C S 272/463 Introduction to data structures
Fall 2019
Lab 6: Analyze the running time of program

1 Learning objectives

Objective 4

2 Requirements

Please ANALYZE the worst-case running time of the following methods, WRITE down your analysis in DETAIL, and denote their time complexity in Big-O.
Hint: You need to define `n` first, before showing whether the method is $O(n)$, $O(logn)$, $O(n^2)$, etc. Please put your analysis to a word file.

The `IntArrayBag` has two instance variables.

```
public class IntArrayBag
{
   // Invariants of the IntArrayBag class:
   //   1. The actual number of elements in the bag is in the instance variable
   //      manyItems, which is no more than data.length.
   //   2. For an empty bag, we do not care what is stored in data array;
   //      for a non-empty bag, the elements in the bag are stored in data[0]
   //      through data[manyItems-1], and we don not care what is in the
   //      rest of the data array.

   private int[ ] data;
   private int manyItems;

   //methods
}
```

(1) (25 pts) The add method in `IntArrayBag` that we discussed in our class.

```
public void add(int element)
{
      if (manyItems == data.length)
      {
       int biggerArray[ ];

          biggerArray = new int[manyItems*2 + 1];
          for(int i=0;i < manyItems;i++){
               biggerArray [i] = data[i];
          }
          data = biggerArray;
      }

      data[manyItems] = element;
      manyItems++;
}
```

(2) (25 pts) A method to count the number of occurrences of a particular element target. This method is implemented in the `IntArrayBag` class that we discussed in class.

```
public int countOccurrences(int target)
{
      int answer = 0 ;
      int index;

      answer = 0;
      for (index = 0; index < manyItems; index++)
         if (target == data[index])
            answer++;
      return answer;
}
```

(3) (25 pts) A method to find a node at a specified position in a linked list starting from the given head. This method is implemented in the `IntNode` class that we discussed in class.

```
public static IntNode listPosition(IntNode head, int position)
{
  IntNode cursor;
  int i;

  if (position <= 0)
       throw new IllegalArgumentException("position is not positive");

  cursor = head;
  for (i = 1; (i < position) && (cursor != null); i++)
     cursor = cursor.link;

  return cursor;
}
```

(4) (25 pts) A method to compute the number of nodes in a linked list starting from the given head. This method is implemented in the `IntNode` class that we discussed in class.

```
public static int listLength(IntNode head)
{
   IntNode cursor = null;
   int answer = 0;

   for (cursor = head; cursor != null; cursor = cursor.link)
      answer++;

   return answer;
}
```

3 Submission

Submit through canvas a zipped file containing your word file.

4 Grading Criteria

(1) The score allocation is beside the questions.