

CS062 Midterm Study Guide Fall 2017

This study guide contains a list of topics that will be covered on the midterm along with some practice problems. A sample midterm (from past years) has also been posted on the exams web page. The sample midterm provides additional practice problems for you to do. While we will not repeat any of these questions on this year's midterm, this sample midterm should give you an idea of what the midterm in this class will be like.

List of Topics

Topic: assertions and pre- and post-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

Reading: JS Ch. 10

Topics: Java graphics/GUI

Reading: Handouts

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)

5. Given a function $f(n)$ you should be able to find a simpler function $g(n)$ so that it is $O(g(n))$. E.g., $f(n) = n^2 + 2$ is $O(n^2)$. Find a simpler $g(n)$ for each of these functions f such that $f(n)$ is $O(g(n))$:

- a) $f(n) = 2n + 1$
- b) $f(n) = n^3 - n^2 + 83$
- c) $f(n) = 10n + \log n$
- d) $f(n) = 2^n + n^{17}$
- e) $f(n) = 2 + \log n$

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. Set up a proof the following using induction. You may (or may not) need to use strong induction:

- a. Prove that $1 + 3 + 5 + 7 + \dots + (2n-1) = n^2$ 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 $n \geq 4$
- e. Prove that selection sort on an ArrayList with n elements performs at most n^2 comparisons.

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: 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.