CISC-365*
Test #4
March 26, 2019

Student Number (Required) ______________________

Name (Optional)________________________________

This is a closed book test. You may not refer to any resources.

This is a 50 minute test.

Please write your answers in ink. Pencil answers will be marked, but will not be re-marked under any circumstances.

The test will be marked out of 50.

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TOTAL /50

☐ By writing my initials in this box, I authorize Dr. Dawes to destroy this test paper if I have not picked it up by April 30, 2019.

“If you don’t go out on the branch, you’re never going to get the best fruit”

Sarah Parish
Question 1 (15 marks)

Suppose we are solving a minimization problem using the Branch and Bound technique. Let $P$ be a partial solution, and let $l$ and $u$ be the lower and upper bounds computed for $P$.

(a) [5 marks] Is it possible for some full solution that expands on $P$ to have an actual cost $x$ where $x > \text{Global Upper Bound } U$? Explain your answer.

(b) [5 marks] Is it possible for a partial solution $P'$ that expands on $P$ to have bounds $l'$ and $u'$ such that $l' < l$? Explain your answer.
(c) [5 marks] Is it possible for a partial solution $P'$ that expands on $P$ to have bounds $l'$ and $u'$ such that $l' > u$? Explain your answer.
Question 2 (35 marks):

You have accepted the job of coordinating a camping trip for a group of Canadian politicians. You are providing them with tents – each tent can accommodate exactly four campers. Your task is to divide the campers into groups of four. Fortunately the group contains 32 members so you know you will need exactly eight tents. The tents are numbered 1 to 8.

Unfortunately the members of the group don’t like each other very much. You have been provided with a matrix A that records the levels of dislike between the individuals. $A[i,j] =$ the level to which Person $i$ dislikes Person $j$. Note that it is not necessarily true that $A[i,j] = A[j,i]$. The values in A are all in the range $[1 .. 10]$

The Unhappiness in a tent is the sum of the dislike values each person in a tent feels towards the other three people in the tent. The Group Unhappiness is the maximum of the Unhappiness of all the tents. For example if the Unhappiness values for the tents are $\{18, 24, 16, 19, 12, 17, 33, 27\}$ then the Group Unhappiness is 33.

In this question you will design a Branch and Bound algorithm to find the assignment of campers to tents that minimizes the Group Unhappiness.

For most parts of this question there are several possible answers. Answers that show deeper understanding of Branch and Bound methods will earn higher grades.

(a) [4 marks] Suppose there is a predefined function $F(P,t)$ that returns the Unhappiness of tent $t$ in solution $P$. Using this function, write code or pseudo-code to compute the Group Unhappiness for any solution $P$. 

(b) [5 marks] Characterize your solution method as a sequence of decisions. Explain your reasoning.

(c) [6 marks] How will you compute the initial value of the Global Upper Bound $U$? Explain your reasoning.
(d) [6 marks] How will you compute the Cost So Far for partial solutions? Explain your reasoning.

(e) [8 marks] How will you compute the Guaranteed Future Costs for partial solutions? Explain your reasoning.
(f) [6 marks] How will you compute the Feasible Future Costs for partial solutions? Explain your reasoning.