CISC-235*
Test #3
March 16, 2015

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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“Facebook is not your friend, it is a surveillance engine”

Happy birthday to Richard M. Stallman
Question 1 (10 marks)

Devise a double hashing function that would be suitable for storing a set of 800 Canadian Postal Codes, which always have the form “LDL DLD” where L represents any letter from A to Z, and D represents any digit from 0 to 9. Assume the hash table has 1024 addresses. Justify your answer.

a) [7 marks]: Assume that the postal codes come from all across the country, so all combinations of letters and digits are equally likely.

b) [3 marks]: Assume that all the postal codes come from the Kingston area, so they all begin with K7L, K7M or K7P. What, if anything, would you change?
Question 2 (10 marks)

Suppose you have a hash table with over 1000 addresses, and assume the keys are all 5-digit integers. Explain why this hash function is inappropriate, regardless of what type of collision resolution is being used:

\[
h(k): \\
t_1 = k^k \\
t_2 = t_1 \mod 10000 \\
\text{return } t_2 / 100
\]
**Question 3 (10 marks)**

Suppose you are asked to create a data structure to store a priority queue for an application in which the only possible priorities are 11, 32, 79 and 100000. The necessary operations are:
- add a new item to the priority queue
- locate and extract the item with the highest priority currently in the queue.
If two items are tied for highest priority, the one that was added earlier should be the one chosen.

Your goal is to minimize the time complexity of the operations.

Describe the data structure (or structures) you would use in this situation. Explain your answer.
Question 4 (10 marks)

Consider a fixed set of n objects that are stored in a priority queue. (By fixed, we mean that no objects are added or removed from the set.) Each item has priority in the range [1..n]. When the object with the highest priority is removed from the head of the priority queue, it is immediately reinserted into the queue with a random priority in the range [1..n].

How would you implement this priority queue? Describe the data structure you would use, and the algorithm to remove and re-insert the highest priority object.
Question 5 (10 marks)

Let $G$ be a graph on $n$ vertices. Using either the adjacency matrix representation or the adjacency list representation, give an algorithm (in pseudo-code) that will start at a given vertex $x$ and will return a list containing all the vertices that are neighbours of $x$'s neighbours. You may assume that the vertices are numbered $1, 2, \ldots, n$. 