

# CS2302 - Data Structures

Fall 2017

## Lab 2

Due Monday, September 18, 2017

For this lab you will implement several methods to determine if a reference-based list of integers in a certain range contains duplicate elements. We will implement reference-based lists using the class `iNode`, defined as follows:

```
public class iNode{
    public int item;
    public iNode next;

    public iNode(int i, iNode n){
        item = i;
        next = n;
    }

    public iNode(int i){
        item = i;
        next = null;
    }
}
```

Write a method that receives two integers  $n$  and  $m$  and builds and returns the reference to the first element of a list of `iNodes` of length  $n$  that contains random integers in the 0 to  $m - 1$  range. Then implement the following methods to determine if the list contains duplicates:

1. Compare every element in the list with every other element in the list using nested loops.
2. Sort the list using bubble sort, then determine if there are duplicates by comparing each item with the item that follows it in the list (if there are duplicates in the original list, they must be neighbors in the sorted list).
3. Sort the list using merge sort, then determine if there are duplicates by comparing each item with the item that follows it in the list.
4. Take advantage of the fact that the range of the integers in the list is fixed (0 to  $m - 1$ ). Use a Boolean array  $S$  of length  $m$  to indicate if elements in the array have been seen before. Then determine if there are duplicates by performing a single pass through the unsorted list. Hint: while traversing the list,  $S[i] = true$  if integer  $i$  has been seen before in the search.

Determine the big-O running time of each of the previous methods (1 to 4) with respect to  $n$  and run experiments with several different values of  $n$  and  $m$  (with  $m < n$ ). Illustrate your results by means of plots and/or tables. Discuss whether the theoretical results match the outcomes of the experiments, making sure you evaluate the algorithms' behavior with a wide range of values of  $n$ . Write a report describing your work, as stated in the syllabus.