

# 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  $O(n)$ ,  $O(\log n)$ ,  $O(n^2)$ , 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 do 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.