# CS5413 - Assignment: DFS and etc.

The input graph is to be given in the form of adjacency matrix as follows. Note that the input should in a file. Note that each edge is to be assigned with a weight ("1" is just to show a format).

| | a | b | c | d | e | f | g | h | i | j |
|---|---|---|---|---|---|---|---|---|---|---|
| a | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| b | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| c | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| d | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| e | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| f | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| g | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| h | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| i | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| j | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |

(a) Implement the the following algorithm (70%).

```
DFS(G)
1 for each vertex u ∈ V[G]
2       do color[u] ← WHITE
3          π[u] ← NIL
4 time ← 0
5 for each vertex u ∈ V[G]
6       do if color[u] = WHITE
7          then DFS-VISIT(u)

DFS-VISIT(u)
1 color[u] ← GRAY
2 time ← time+1
3 d[u] ← time
4 for each v ∈ Adj[u]
5       do if color[v] = WHITE
6          then π[v] ← u
7                  DFS-VISIT(v)
```

8 *color*[u] $\leftarrow$ BLACK
9 *f[u]* $\leftarrow$ *time* $\leftarrow$ *time* + 1

Output: an adjacency matrix with discovery time and finishing time on each vertex.

(b) Then implement the following algorithm. (20%)

TOPOLOGICAL-SORT(G)
1 call DFS(G) to compute finishing times *f[v]* for each vertex $v$
2 as each vertex is finished, insert it onto the front of a linked list
3 **return** the linked list of vertices

Output: a sorted list of vertices with the finishing time in decreasing order.

(c) Given directed graph $G = (V, E)$ (10%), a **strongly connected component (SCC)** of $G$ is a maximal set of vertices $C \subseteq V$ such that for all $u, v \in C$, both $u \rightsquigarrow^b v$ and $v \rightsquigarrow^b v$. Implement an algorithm in the book to find the SCCs in the graph.
Output: a set of sub-adjacency graphs as resulting SCC's. No birding edges need be indicated.