CS062 Midterm Study Guide
Fall 2016

This study guide contains a list of topics that will be covered on the midterm along with some practice problems. Two sample midterms (from past years) have also been posted on Piazza. These sample midterms provide additional practice problems for you to do. Note that some of the questions are not relevant for our class (e.g. questions about threads). However, these sample midterms give you an idea of what the midterm in this class will be like.

Comparators will play a minor role if they appear in any question. Thus, for example, you should ***not*** expect to be asked to write Comparator class.

List of Topics

Topic: assertions and conditions
Reading: JS Ch. 2

Topic: arrays and ArrayList
Reading: JS Ch. 3

Topic: Complexity and induction
Reading: JS Ch. 5

Topic: Sorting
Reading: JS Ch. 6

Topic: Linked lists
Reading: JS Ch. 9

Topic: Stacks and queues
Reading: JS Ch. 10

Additional Practice Questions

1. Define a post-condition. Define a pre-condition.

2. (Circle all that are true) The `assert` keyword should be used to check:

   a. A pre-condition of a public method
   b. A post-condition of a public method
   c. A pre-condition of a private method

d. A post-condition of a private method

(You should also be able to explain why each of these statements is true or false)

4. Write the definition of Big-O

5. Given a function f(n) you should be able to show that it is O(g(n)) for some (provided or not provided) function g(n). Here are some practice examples:

a) Show that $f(n) = 2n+1$ is $O(n)$
b) Show that $f(n) = n^3-n^2+83$ is $O(n^3)$
c) Show that $f(n) = 10n$ is $O(n^2)$
d) Show that $f(n) = 10n$ is $O(n)$
e) What is the Big-O complexity of f(n) = sqrt(n)? // the square root function

6. Explain how using mathematical induction to prove a proposition P(n) over the natural numbers is similar to a chain reaction of falling dominos.

7. Prove the following using induction. You may (or may not) need to use strong induction:

a. Prove that $1 + 3 + 5+ 7 + \ldots + (2n-1) = n^2$ for all $n \geq 1$
b. Prove that $n^2 +n$ is even for all $n \geq 1$
c. Prove that 5^n-4n-1 is divisible by 16 for all $n \geq 0$
d. Prove that $2^n < n!$ for all $n \geq 4$

8. You should understand how the following sorting algorithms work as well as being able to state the worst-case (and average-case complexity if different from the worst-case) complexity for each: InsertionSort, SelectionSort, MergeSort, QuickSort.

9. You should know under what conditions one sorting algorithm is better than another sorting algorithm. This means that you should know under what conditions a sorting algorithm might achieve its worst- or best-case complexity. For example, list a circumstance in which it might be more desirable to use MergeSort rather than QuickSort.