CS 216 Exam 1

You MUST write your name and e-mail ID on EACH page and bubble in your userid at the bottom of EACH page – including this page.

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 forms. So please do that first. Sorry to have to be strict on this.

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

There are 10 pages to this exam – once the exam starts, please make sure you have all 10 pages.

Pages 2-9 are worth 12 points each (for a total of 96 points), and the first and last pages are worth 2 points each. The three point questions on this exam should not take more than a line or two to answer – your answer should not exceed about 20 words. There are 100 points of questions and 1 hour 45 minutes (105 minutes) to take the exam, which means you should spend one minute per question point – the other 5 minutes are to fill out the bubble footers.

If you do not bubble in a page, you will not receive credit for that page!

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 here:

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There are 10 types of people in the world –
those that understand binary and those that don't.

C/C++

1. [3 points] Why might we want to write a *method* template?

2. [3 points] Why do we use the `#ifndef/#define/#endif` commands in .h files?

3. [3 points] When is the copy constructor called, and when is the `operator=()` method called? Why might we want those methods to be different?

4. [3 points] When might we want to specifically have an `explicit` constructor? When might we want to specifically *not* have an `explicit` constructor?

C/C++, continued

5. [3 points] Why/when might we want to pass something by a constant reference?

6. [3 points] What are the three main differences between pointers and references in C++?

7. [3 points] List two DIFFERENT things that could cause a program to crash with a segmentation fault. Can you think of a third? The third is not required for full credit, though.

8. [3 points] What is an ADT? You need to describe (briefly!) what it is, not just expand the acronym.

Lists

9. [6 points] List the big-theta running times for the following list operations for lists implemented two ways: using arrays and using doubly linked lists. In the function names below, a parameter of *x* is the value to insert, remove, find, find the kth of, etc.

	`printAll()`	`insert(x)`	`remove(x)`	`find(x)`	`findKth(x)`
Arrays					
Doubly linked					

10. [3 points] Stacks and queues can be implemented, using linked lists, such that all their operations are constant time. An array implementation, however, causes some of the operations to be linear time. Why, then, would we want to sometimes implement stacks and queues using arrays?

11. [3 points] What is the purpose of iterators? Meaning, why do we use them instead of just directly transversing through the list?

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Numbers

12. [3 points] Why aren't floating point numbers spatially uniform? And what does spatially uniform mean, anyway?

13. [9 points] Most networking protocols specifically state that all data is to be sent big endian. This causes a problem for Intel x86 computers, as they are little endian. Thus, there is functionality to convert the data as it is sent and received. Write a function called `convert()` that takes in – and returns – an `unsigned int`, and converts it from big-endian to little endian – in other works, you need to shift the bytes around. As a hint, there are a number of ways to do this – you could use unions, but you could also just use regular mathematical operations.

Numbers, continued

14. [12 points] We have seen IEEE 754 single precision floating point numbers (i.e. 32 bits), as well as double precision floating point numbers (i.e. 64 bits). It turns out that neither is appropriate for our purposes here – floats are too imprecise, and doubles are too big. So we are going to define a new floating point type that uses 48 bits – your job is to design this type. You should answer all the following questions:
    a. How many bits in the mantissa? In the exponent? What is the exponent offset?
    b. How many digits of accuracy? Why? If your answer is that it's the average of the number of digits of accuracy for floats and doubles, you won't get credit for the why part.
    c. Encode 10.25 into this new floating point type (you can leave your answer in hex and in big-endian). The grade for your answer for this part will be independent of your answers for the previous parts, as long as your answers for the previous parts were somewhat reasonable.

Arrays/big-Oh

15. [3 points] Other than the identifier name, what is the functional difference between creating two arrays, one by `int x[4];` and the other by `int *y = new int[4];`?

16. [3 points] How are multi-dimensional arrays stored in memory? You should define what your answer means, not just give a 3 word answer.

17. [3 points] Why is big-Oh rather useless for comparing algorithms?

18. [3 points] Give a big-omega value that works for any algorithm ever created.

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UNIX

19. [3 points] List all the gdb commands that you can think of. If you get past 10, you need not list any more. You don't have to list 10 to get full credit here, though.

20. [3 points] What does the `chmod` command do?

21. [3 points] Name a UNIX shell environment variable that we might want to set (one that has some meaning, not just one that you made up yourself).

22. [3 points] What are the commands in Unix to list the contents of a directory, copy a file, and move a file?

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Miscellaneous

23. [3 points] Do you attend lecture? Let's find out! Last week, Professor Bloomfield had a really long rant at the beginning of class – what was it about? Hint: it involved the navy…

24. [3 points] Did you attend the review session? You'll get full credit for this question, as long as you answer it honestly (we know *most* of the people that were there, but not all).

25. [3 points] What is -17 as a two-complement, 8-bit integer? You should leave your answer in hex.

26. [3 points] Convert 3210 in base 4 to base 2 (i.e. binary). You can leave your answer in binary or in hex.

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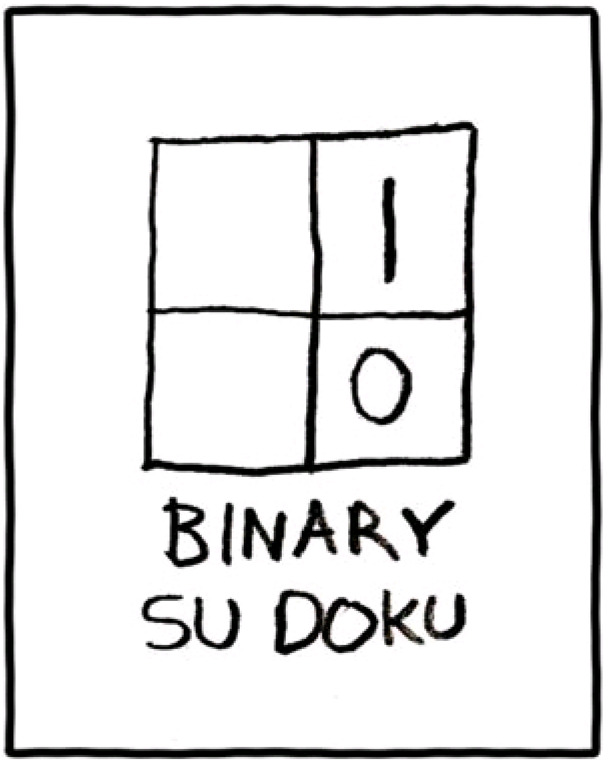
But you get two points for bubbling in the form at the bottom of this page. Woo-hoo!



Can you finish the binary Sudoku? It’s not required, but it’s quite a challenge!

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