CS2105: Data Structures and Algorithms with Java

Lab 4: Linear Search and Binary Search - Performance Comparison [1 Mark]

Objective: Compare Linear Search and Binary Search using key comparisons, then estimate running time.

Part 1 — Linear Search vs Binary Search

Use the following sorted array:

```
int[] data = {3, 7, 11, 15, 19, 23, 27, 31, 35, 39};
```

1. Write a method named linearSearch(int[] data, int key) to implement the Linear Search algorithm. Search the array sequentially and return the index of the key if found, or -1 if not found. ***You may refer to the lecture slides for the Linear Search algorithm.***
2. Write an iterative method named binarySearch(int[] data, int key) to implement the Binary Search algorithm. Return the index of the key if found, or -1 if not found. ***You may refer to the lecture slides for the Binary Search algorithm.***
3. Write both methods inside the same class, *SearchComparisonLab*. Include a main method in the same class to test both search methods.
4. Modify both methods to count the number of key comparisons. Count one comparison each time the search key is compared with an array element.
5. Test both methods using the keys: 3, 27, 39, and 50.
6. Complete the table using your program output.

Key	Linear Search Comparisons	Binary Search Comparisons
3		
27		
39		
50		

Analysis: Which algorithm performs fewer comparisons as the input size grows? Explain using time complexity.

Part 2 — Running Time Estimation

Assume one key comparison takes **10^{-6} seconds**. Estimate the running time using:

Estimated Time = Number of Comparisons × 10^{-6} seconds

Key	Linear Search Estimated Time (s)	Binary Search Estimated Time (s)
3		
27		
39		
50		

Based on your estimated running times, explain how the difference between Linear Search and Binary Search becomes more significant as the input size increases.

Deliverables

1. Java source file: SearchComparisonLab.java, including both search methods and required tests.
2. PDF file with both completed tables, answers to the questions, and a screenshot of the output.
3. Submit both files via Blackboard before the deadline.

Important: Half a mark will be deducted for late submission, incomplete submission, or absence without an excuse.

Good luck