CROSS RIVER UNIVERSITY OF TECHNOLOGY
FACULTY OF SCIENCE
DEPARTMENT OF COMPUTER SCIENCE
FIRST SEMESTER 2018/2019 EXAMINATION

CSC 3106 – ANALYSIS OF ALGORITHMS **TIME: 2.00 HOURS**

INSTRUCTION: Answer any **4** questions.

Q1 a) When two algorithms solve the same problem but look different, what features would you consider to select the more efficient one?

b) What are the basic asymptotic efficiency classes?
c) Estimate the complexity of the algorithm below:

```
for (int i = 0; i < N; i ++)
{
        If (arr (i)! = invalidChar)
        {
                arr (ptr) = arr (i);
                ptr++;
        }
}
```

Q.2 a) In a tabular form, write the mathematical equivalents of big – 0, big-**Ω**, big-**Θ**, little-oh, and little-omega notations in algorithm analysis.

b) What is meant by an algorithm's growth rate, and what is the advantage of using it in the expression of an algorithm's complexity?

c) What is meant by "Worst-case", "Average-case", and "Best-case" complexities of an algorithm?

Q. 3 a) What is the time efficiency class of sequential search:

i) in the worst case (ii) in the best case, and (iii) in the average case?

a) Write the insertion sort algorithm and estimate its running time.

Q. 4 a) What is meant by "**hashing**" and "**hash table**", and why are they important?

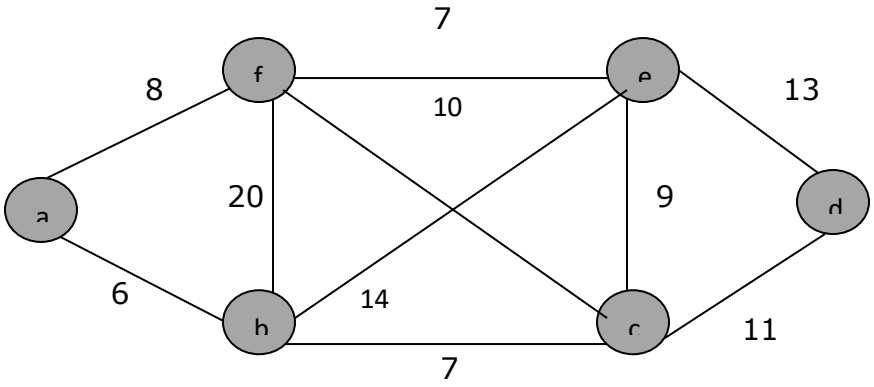
b) For the input 30,20, 56, 75, 31, 19 and has function ***h(K)*** = ***(sum of digits of K) mod 10***, construct the:

(i) Open hash table,

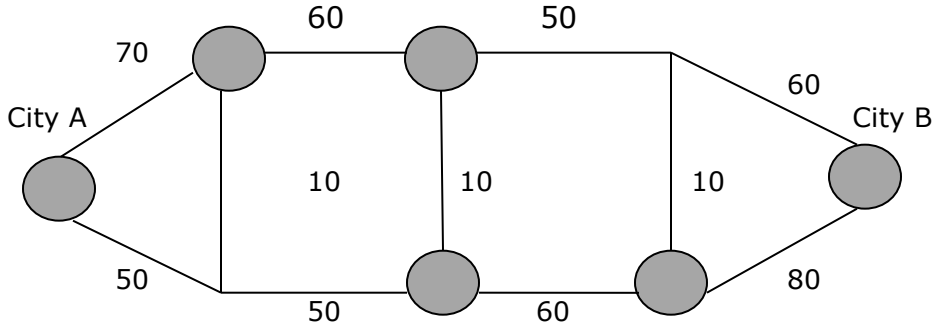
(ii) Closed hash table.

c) What are the maximum, minimum and average chain lengths in the hash table? Explain your reasoning.

Q.5 a) Apply Kruskal's algorithm to find a minimum spanning tree of the following graph:



b) A traveler wants to deliver a shipment from City A to City B in the road network below using a Rechargeable Electric car. Charging stations are marked as circles and lines between circles represent distances (in miles) between the cities in the way. The numbers beside the lines are the estimated distances.



