Write Your Student ID Here

CPSC 203 – Winter 2014

Introduction to Problem Solving Using Application Software

MIDTERM EXAM

DO NOT OPEN UNTIL INSTRUCTED

ADDITIONAL INSTRUCTIONS

- There are **15** multiple-choice questions. **Each multiple-choice question is worth 2 points**
- Mark answers for multiple choice questions in **bubble sheet**
- Choose the best answer to each multiple-choice question
- Write the answers to the short-answer questions in this booklet
- This booklet contains 11 pages including this page
- The exam is open book; only your textbook and the lab manual are allowed
- No other aids are allowed including notes, other books, mp3 players, calculators or computers
- Cell phones must be switched off and out of sight and reach
- Write your ID and name in the indicated boxes

	Your Mark	Maximum Possible Mark
Short Answer Question 1		8
Short Answer Question 2		8
Short Answer Question 3		8
Short Answer Question 4		8
Short Answer Question 5		10
Short Answer Question 6		10
Multiple Choice Questions		60 **(JT: 15 x 2 = 30)**
Total		72

Part I – Multiple Choice Questions

!!! MARK YOUR ANSWERS FOR THIS PART IN THE BUBBLESHEET PROVIDED !!!

1. Suppose that a friendly instructor had added some helpful sticky notes to your textbook to aid in your midterm preparations. If your textbook has 2048 pages, how many pages do you need to check before you can be 100% certain that you have found all the helpful sticky notes
    a. 2048
    b. 10
    c. 11
    d. 2047

2. Suppose you were trying to decide on a restaurant, and you narrowed down your options to a set of ten places. You looked up each of the restaurants online and determined how many minutes it would take you to drive there and what the average customer review score was (i.e., a number of stars between 0 and 5, with 0 representing the worst restaurant imaginable and 5 representing the best restaurant). You have decided that you will give well-reviewed restaurants or restaurants that are very close by higher scores and then eat at whichever restaurant had the highest score overall. Which of the following objective functions (i.e., scores) would make the most sense for your decision?
    a. 0.3 * average_customer_score - 0.5 * minutes_away
    b. 0.2 * average_customer_score + 0.8 * minutes_away
    c. average_customer_score * minutes_away / 5
    d. 0.7 * (5 - average_customer_score) + 0.3 * minutes_away

3. Which of the following is an element of $(\{x,y,z\} \times \{1,2\}) \cap (\{z\} \times \{1,2,3\})$?
    a. (x,2)
    b. (z,2)
    c. (1,z)
    d. None of the above

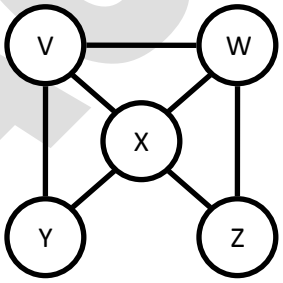
4. Let A = {red, green, blue}, B = {yellow, blue}, and C = {green}. Which of the following statements is true?
    a. $(C \subseteq B) \wedge (B \subseteq B)$
    b. $(A \cap C = \varnothing) \rightarrow (B \subseteq A)$
    c. $(B = C) \wedge (C \subseteq A)$
    d. $(C \subseteq A) \rightarrow (B \subseteq A)$

5. If A and B are both sets, then in which of the following situations would the size of the set $A \times B$ be 0?
    a. (the size of A is 1) $\wedge$ (A is a subset of B)
    b. (the size of A is 1) $\wedge$ (the size of B is 0)
    c. $\neg$(the size of A is 1) $\wedge$ (the size of B is 1)
    d. (the size of A is 1) $\vee$ (the size of B is 1)

6. Let A = {Rob, Jalal}. Which of the following statements is true?
    a. Jalal $\notin$ A
    b. {Jalal, Carey} $\subseteq$ A
    c. {Rob} $\notin$ A
    d. {Rob, Jalal} - {Jalal} $\subseteq \varnothing$

