August 19, Winter, 2020

Islamic University of Technology (IUT)
Organisation of Islamic Cooperation (OIC)
Department of Computer Science and Engineering (CSE)
Semester Final Examination (Online)

CSE 4303: Data Structures

Duration: 1 Hour 30 Minutes + 10-15 minutes for submission

Full Marks: 75

Instructions:

- Write your Name, Student-ID and Course Code on the top of the first page. Maintain a serial number on the Top-right corner of each page.
- Answer all the questions. Figures in the right margin indicate marks.
- Sit in proper position and maintain the environment as per the Guidelines.
- No examinee is allowed to scan the file unless 1 hour 30 minutes is finished.
- For any circumstances, follow the instructions of the invigilator.

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1 The following set of numbers represent a Max Heap. 5

A = {15,13,9,5,12,8,7,4,0,6,2,1}

Perform the operation 'Heap_Extract_Max(A)' once.

2 Why is the process of building a Max heap from an arbitrary set of numbers designed in 'Bottom-up' approach? 5

3 Suppose an AVL Tree is used to implement a Min Priority Queue. What will be the complexity of the following operations: 3

a) push(x)
b) pop()
c) minimum()

4 Let T be a Binary Search Tree whose keys are distinct. Let x be a leaf node, and y be its parent. Justify that $y.key$ is either the smallest key in T larger that $x.key$ or the largest key in T smaller than $x.key$. 7

5 Build a Segment Tree using the following set of numbers for finding the Maximum value amongst a given range: 10+5

{10,5,7,-2,8,14,3,0,1,-12}

Show the detailed steps of recursion along with the step by step development of the Segment Tree.

Finally, show the detailed steps for finding the Maximum value for the range (3...7).

6 A Hash function is defined as '**h(x)=x mod 10**' A set of number is given as follows: 5+10

S={4371,1323,6173,4199,4344,9679,1989}

Show the resulting:

a) Separate chaining Hash Table.
b) Hash Table with a second hash function for solving collision:
$f(i)=i*hash_2(x)$ and $hash_2(x)=7-(x \bmod 7)$.

7 Implement a Dictionary using Trie data structure which will include a set of words. The dictionary allows the following features: 3×5

a) Allows Spell-checking and produces an error message if misspelt.
b) When the prefix of any word is inserted, it shows the number of words that starts with that prefix.

Write pseudocodes of the necessary functions for building the dictionary and implementing Features (a) & (b).

8 Let's assume the Dictionary mentioned in Question-7 is now stored in a Hash-Table. The Hash function is represented by, 10

$$Hash(word) \sum_{i=0}^{wordSize-1} word[wordSize - i - 1] \times 37^i$$

Let's say the Hash table will is represented by an Array for size 100. Each word is mapped at a specific location using the Hash function. However, if two words are mapped to the same index, Linear Probing will be considered as the Collision Resolution method.

Design the algorithm and write necessary pseudocodes to satisfy the requirements.