If the traveler's car can only drive **m** miles before needing to recharge, draw the shortest path from City A to City B if:

i) **m** = ∞
ii) **m** = 100.

Q.6 a) What is the basic difference between Prim's and Dijkstra's algorithms?

b) Apply Djikstra's algorithm on the graph below (Fig. Q6) and find the shortest path from node 1 to the rest of the nodes.

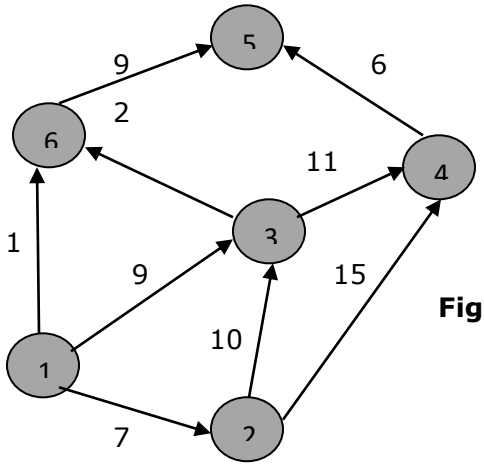


Fig. Q6

GOOD LUCK

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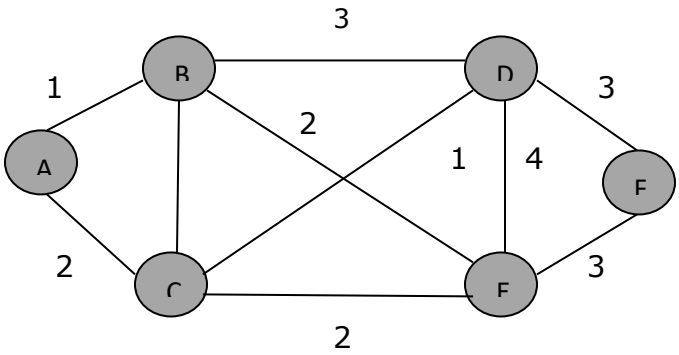
FIRST SEMESTER 2018/2019 EXAMINATION

CSC 3106 – ANALYSIS OF ALGORITHMS **TIME:** 1 HOUR 40 MINS

INSTRUCTION: Answer any **4** questions.

Q.1 a) Apply Dijkstra's algorithm on the graph below (Fig. Q1) and find the shortest path from node A to the rest of the nodes. (Explain step by step).



b) Mention two similarities and two differences between Prim's and Dijkstra's algorithms.

Q.2 a) What is a spanning tree? What is Minimum Spanning Tree?

b) Execute Kruskal's algorithm to find the minimum spanning tree of the graph of Fig. Q1 aboev:

c) What is Brute-force technique? Write the Brute-force algorithm for finding the god of two given numbers.

Q.3 a) Given the following code fragment, what is Big-O running time?

```
Test = 0
for i in range (n) :
     for j  in range (n) :
            test  =  test  +  i*j
```

b) Distinguish between asymptotically **upper bound** and asymptotically **tight bound**.

c) What does the following algorithm running times connote?

1, nlogn, 2^n, n^3, $n^!$, n^2, n

Arrange them from slowest to fastest.

Q.4 a) How do you determine the space and time factors when measuring the efficiency of an algorithm?

b) There are four algorithms A1, A2, A3, A4 to solve a given problem (n) with the orders log(n), nlogn, log(log(n) respectively. The approximate time requirement is 1 second with n = 8. Which algorithm should execute slowest if n = 16?

c) Write the bubble sort algorithm ad compute its run time complexity.

Q.5 a) Define the term "**hashing**" and explain why it is important.

b) For the keys 12, 44, 13, 88, 23, 94, 11, 39, 20, 16, 5 and hash function ***h(K) = (2i + 5) mod 11***, construct the:

i) open hash table,

ii) closed hash table.

c) What are the maximum, minimum and average chain lengths in the hash table? Explain your reasoning.

