For this lab you will implement several methods to determine if a list of integers in a certain range contains duplicate elements.

Use the method you implemented for Lab 1 that receives two integers \( n \) and \( m \) and builds and returns 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 insertion 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 quicksort, 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 discussing your work, as described in the syllabus.