7. Consider a graph of four vertices wherein every vertex is connected (by an undirected edge) to every other vertex. Such a graph would contain:
    a. 1+ cycles (i.e., one or more cycles)
    b. 1+ cycles, 1+ Euler paths
    c. 1+ cycles, 1+ Euler paths, 1+ Euler cycles
    d. None of the above

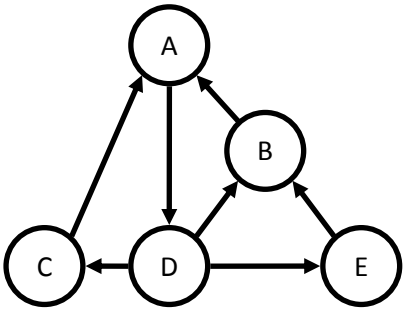
8. What is the minimum number of colours necessary to colour this graph such that no two adjacent vertices share the same colour?



    a. 2
    b. 3
    c. 4
    d. 5

9. Which of the following represents a correct definition for the graph in the previous question?
    a. V = {V, W, X, Y, Z}, E = ((V,W), (V,X), (V,Y), (W,X), (W,Z), (X,Y), (X,Z))
    b. V = {V, W, X, Y, Z}, E = {(V,W), (V,X), (V,Y), (W,X), (W,Z), (X,Y), (X,Z)}
    c. V = {V, W, X, Y, Z}, E = ({V,W}, {V,X}, {V,Y}, {W,X}, {W,Z}, {X,Y}, {X,Z})
    d. V = {V, W, X, Y, Z}, E = {{V,W}, {V,X}, {V,Y}, {W,X}, {W,Z}, {X,Y}, {X,Z}}

10. Which statement about the following graph is true?



    a. This graph is a tree
    b. The in-degree of B is the same as the out-degree of D
    c. The in-degree of D is the same as the out-degree of E
    d. Either B is adjacent from A or A is adjacent to C

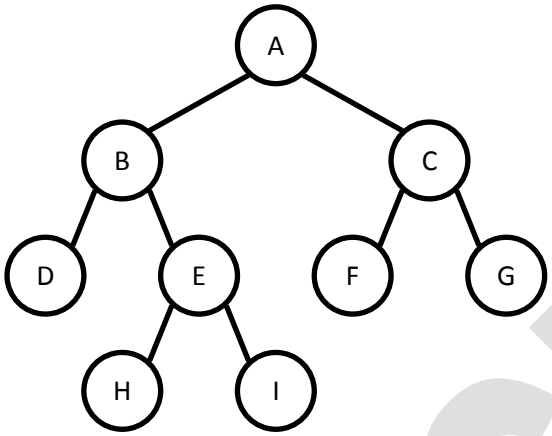
11. Suppose there is a file where 99% of the symbols in the file are spaces. If we use Huffman's algorithm to find an encoding, which of the following is the most likely code for the space?
    a. 0101010101
    b. 1111
    c. 0
    d. We cannot answer without knowing how many different symbols are used in the file.

12. Imagine a fan that has three different speeds {Low, Medium, Fast} and the ability to oscillate (i.e., rotate back and forth) that has two modes {On, Off}. How many states are needed to build a finite state machine that has a unique state for every possible state of the fan (i.e., the speed and whether or not the fan is oscillating)?
    a. 4
    b. 5
    c. 6
    d. 7

13. If we use the code 1111 to represent the letter 'R', 00 to represent 'O', 11 to represent 'B', and 0 to represent I, then to what word does the sequence 11110011 correspond?
    a. ROB
    b. BBOB
    c. RIIB
    d. All of the above

14. Which of the following is a non-prefix set of codes?
    a. {A = 00, B = 01, C = 100, D = 101}
    b. {A = 10, B = 01, C = 100, D = 101}
    c. {A = 00, B = 1, C = 100, D = 101}
    d. {A = 00, B = 01, C = 001, D = 101}

15. Which of the statements about the following tree is true?



a. F and H are siblings
b. E is an ancestor of A
c. B is a leaf node
d. C is a descendent of A

Part II – Short Answer Questions

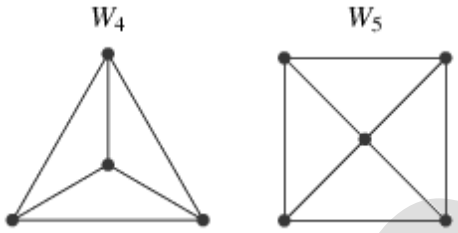
!!! WRITE YOUR ANSWERS FOR THIS PART IN THIS BOOKLET !!!

