WOMEN'S UNIVERSITY IN AFRICA

Addressing gender disparity and fostering equity in University Education

FACULTY OF MANAGEMENT AND ENTREPRENEURIAL SCIENCES

BSc HONOURS DEGREE IN INFORMATION SYSTEMS

MAIN PAPER

IS224: DESIGN AND ANALYSIS OF ALGORITHMS

INTAKE 24: SECOND YEAR SECOND SEMESTER

TIME: 2 HOURS AFTERNOON

INSTRUCTIONS TO CANDIDATES

Answer any **four** questions.

Question 1

Merge Sort divides the array into two nearly equal sizes, sorts each of them recursively and merges the result. Rather than separate an array into two half-size arrays for sorting, consider the following two approaches:

Divide it into three subarrays of size $\lfloor n/3 \rfloor$, $\lfloor (n+1)/3 \rfloor$ and $\lfloor (n+2)/3 \rfloor$, respectively, to sort each of these three subarrays recursively, and then merge the three sorted subarrays.. Hence give the complexity for each.

a) 12 14 25 27 11 12 13 16 21 11 [8]

b) Apply divide and conquer quicksort to sort the list

216 88 46 98 7 55 108 333 250 11 [6]

c) Using the binomial coefficient algorithm for both the divide and conquer and dynamic calculate $^5C3$. Hence give the complexity for each algorithm [6]

d) Illustrate large integer multiplication for A ∗ B where

A = 1135 and B = 2214 [5]

Question 2

a) Given g(n) =2^n and f(n) = 5^{Inn} . Prove that g(n) €Ω(f(n)) [5]

b) List the following functions according to their order of growth from the lowest to the highest:

$(n-2)!$, $5 \lg(n+100)10$, $22n$, $0.001n^4 + 3n^3 + 1$, $\ln 2\, n$, $\sqrt{3}\, n$, $3n$ [5]

c) Find the order of growth for solutions of the following recurrences

$$T(n) = 4T(n/2) + n^2,\ T(1) = 1,\ T(0) = 1$$ [8]

d) Prove by induction

$3.5^{2n-1} + 1$ is divisible by 6. [7]

Question 3

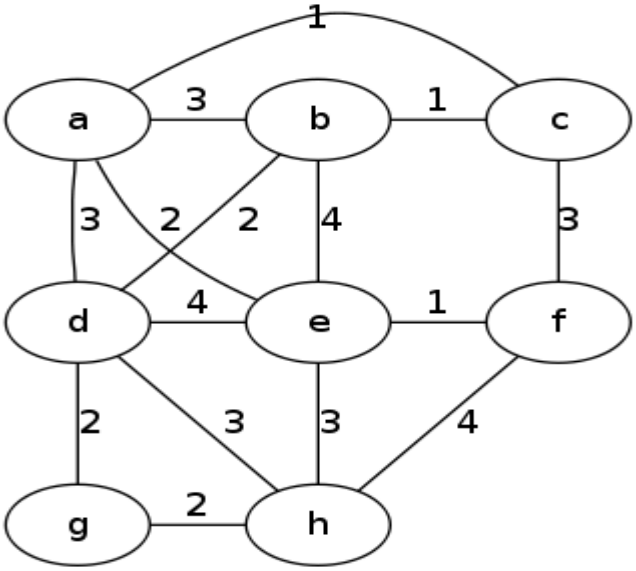
The Women University in Africa wants to improve the existing campus wide network. They want to install a new fibre optic cable that interlink the part of Administration, Library, Main gate, Lecture rooms and IT Centre (the main host. The IT centre will be hosting the mainframe computer although these sections will be having a mini computer. Connections are as follows:

IT Center (ITC) can connect to Administration	---	40m
IT Centre (ITC) to Main gate	---	160m
IT Centre (ITC) to Library	---	200m
Library to Admin	---	110m
Library to main gate	---	140m
Administration to Main gate	---	30m
Administration to Library	---	80m

As a networking manager your duty is to design the best network. Come up with the graph and determine the minimum spanning tree. Use the Floyd's algorithm to determine the shortest path. [25]

Question 4

a) Use both the Prim's algorithm and the Kruskal Algorithm to determine the MSP



[20]

b) Explain the n-Celebrity problem/algorithm and how it can be applied to real computing issues. Indicate how the celebrity is identified and the algorithm complexity. [5]

Question 5

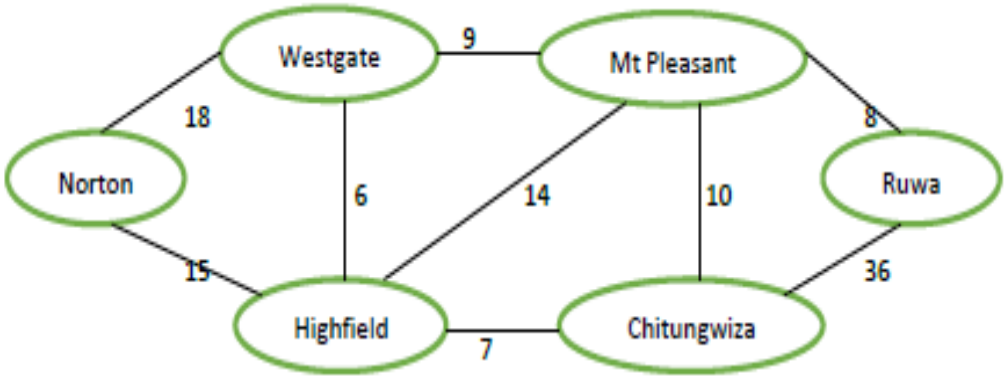
a) Use the 0-1 knapsack problem (both greedy and dynamic approaches) to determine the optimal amount the thief will carry

Knapsack problem instance n = 4, m = 15, (P1, P2, P3, P4) = (10, 10, 12, 18) and (W1, W2, W3, W4) = (2, 4, 6, 9). [20]

b) The n-queens problem is regarded as a backtracking algorithm. Illustrate the n-queens problem for a 4X4 chase board and determine the complexity. [5]

Question 6

a) Use the Dijikstra algorithm to determine the distance from Norton to Ruwa.



[16]

b) Given a *nXn* matrix multiplying another nXn matrix. What is the number of multiplications needed to multiply the two matrices? Using the divide and conquer approach illustrate the idea of Strassen for matrix multiplication algorithm and give the complexity. [9]

END