

## CS 2150 Exam 1, fall 2018

**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 6 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!**

**Answers for the short-answer questions should not exceed about 20 words; if your answer is too long (say, more than 30 words), you will get a zero for that question!**

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.

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*You step in the stream,  
But the water has moved on.  
This page is not here.*

(the bubble footer is automatically inserted into this space)

**Page 2: C++**

1. [3 points] Write a *snippet* of code that will *always* cause a segmentation fault. A snippet is just enough to show the cause – you don't have to worry about `#include` lines, using `namespace std;`, the `main()` declaration, etc.
2. [3 points] *Briefly* give an example of when you might want the `operator=()` operator override function to be different than the copy constructor.
3. [3 points] *Briefly* describe what the `friend` keyword does in C++.
4. [3 points] A reference in C++ is just a memory address, as is a pointer. Since the language already had pointers, why were references added?

**Page 3: Lists**

5. [3 points] Imagine that you had a large *singly* linked list that *might* have a cycle (a cycle is when the ListNodes form a big circle). You can assume that, if a cycle exists, then the *entire* list is that cycle. *Briefly*, how might you *detect* that a cycle exists in your list?
  
6. [3 points] How might you implement `findKth()`, which finds the  $k^{\text{th}}$  value, in a linked list in constant time?
  
7. [3 points] Give an example scenario in which doubly-linked list has better performance than singly-linked list does. (We are not looking for the extra time needed to assign the second pointer in a doubly-linked list here). Also note that this may be practical performance, not asymptotic performance.
  
8. [3 points] What do we use Abstract Data Types (ADT) for?

**Page 4: Numbers**

9. [4 points] Imagine that you were designing a new floating point type. In addition to the sign bit, you have to assign how many bits represent both the exponent and the mantissa. Why might you put more bits into the exponent? Why might you put more bits into the mantissa?
10. [4 points] Convert -2150 into a 16-bit two's complement integer, and show your result as a *little*-Endian hexadecimal number. Note that  $2150 = 2048 + 64 + 32 + 4 + 2$ , and  $2048 = 2^{11}$ . You *must* show your work to receive credit for this problem!
11. [4 points] Consider a 24-bit floating point type that has 1 sign bit, 6 exponent bits, and 17 mantissa bits. Other than that, it encodes just as a IEEE 754 number does. What is the maximum (finite) value that this type can hold? You can leave your answer in formulaic form. Also, what is its (big-Endian) representation for that value? As a hint, if there are  $e$  bits in the exponent, then the exponent offset is  $\frac{2^e}{2} - 1 = 2^{e-1} - 1$



Page 6: No questions here

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MISS LENHART COULDN'T BE HERE TODAY, SO SHE ASKED ME TO SUBSTITUTE.

MATH

MR. MUNROE

I'VE PUT OUT YOUR TESTS. PLEASE GET STARTED.

MR. MUNROE, MISS LENHART NEVER TAUGHT US THIS.

THAT'S BECAUSE MISS LENHART DOESN'T UNDERSTAND HOW IMPORTANT CERTAIN KINDS OF MATH ARE.

THIS MATERIAL IS MORE VITAL THAN ANYTHING YOU'VE EVER LEARNED

NO BUTS.

BUT THIS JUST LOOKS --

BUT --

THIS IS A MATTER OF LIFE AND DEATH.

Name: \_\_\_\_\_

1. The velociraptor spots you 40 meters away and attacks, accelerating at  $4 \text{ m/s}^2$  up to its top speed of 25 m/s. When it spots you, you begin to flee, quickly reaching your top speed of 6 m/s. How far can you get before you're caught and devoured?
2. You are at the center of a 20m equilateral triangle with a raptor at each corner. The top raptor has a wounded leg and is limited to a top speed of 10 m/s.
3. Raptors can open doors, but they are slowed by them. Using the floor plan on the next page, plot a route through the building, assuming raptors take 5 minutes to open the first door and halve the time for each subsequent door. Remember, raptors run at 10 m/s and they do not know fear.