EGERTON UNIVERSITY

UNIVERSITY EXAMINATIONS

NJORO CAMPUS

SECOND SEMESTER 2011/2012

FIRST YEAR EXAMINATION FOR THE AWARD OF THE DEGREE BACHELOR OF COMPUTER SCIENCE

COMP 102: DESCRETE MATHEMATICS FOR COMPUTER SCIENTISTS

STREAM: BSC Y1S2 **TIME:** 2 HOURS

DAY: MONDAY 12.00 – 2.00PM **DATE:** 20/08/2012

INSTRUCTIONS

(a) This paper contains FIVE Questions.

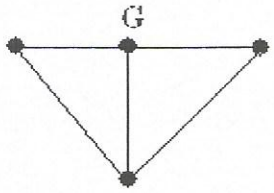
(b) You are required to answer THREE questions in all

(c) Question ONE is Compulsory

(d) Where diagrams are required they should be neatly drawn.

Question ONE: (30 marks)

(a) Find all the spanning trees of the graph G shown below. [4 marks]



(b) Let U = {1,2,3,4,5,6,7,8,9,10}. Find the set specified by each of the following bit strings.

(i) 1111001111 (ii) 0101111000 (iii) 1000000001 [3 marks]

(c) Let N = {2,3, 4,5,6,7,8,9,10} and define a relation R on N by writing xRy if x divides y for x,y0 ∈ N.

(i) Create a digraph for R

(ii) Form the matrix representation for c(i) above

(iii)Decide if the relation is an equivalence relation [4 marks]

(d) Evaluate the following *Polish* expressions and produce the tree representing them.

(i) -+23*-512

(ii) +*--*+*432352-1-2 [3 marks each total = 6 marks]

(e) Show that the hypothesis "It is not sunny this afternoon and is colder than yesterday," "We will go swimming only if it is sunny," "If we do not go swimming, then we will take a canoe trip," and "If we take a canoe trip, then we will be home by sunset" lead to the conclusion "We will be home by sunset." [6 marks]

(f) A dealer went to Chambumba computer garage and found 125 computers in stock with the following characteristics: 25 were *HPs*, 40 had 1 GB RAM, 10 had flat screen and 1 GB of RAM but not *HPs*. 54 CRT screen, 10 were *HPs* with flat screen, 15 were *HPs* with 1 GB RAM and 5 were *HPs* with CRT screen.

(i) Draw a Venn diagram and write down the set operation for each region together with its respective cardinal number. [each region with correct cardinal number and set operation is 1 mark, total = 5marks]

(ii) How many computers had 1GB RAM and CRT screen that were *HPs*?

[1mark]

(iii)How many computers were not *HPs* but had 1GB RAM or flat screen?

[1 mark]

Question Two (20 marks)

(a) The following cities are accessible from the named motorways: Bath M4; Birmingham M6, M5; Winchester M3; Bristol M4, M5; Canterbury M2; Cardiff M4; Exeter M5; Leeds M1; London M1,M2,M3,M4; Manchester M6; and Sheffied M1. Suppose that set consists of the names of the cities and that the set M consists of the names of the motorways as given above. The relation A can be defined as follows:

A = {(x,y): (x,y) ∈ MxC and motorway x gives access to city y}

(i) How many elements are there in MxC? How many elements are there in A? [3 marks]

(ii) Tabulate the ordered pairs which are elements of the set D, defined thus: D ⊂ A, and (x,y) ∈ D if (x,y) ∈ A and x = 'M4' or y = 'London' [4 marks]

(iii) The cities Bath, Winchester, Canterbury and London are classified as not historic. Suppose we have the Boolean set H = {T,F}, where a value T corresponds to historic and a value F corresponds to non-historic. Draw a bipartite graph representation of the relation where

B = { (x,y): (x,y) ∈ *CxH* and city y has historic classification z} [4 marks]

(iv) How many elements does *CxH* have? [1.5 marks]