1. Draw the diagram for a Finite State Machine (FSM) that will represent the chip that controls a single-slice toaster. The person using the toaster can interact with it by inserting or removing a slice of bread, pushing down the lever, or pressing either the "cancel" or the "bagel" buttons. The lever will only work if there is a slice of bread or toast in the machine, and, if so, the lever will turn on the left and right heating elements. If both elements are turned on, the user can press the "cancel" button to turn off both elements or the "bagel" button to turn off the right element only. The lever cannot be pushed up and you do not need to worry about the timer built into the toaster. Finally, you should note that you cannot remove bread or toast from the toaster while either element is on.

   (n.b., You need only four states and five different types of transition.)

2. A file contains only 6 types of symbols (characters): A, B, C, D, E, and F. Statistics on the file shows that 39% of the characters are A, 16% are B, 17% are C, 15% are D, 9% are E, 4% are F. Use Huffman's Algorithm (on page 80 of your textbook) to organize these characters into a binary tree. Show your work for each round of the algorithm and do not forget to specify the final binary code for each of the six characters.

3. A wheel graph with k vertices (denoted W_k) is formed by placing one vertex at the center of the graph and then evenly spacing the remaining vertices around the outside. The center vertex is connected to every other vertex, but every vertex on the outside of the "wheel" is only connected to the center and the two nearest outside vertices - one on either side. Depicted below are W_4 and W_5. (This question is concerned only with wheel graphs where $k \geq 4$)



a. Draw W_6, W_7, and W_8.

b. Which of these graphs have an Euler cycle? Which of these graphs have an Euler path?

c. It should be obvious that there are an infinite number of wheel graphs, starting a W_4 and approaching W_∞. What percentage of these graphs will have an Euler cycle? What percentage of these graphs will have an Euler path?

4. A veterinarian who deals with only cats, dogs, and birds is reviewing his client records. He has 30 clients and each of them has at least one pet.

    6 of his clients have only birds
    5 of his clients have all three types of pets - cats, birds, and dogs
    2 of his clients have cats and birds but not dogs
    15 of his clients have birds (but they might have other pets as well)
    2 of his clients have only cats
    3 of his clients have only dogs

    a. Draw the Venn Diagram for these three intersecting sets and fill in the number of clients that belong to each of the seven different regions.

    b. How many of his clients have cats and dogs but no birds?

    c. How many of his clients have cats?

5. Consider the following screenshot from Microsoft Excel and compute the result of each of the following formulae. (**JT's extra: you can assume that all other cells are empty**)

	A	B	C
1	3	1	5
2	1	3	10
3	4	5	1
4	1	9	9
5	4	4	4
6	1	8	8
7	4	10	4
8	10	8	2
9	7	9	10
10	10	5	2

a. =AVERAGE(A1:C1)

b. =MAX(A1:C6)

c. =OFFSET(B6,-3,1)

d. =COUNTA(A1:A12)

e. =SUM(OFFSET(A8,-4,2,4,1))

6. Consider the proposition $((p \rightarrow q) \wedge (q \rightarrow r))$.

   a. Complete the following truth table for the proposition $((p \rightarrow q) \wedge (q \rightarrow r))$.

p	q	r	$p \rightarrow q$	$q \rightarrow r$	$((p \rightarrow q) \wedge (q \rightarrow r))$
F	F	F			
F	F	T			
F	T	F			
F	T	T			
T	F	F			
T	F	T			
T	T	F			
T	T	T			

   b. Based on the result from your truth table, is this proposition a tautology, a contradiction, or a contingency?