

**[May use one side of an 8.5 × 11 inch sheet of paper]** Show all of your work clearly in the space provided or on the additional page at the end of the exam. If the additional page is used, clearly identify to which exam question it is related. Be sure to **read each problem carefully**. Note that the exam is double sided.

**1.** (10 points) Clearly and concisely explain the purpose of big-oh notation.

**2.** (10 points) Give one example of where the use of big-oh notation is appropriate. Give one example of where the use of big-oh notation is inappropriate.

3. In lab 2 you benchmarked the `ArrayList`, `SortedList`, and `LinkedList` classes.

(a) (15 points) What is the asymptotic time complexity for calling `contains` on each container. You should assume that the `SortedList` uses binary search to arrive implement `contains`. Be sure to justify your answers.

(b) (10 points) Suppose that a `SortedList` was created which used binary search to implement `contains`. What is the asymptotic time complexity for the `contains` algorithm. Justify your answer.

4. In lab 3 you implemented a `DoublyLinkedList`.

(a) (20 points) Show your implementation of the `peek` method. Be sure to provide enough details about your class design that it is clear what is going on in your implementation (e.g., indicate the attributes of the class).



**(b)** (20 points) Show your implementation of the `offer` method. Be sure to provide enough details about your class design that it is clear what is going on in your implementation (e.g., indicate the attributes of the class).

5. (15 points) Recall that the definition of big-oh notation is:

An algorithm is  $O(g(n))$  if there exists some constants  $c$  and  $n_0$ , such that:

$$f(n) < c \cdot g(n), \text{ for all } n > n_0$$

where  $f(n)$  is a function that describes the exact execution time of some algorithm with input size  $n$ .

Concisely and precisely explain the role of  $c$  and  $n_0$  in the definition. I.e., What do they do? Why are they needed?



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Additional work area for any problem. Clearly identify which problem is associated with the work on this page.