(v) How many elements does the composition of *AoB* have? [1.5 marks]

(vi) Suppose *AoB* = K: Write out the set of ordered triples V, defined by

V = { (x,y,z): (x,y,z) ∈ K and x = 'M4' and z = T} [2 marks]

(vii) Write out a set definition in terms of K, similar to the one in (vi), of the names of all historic cities [2 marks]

(b) Find the transitive closure of the relation R = { (1,1), (1,2), (2,2), (3,1), (3,3) on {1,2,3} [2 marks]

Question Three (20 marks)

(a) Let R be the relation defined by xRy if x-y is even. Show that R is an equivalence relation. [4 marks]

(b) I a survey, 250 Egerton University students were asked whether they read Nation or Standard. It was found that, 75 read the nation, 87 read the standard and 38 read both. Find out how many read neither nation nor standard. [3 marks]

(c) Let $f(x) = x^2 + 4$ and $g(x) = x + 6$. Find $gof(x)$ and $fog(x)$ [3 marks]

(d) Represent the following sets using Venn diagrams. $B \cup (A \cap C)$, $A - (B - C)$ and $C - (A \cap B)$ [3 marks]

(e) What are the advantages of

- Lists over n-tuple [1.5 marks]

➲ Linked lists over lists [1.5 marks]

(f) Re-write the linked list below to include Tuesday and Thursday In their proper place in the sequence. [4 marks]

Start = 1

Address	Day name	Pointer
1	Sunday	2
2	Monday	3
3	Wednesday	4
4	Friday	5
5	Saturday	0

Question Four: (20 marks)

(a) Show that the hypothesis: "I take the bus or I walk. If I walk I get tired. I do not get tired." Leads to the conclusion 'therefore I take the bus." [6 marks]

(b) The characters of the word LIVINGSTON are stored as a list L1 thus <L,I,V,I,N,G,S,T,O,N,E>. Find Tail (tail (L1) and Head (tail (L2)). [4 marks]

(c) Write out a truth table for the expression $\overline{(AVB)} \Rightarrow C$.(*Hint: the table will have eight rows*) [4 marks]

(d) Interpret this expression in practical terms if A = 'there is a bug in program X', B = 'computer Y is not functioning properly', and C = 'program X can run successfully on computer Y'. Can the direction of the implication be reversed? [2 marks]

(e) Briefly describe TWO application areas of trees in computer science. [4 marks]

Question Five: (20 marks)

(a) Given $f : R \rightarrow R$ defined by $f(x) = 2x^2 - 3$ and $g : R \rightarrow R$ defined by $g(x) = 8x + 1$. Find (gof)x and (fog)x [4 marks]

(b) Consider the ordered 7 tuple (p,q,r,s,t,u,v). Represent it as an ordered pair [2 marks]

(c) Define C = {a,b,c,d}, D = {w,x,y,z} and E = {p,q,r}. Four relations are defined as follows.

R_1 = {(a,w), (b,w), (c,y), (d,z)}, so R1 $\subseteq$ CxD

R_2 = {(a,w), (b,y), (c,z), (d,x)}, so so R2 $\subseteq$ CxD

$R_3 = \{(a,p), (b,q), (c,q), (d,q)$, so $R3 \subseteq CxE$

$R_4 = \{(w,p), (x,q), (x,r), (y,q)$, so $R4 \subseteq CxE$

(i) Draw a bipartite graph representation of these relations

(ii) Giving reasons identify which of these relations are functions and which ones are not.

(iii)In which case is the inverse relation also a function?

[2marks each total =6 marks]

(d) Put the following fully parenthesized expression into an appropriate binary positional tree form. Carry out the preorder search to produce a prefix expression. Evaluate the prefix expression when a = 4, b = 3, c = 6, d = 11 and e = 3. Repeat with post-order search and evaluate the reverse polish (postfix) expression. (((a-b)*(c*d))-e [8 marks]

Good Luck

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