Đề số 2
Thời gian: 120 phút

INT2203 - DATA STRUCTURES AND ALGORITHMS
FINAL EXAMINATION
Date: 12/23/2020

(Thí sinh không được sử dụng tài liệu hoặc thiết bị liên lạc)

Question 1.
Given a linked-list with values already sorted, what is the average running time to search the list for a value?

Question 2.
What is the sorting algorithm that is theoretically optimal in terms of running time as well as memory usage? What is its biggest disadvantage?

Question 3.
a. Give a trace of the process of inserting the keys **3 1 5 8 4 9 2 7 6** into an initially empty heap.
b. Given the heap resulted from *Part* ***a***, show the heap after of deleting **each** of the top 02 keys. (one after the first deletion, another after the second deletion)

Question 4.
Given a hash table of size 11 and a hash function **h(x) = x mod 11**. You need to insert into the hash table this series of values: **23, 15, 35, 39, 44, 91, 12, 69, 20, 17, 57**.
a. What is the better way to handle collision in this problem? Why? (answer in one line)
b. Write down the final hash table after inserting the series using the collision handling method that you've chosen.

Question 5.
a. *Insert* **6 4 9 8 7 1 2 3** (in that order) into a binary search tree; you need to draw only the final tree.
b. Show the final tree after deleting **6** from the tree resulted from *Part* ***a***.
c. Now the tree is very much unbalanced. How would you propose to solve this issue? Using a better type of trees from the beginning? Fixing the current tree? How? Please detail your answer in no more than three lines of text.

Question 6.
Given a directed graph of 12 vertices and 18 edges listed bellow

9→5, 3→4, 2→0, 1→7, 4→7, 11→4, 8→0, 8→9, 11→8,
0→9, 3→1, 7→3, 6→3, 6→11, 4→11, 9→2, 5→2, 2→10

a. Draw an adjacency-list representation of the graph. Vertices in each adjacency list must be sorted in ascending order, this order will be used in *Part* ***b***.

b. Use depth-first search to visit every vertex in the graph starting at vertex **6**, write down the vertices in the order that they are visited.

Question 7.

Given an undirected graph of 8 vertices and 16 weighted edges listed bellow

0-2 0.28	1-3 0.58	1-7 0.93	2-5 0.34	3-7 0.38
0-4 0.32	1-5 0.40	2-3 0.16	2-7 0.37	4-5 0.36
0-7 0.35	1-6 0.52	2-4 0.19	3-5 0.26	4-6 0.29
				5-6 0.17

Computing the graph's minimal spanning tree using Prim's algorithm. List the edges of the tree in the order that they are found by the algorithm.

Question 8.

Given a directed graph of 8 vertices and 15 weighted edges listed below,

0→4 0.39	1→5 0.38	4→7 0.52	6→0 0.28	7→1 0.58
0→6 0.28	2→4 0.29	5→0 0.37	6→2 0.32	7→3 0.40
1→3 0.26	3→0 0.34	5→6 0.35	6→5 0.35	7→5 0.93

Give a trace that shows the process of computing the shortest path tree rooted at vertex 1 using Dijkstra's algorithm.

Question 9.

How would you find a maximum spanning tree of an edge-weighted graph? Use no more tha 02 lines of text to explain your solution.

Question 10.

Given a sequence of N integer $\{a_1, \ldots, a_N\}$ and an integer M, M <= N, there are (N - M + sub-sequences of length M: $\{a_1, .., a_M\}$, $\{a_2, .., a_{M+1}\}$, ..., $\{a_{N-M+1}, .., a_N\}$. Present an algorit that finds the minimum value of each sub-sequence.

Example: Given N = 5, the sequence {1, 4, 3, 2, 1}, and M = 3, there are 3 sub-sequenc {1, 4, 3}, {4, 3, 2}, and {3, 2, 1}. The correct output is 1, 2, 1.

What is the order of growth of that algorithm?

END