University of Nevada, Las Vegas Computer Science 477/677 Fall 2015

Assignment 3: Due September 17, 2015

Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet. But the handwriting on this document must be your own. You may attach extra sheets, using a stapler.

1. Construct a treap with alphabetic key and numeric min-heap order. You are to insert the items one at a time and show the treap after each rotation. Insert the letters in the order: D, N, L, H, J, K. The numeric heap keys are given in the following table.

D	23
N	12
L	10
H	15
J	20
K	8

2. In all parts of this problem, let n be the number of data items, and m be the size of the hash table. Assume that each hash function is pseudo-random.

   (a) Suppose we are using closed hashing, where $m \approx 2n$, only one item can fit into a hash table location, and we are using quadratic probing. Approximately how many hash table locations, on the average, will we need to examine in order to insert one new item?

   (b) Suppose we are using open hashing, where $n = 2m$. What is the average number of items in one location of the hash table?

   (c) Suppose we are using open hashing, where $n = 2m$. Approximately what is the probability that a randomly chosen location in the hash table contains exactly two items? (To two decimal places.)

3. For $n = 8$, we have a cuckoo hash table of size $m = 10$. The two hash values for each item are given in the table below. Work through the steps of entering the items in alphabetical order.

A	2	4
B	5	2
C	0	3
D	5	7
E	3	6
F	1	9
G	1	8
H	4	0

4. Let X be a 3-dimensional array, where $X[i, j, k]$ is defined for $1 \leq i \leq 10$, $-2 \leq j \leq 8$, and $3 \leq k \leq 17$. If X is stored in main memory in column major order, with base address 2048, and where each item takes two locations in main memory, at what address in main memory is $X[7, 3, 8]$ stored?

5. We say that T is a *triangular array* if $T[i, j]$ is defined only for $j \leq i$. We will assume that the indices start with 1, not 0.

   Suppose T is a triangular array, where i ranges from 1 to 100, T is stored in main memory in row-major order with base address 1, and each item of T takes one location in main memory.

   (a) How much space in main memory is allocated to T?

   (b) What is the address of $T[14, 8]$ in main memory?

6. Assume that you have implemented a sparse array type using a binary search tree.

   (a) Show the output of the code segment below.

   (b) Show the binary search tree after the code has executed.

```
A:sparse_array_of_integer;
store(A,19,6);
cout << fetch(A,30) << endl;
store(A,12,17);
cout << fetch(A,19) << endl;
store(A,31,1+fetch(A,12));
store(A,19,fetch(A,16));
store(A,29,2+fetch(A,19));
cout << fetch(A,12) << endl;
cout << fetch(A,16) << endl;
cout << fetch(A,19) << endl;
cout << fetch(A,29) << endl;
cout << fetch(A,30) << endl;
cout << fetch(A,31) << endl;
```