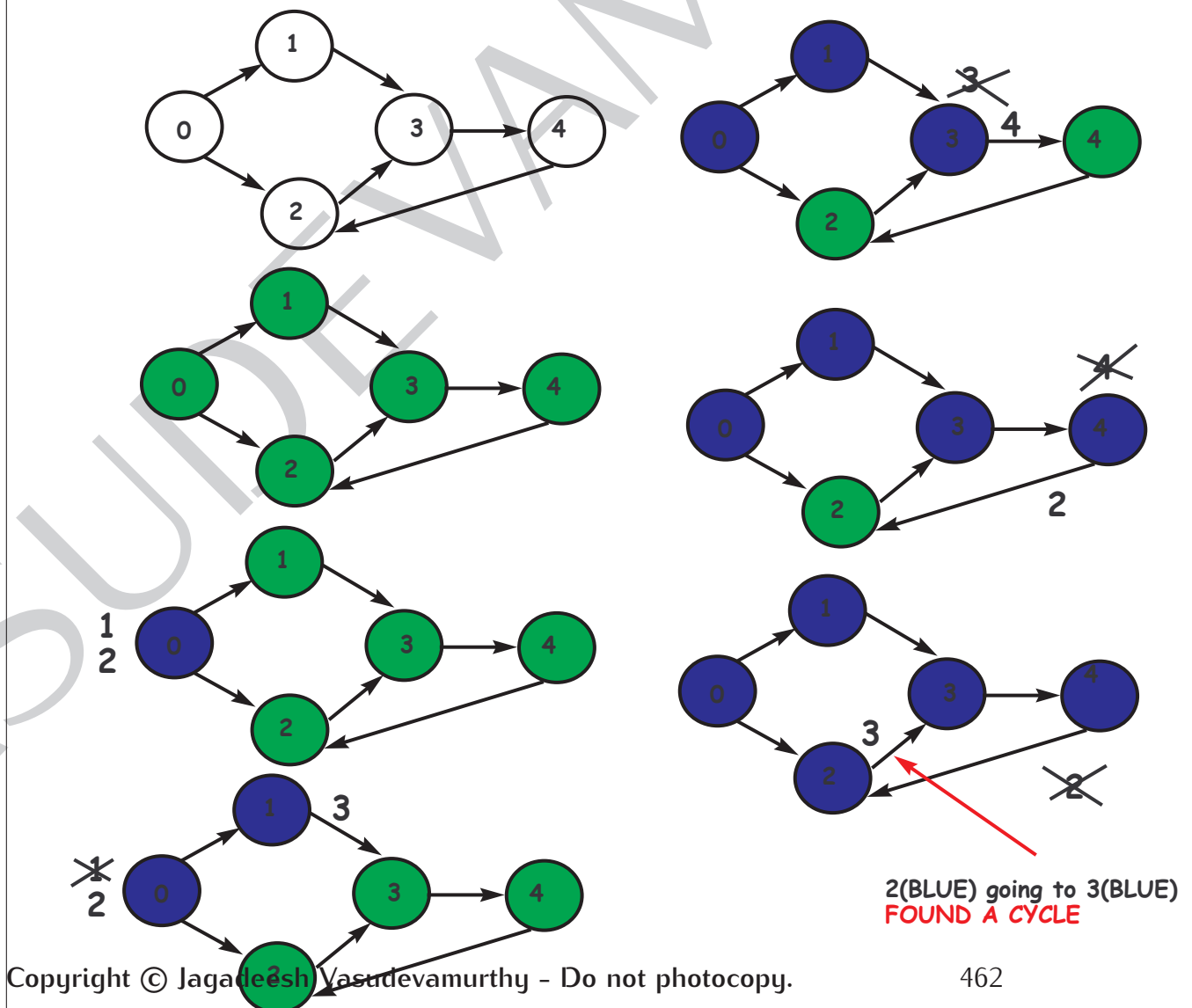


Figure 18.18: Depth first search on a graph that has a loop

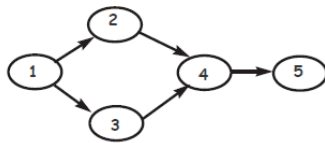
DFS on graph

Time complexity = $O(V+E)$

```
public void dfs(String t, String s, boolean[] cycle, int[] work, ArrayList<String> ans) {
    GraphMDfs z = new GraphMDfs(t, this, s, cycle, work, ans)
}
```

title → starting node → cycle[0] = true/false → work[0] = workdone → **Graph.java**

Unweighted directed graph without loop

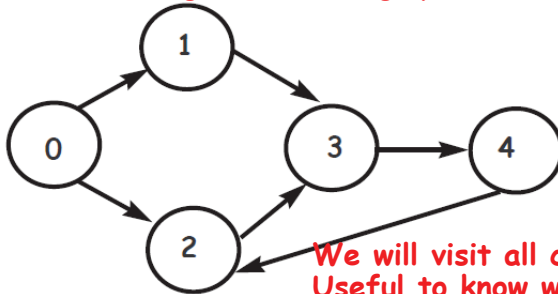


Must write a routine to prove order is right

Num Vertices = 5
 Num Edges = 5
 Work done = 10
 Has Cycle = NO
 DFS topological order = 1 3 2 4 5
 dfs assert passed

Must write code in GraphDfs

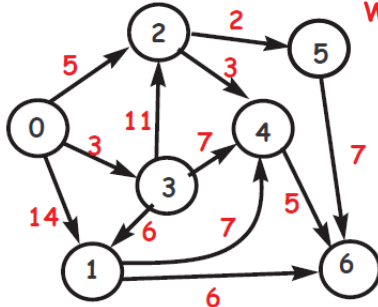
Unweighted directed graph with loop



We will visit all cities exactly once.
 Useful to know whether graph is connected

Num Vertices = 5
 Num Edges = 6
 Work done = 11
 Has Cycle = YES
 DFS topological order = 0 1 3 4 2
 This order has no meaning

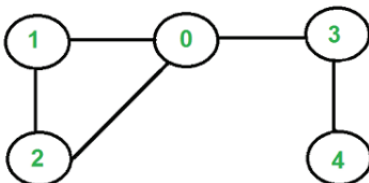
Weighted directed graph without loop



Num Vertices = 7
 Num Edges = 12
 Work done = 19
 Has Cycle = NO
 DFS topological order = 0 3 1 2 5 4 6
 dfs assert passed

Must write a routine to prove order is right

Unweighted undirected graph



We will visit all cities exactly once.
 Useful to know whether graph is connected

Num Vertices = 5
 Num Edges = 10
 Work done = 15
 Has Cycle = YES
 DFS topological order = 1 0 2 3 4
 This order has no meaning