CS 2443: Quiz 2

Department of Computer Science, IIT Hyderabad

15-Feb-2021

- Total marks: 10.
- Read the question carefully and answer to the question only.
- Maintain academic honesty.

---

1. Describe a recursive formula and prove its correctness for the following generalization of the SUBSET SUM problem. Given two arrays $X[1 \dots n]$ and $W[1 \dots n]$ of positive integers and an integer T, where each $W[i]$ denotes the weight of the corresponding element $X[i]$, compute the maximum weight subset of X whose elements sum to T. If no subset of X sums to T, then the output is $-\infty$. [3]

2. Consider the algorithm $BFS(G, s)$ and finding shortest distance through BFS mentioned in the lecture, where G is a graph and s is a vertex in G. Prove that for any vertex v in the layer L_i, the distance from s to v is i. [2]

3. Let G be a graph. Consider the following relation $\sim$. For any two vertices u and v, $u \sim v$ if and only if there are two edge-disjoint paths P_1 and P_2 from u to v (i.e., $E(P_1) \cap E(P_2) = \emptyset$). Is $\sim$ an equivalence relation? Justify your answer. [2]

4. Consider the digraph D mentioned in Figure 1. List all the strongly connected components in it. Consider the algorithm DFS-Loop mentioned in the lecture (see Figure 2). Suppose you run DFS-Loop on the graph D in Figure 1 (you may assume a labeling of vertices to $1, \dots, 5$.). Then, list the finishing time of each vertex. [1+2]

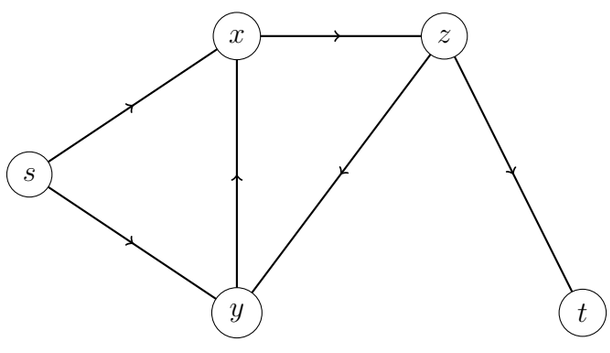

Figure 1: Digraph D

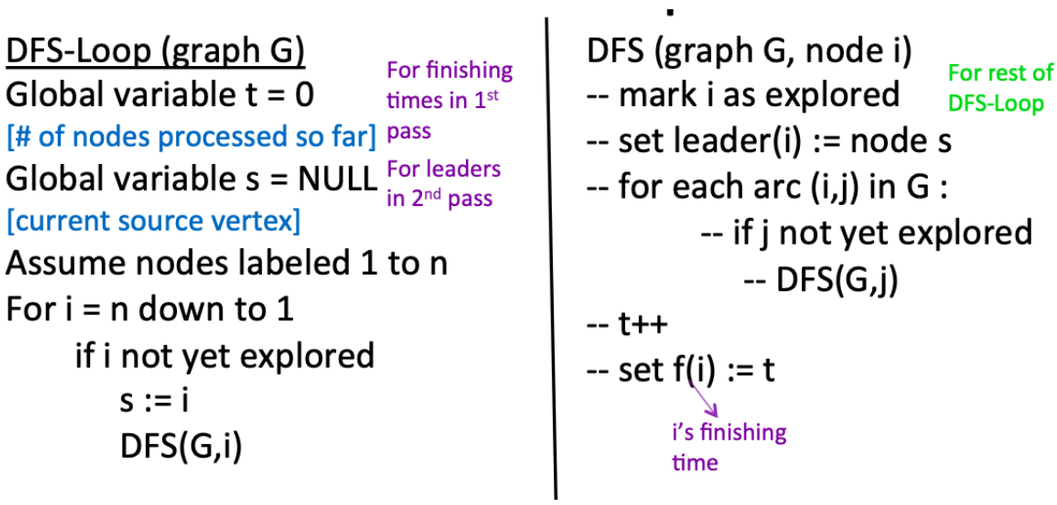

Figure 2: DFS-Loop