CS 2150 Final Exam

Name

You MUST write your e-mail ID on **EACH** page and bubble in your userid at the bottom of this first page. And put your name on the top of this page, too.

If you are still writing when "pens down" is called, your exam will be ripped up and not graded – even if you are still writing to fill in the bubble form. So please do that first. Sorry to have to be strict on this!

Other than bubbling in your userid at the bottom of this page, please do not write in the footer section of this page.

There are 8 pages to this exam. Once the exam starts, please make sure you have all the pages. Questions are worth different amounts of points.

If you do not bubble in this first page properly, you will not receive credit for the exam!

This exam is CLOSED text book, closed-notes, closed-calculator, closed-cell phone, closed-computer, closed-neighbor, etc. Questions are worth different amounts, so be sure to look over all the questions and plan your time accordingly. Please sign the honor pledge below.

A crash reduces
Your expensive computer
To a simple stone.

(the bubble footer is automatically inserted into this space)

Page 2: C++

1. [4 points] Give a compelling example, *other* than the ones discussed in lecture, why we would want to use shared multiple inheritance and one when we would want to use replicated multiple inheritance. Briefly explain why in each case.

2. [4 points] For each of the following two constructors, briefly explain the error. Assume that there is a `ListNode *list` field in the Foo class.

```
Foo() {
   ListNode* list = new ListNode();
}
```

```
Foo() {
   ListNode temp;
   list = &temp;
}
```

3. [4 points] What is dynamic dispatch? Give a compelling example as to when we would want to use it.

Page 3: Midterm 1 stuffs

4. [9 points] Consider the following code segment:

```
union bar {
   float f;
   short s;
} x;
cout << sizeof(short) << endl;
x.f = 80.25;
cout << x.s << endl;
```

Assume everything is big-Endian. When put into a `main()` function and run on a 32-bit machine, the first line of output from this program is 2. What is the second line of output? You **MUST** show all your work! Note that when a `union` consists of different sized types, the smaller type is aligned with the *least* significant bits.

5. [3 points] Is it better to implement a queue with an array or a linked list? Why?

Page 4: Midterm 2 stuffs

6. [6 points] You are to implement the push operation for a stack in IBCM that is similar to the x86 stack's `push` opcode (i.e., starts at the end of memory and grows "down"). This will be implemented using opcodes (i.e., no IBCM hex encoding). You may assume that the stack pointer is pre-set at a variable label 'sp', and that the value to be pushed is at label 'x'. You should list just the instructions needed for the push operation itself; the intent is NOT to write a full IBCM program.

7. [6 points] Give one benefit and one disadvantage of each of the 4 types of trees (BST, AVL, red-black, and splay) discussed in lecture. Note that if one of your advantages is that "A is faster than B", then you cannot use "B is slower than A" as a disadvantage.

Page 5: x86

8. [3 points] List all the steps in the caller's prologue for the C calling convention.

9. [3 points] List all the steps in the caller's epilogue for the C calling convention.

10. [3 points] List all the steps in the callee's prologue for the C calling convention.

11. [3 points] List all the steps in the callee's epilogue for the C calling convention.

Page 6: Heaps & Huffman Coding

12. [3 points] What is the difference between a heap and a priority queue?

13. [3 points] What property(ies) of Huffman coding allow it to (often) achieve a compression ratio greater than 1? When will it not achieve a compression ratio greater than 1?

14. [3 points] In a min heap, when percolating down, which child do you swap with, and why?

15. [3 points] What is a *full binary tree*?

Page 7: Graphs and Memory

16. [4 points] What is spatial locality? What is temporal locality? Briefly describe each one.

17. [4 points] While both have the same big-Theta running times, there are still implementation differences between Prim's and Kruskal's minimum spanning tree algorithms. Which one would lead to a more efficient implementation? Why? You answer should explain why one is better than the other via a comparison.

18. [4 points] Google Maps' graph is too large to perform a proper Dijkstra's algorithm in a reasonable amount of time. How, then, does Google Maps (and GPS devices more generally) find the shortest path across the country?

Page 8: Demographics   Name & userid: _____

We meant to ask these in an end-of-the-semester survey, but we did not get to it in time. So we'll put it here for some extra points on the exam! Sorry if this page is a bit crowded...

19. [0 points] Did you put your name and userid at the top of this page? You need to do so in order to get the points on this page!

20. [2 points] What is your major or minor? If you have not declared, then answer with your intended major or minor. Please circle one.

    - BS CS
    - BS CpE
    - Other (please explain): _____
    - BA CS
    - CS minor
    - Neither majoring nor minoring in computing

21. [2 points] What CS 1 class did you take? Please circle one.

    - CS 1110
    - CS 1120
    - Other (please explain): _____
    - CS 1111
    - AP credit
    - Placed out of it via the CS 1110 placement exam
    - CS 1112
    - Transfer credit

22. [1 points] If you took your CS 1 class in college (i.e. CS 1110, CS 1111, CS 1112, CS 1120, or a transfer class), in what semester did you take it? Please specify a semester by season and calendar year (i.e., "fall 2012" and not "my second year").

23. [2 points] What CS 2 class did you take? Please circle one.

    - CS 2110
    - Other (please explain): _____
    - CS 2220
    - Transfer credit
    - AP credit

24. [1 points] If you took your CS 2 class in college (i.e. CS 2110, CS 2220, or a transfer class), in what semester did you take it? Please specify a semester by season and calendar year (i.e., "fall 2012" and not "my second year").

25. [2 points] Did you attend the final exam review session? You'll get full credit for this question, as long as you answer it honestly (we know most that were there, but not all).

26. [2 points] For the 3-credit courses in the upcoming spring semester:

    - How many CS courses are you enrolled in (not wait-listed)?

    - How many CS courses are you wait-listed for?

    - How many CS courses would you *like* to be enrolled in?