Q.6 a) Express the following functions g(n) in terms of Big-0 notation:

i) $(n-1)^2 * (n+2)$,

ii) $\sqrt[3]{n^9} + (\sqrt{n})^4 - 6$

iii) $\log n + \frac{1}{2} \log n^8$

Use the simplest g(n) possible in your answers, and explain your reasoning.

b) Write the binary search algorithm and give it computing time in the:

i) worst case, (ii) best case, and (iii) average case.

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CROSS RIVER UNIVERSITY OF TECHNOLOGY
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FIRST SEMESTER 2015/2016 EXAMINATION

CSC 3106 - ANALYSIS OF ALGORITHMS **TIME:** 2.00 HOURS

INSTRUCTION: Answer any **4** questions.

Q.1 a) What is "Analysis of Algorithms"?

b) Analysis of algorithms can be done experimentally or theoretically. What are three limitations of experimental studies on the running time of algorithms?

c) Write a Brute Force algorithm to find the greatest common divisor (gcd) of two integers m and n; hence evaluate **gcd(9, 5)** using the back substitution model.

Q.2 a) What is "Asymptotic Analaysis"? Name five reasons for asymptotic analysis of algorithms.

b) Determine the behaviour of the following functions, showing your reasoning:

i) $f(n) = n^6 + 3n$ (ii) $f(n) = 2^n + 12$ (iii) $f(n) = 3^n + 2^n$ (iv) $f(n) = n^n + n$

Q.3 a) Describe what is meant by big-0, big-**Ω**, big-Θ, little-oh, and little-omega notations in algorithm analysis.

b) Give a Big-theta analysis of the worst-case running times of: (i) Bubble sort

(ii) balanced binary tree (iii) Merge-sort (iv) a loop nested to n levels

v) an insertion sort algorithm (vi) a linear search

(vii) a loop nested to two levels, each roughly n iterations.

Q.4 a) Explain what you understand by "collision resolution by chaining".

b) Consider a hash table with 9 slots. The hash function is h(k) = k mod 9. The collisions are resolved by chaining. The following 9 keys are inserted in the order: 5, 28, 19, 15, 20, 33, 12, 17, 10. Find the maximum, minimum, and average chain lengths in the hash table. Explain your reasoning.

Q.5 a) Examine the following segment of Python code and answer the questions that follow.

```
a = 5
b = 6
c = 10
for i in range (n) :
for j in range (n) :
        x = i * j
        y = j * j
        x = f * j
for k in range (n) :
    w = a*k + 45
    v = b*b
d = 33
```

a) What is the exact running time of the algorithm with respect to n?
b) What is the big-O running time?
c) Prove the correctness of the algorithm using its mathematical definition.

Q.6 Study the binary tree below (Fig. 1) and answer the questions that follow.

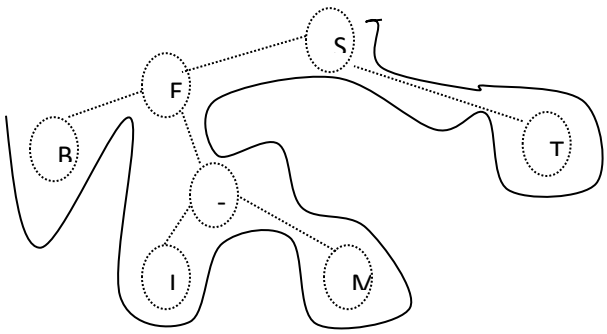

Fig. 1

a) Determine the outputs for In-order, Pre-order, and Level-order traversals of the tree.

b) Determine the minimum-length spanning tree on the weighted graph below (Fig. 2) using Krush algorithm.

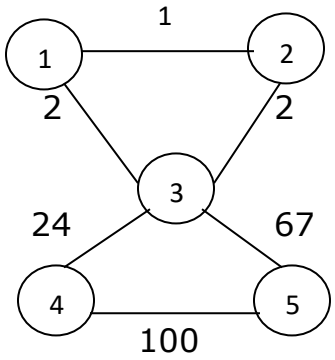

Fig. 2