CS2852 Exam 1

No note-sheets, calculators, or other study aids on this exam. Write your name on all pages and read through the exam before you get started. The exam is printed double-sided.

Have fun!

1. (5 points) Explain a situation where using the Collection interface is preferred over the List interface, **and** vice versa. Recall that one key difference is that List has a get method, whereas Collection does not.

2. (5 pts.) What is the purpose of the Iterable<E> interface?

3. [10 pts. total] For each T(n), write the simplified O(f(n)) expression
   a. (5 pts.) $T(n) = 34 + 10n + 2n^2 + 3n^4 + 4n^5$

   b. (5 pts.) $T(n) = 16n + 50n^2 + 35 + n$

4. (20 pts.) For the ArrayList we wrote in class which has only one instance variable – `T[]` `array;` – write a complete `toArray` method without calling any Java API methods.

The Java API for   `Object[] toArray()`

Returns an array containing all of the elements in this list in proper sequence (from first to last element).

The returned array will be "safe" in that no references to it are maintained by this list. (In other words, this method must allocate a new array even if this list is backed by an array). The caller is thus free to modify the returned array.

This method acts as bridge between array-based and collection-based APIs.

5. (30 pts.) For the ArrayList we wrote in class which has only one instance variable – `T[]` `array;` – write a complete `indexOf` method without calling any other Java API methods inside or out of the ArrayList class.

The Java API for `int indexOf(Object o)`

Returns the index of the first occurrence of the specified element in this list, or -1 if this list does not contain the element. More formally, returns the lowest index i such that (o==null ? get(i)==null : o.equals(get(i))), or -1 if there is no such index.

Parameter: o - element to search for

6. (10 pts.) For the ArrayList that we wrote in class which has only one instance variable – `T[]` `array;` – write the **condition** for a switch statement to be used in the `set(int i, T element)` method that is `true` if an `ArrayIndexOutOfBoundsException` should be thrown.

7. [10 pts. total]

   a. (5 pts.) What is the Big-O order (worst-case asymptotic running-time) of the `add(T element)` algorithm for a singly-linked `LinkedList`, like the one we implemented in class? The add() method should add the new element on at the end of the list. **_Explain_** your answer.
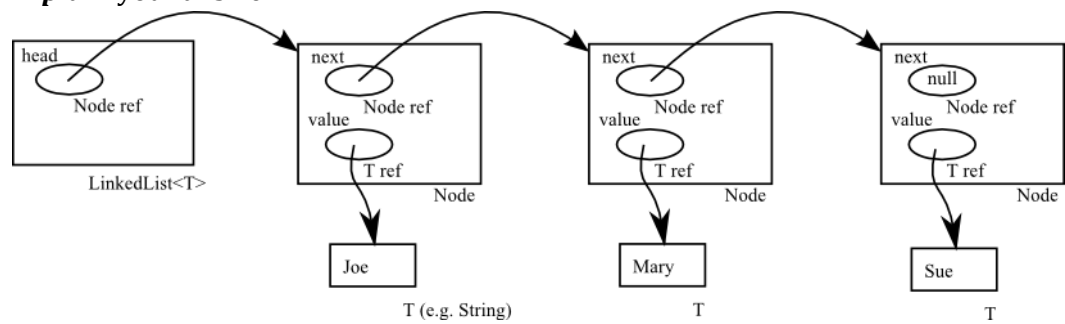
   b. (5 pts.) What is the Big-O order for `add(T element)` for a doubly-linked list? **_Explain_** your answer. (illustrated below)

8. [10 pts. total]

    a. (5 pts.) A method contains an if statement whose condition is true roughly half of the time. The first (true) block has O(1) complexity, while the second (false) block has O(N) complexity. What is the overall complexity? ***Explain*** your answer.

    a. (5 pts.) A method contains an O(N) loop and the body of the loop contains an O(log N) operation. What is the method's complexity? ***Explain*** your answer.