

**Shri Ramdeobaba College of Engineering & Management Nagpur-13**

**Department of Computer Application**

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**Submission for**

**Course Name:** Design Analysis and Algorithm Lab

**Course Code:** MCP546

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**Class Roll No:** 26

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Under the Guidance of

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## Practical 3

**Aim:** Perform binary search on the output files of practical2 and sequential file of practical\_0.

Display the time taken to search a key from these files occurring in the first, middle and last position / not found case.

Compare the time taken for all these cases.

**For file 1 from Practical 0 (Sequential unrepeated numbers):**

```
Code: import java.io.*;
import java.util.ArrayList;
import java.util.List;
import java.util.Scanner;

public class BinarySearchPrac0File1 {
    public static void main(String[] args) throws IOException {
        Scanner scanner = new Scanner(System.in);
        FileReader f = new FileReader("./sequentialUnrepeatedNumbers.txt");

        Scanner fileScanner = new Scanner(f);
        List<Integer> intArray = new ArrayList<Integer>(); // maximum of 100000
                                                         elements in the file
        while (fileScanner.hasNextInt()) {
            intArray.add(fileScanner.nextInt());
        }
        fileScanner.close();

        System.out.print("Enter Element To Find: ");
        int elementToFind = scanner.nextInt();

        long start = System.nanoTime();
        int result=binarySearch(intArray, elementToFind);
        long finish = System.nanoTime();
        if (result == -1){
            System.out.println("Element not present");
        }
        else{
            System.out.println("Element found at index " + result);
        }

        long timeElapsed = finish - start;
        System.out.println("\nTime taken for searching : " + timeElapsed + "
nanoseconds");
```

```

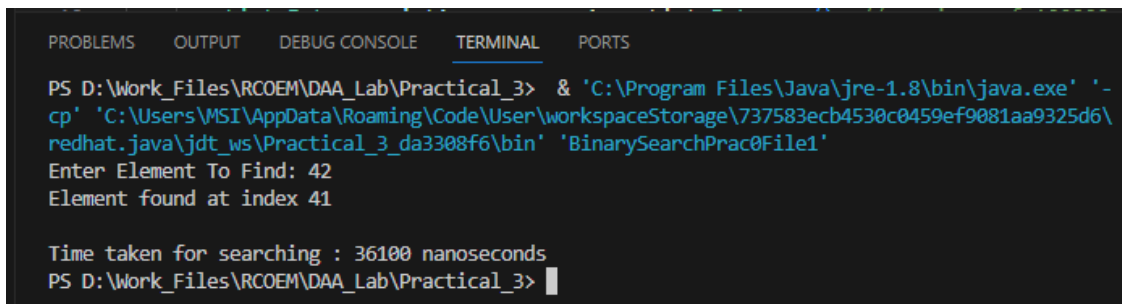
        scanner.close();
    }

    public static int binarySearch(List<Integer> intArray, int x){
        int startInt = 0;
        int endInt = intArray.size() - 1;
        while (startInt <= endInt) {
            int mid = (startInt + endInt) / 2;
            if (intArray.get(mid) == x) {
                return mid;
            } else if (intArray.get(mid) > x) {
                endInt = mid - 1;
            } else {
                startInt = mid + 1;
            }
        }
        return -1;
    }
}

```

## Output:

Element present at beginning:



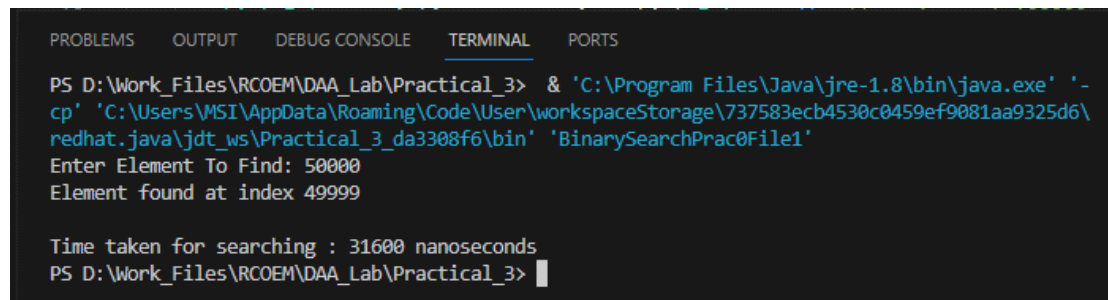
```

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac0File1'
Enter Element To Find: 42
Element found at index 41

Time taken for searching : 36100 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3>

```

Element present at middle:



```

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac0File1'
Enter Element To Find: 50000
Element found at index 49999

Time taken for searching : 31600 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3>

```

Element present at end:

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac0File1'
Enter Element To Find: 99999
Element found at index 99998

Time taken for searching : 26000 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> |
```

Element not present:

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac0File1'
Enter Element To Find: 1000000
Element not present

Time taken for searching : 29200 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> |
```

**For file 2 from Practical 2 (Random Unrepeated Numbers Sorted Output):**

```
Code: import java.io.*;
import java.util.ArrayList;
import java.util.List;
import java.util.Scanner;

public class BinarySearchPrac2File1 {
    public static void main(String[] args) throws IOException {
        Scanner scanner = new Scanner(System.in);
        FileReader f = new
        FileReader("./randomUnrepeatedNumbersSortedOutput.txt");

        Scanner fileScanner = new Scanner(f);
        List<Integer> intArray = new ArrayList<Integer>(); // maximum of 100000
                                                         elements in the file

        while (fileScanner.hasNextInt()) {
            intArray.add(fileScanner.nextInt());
        }
        fileScanner.close();

        System.out.print("Enter Element To Find: ");
        int elementToFind = scanner.nextInt();

        long start = System.nanoTime();
        int result=binarySearch(intArray, elementToFind);
        long finish = System.nanoTime();
        if (result == -1){
            System.out.println("Element not present");
        }
        else{
            System.out.println("Element found at index " + result);
        }

        long timeElapsed = finish - start;
        System.out.println("\nTime taken for searching : " + timeElapsed + "
nanoseconds");

        scanner.close();
    }

    public static int binarySearch(List<Integer> intArray, int x){
        int startInt = 0;
        int endInt = intArray.size() - 1;
        while (startInt <= endInt) {
            int mid = (startInt + endInt) / 2;
            if (intArray.get(mid) == x) {
```

```

        return mid;
    } else if (intArray.get(mid) > x) {
        endInt = mid - 1;
    } else {
        startInt = mid + 1;
    }
}
return -1;
}
}

```

## Output:

Element present at beginning:

```

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac2File1'
Enter Element To Find: 42
Element found at index 41

Time taken for searching : 37900 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3>

```

Element present at middle:

```

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac2File1'
Enter Element To Find: 50000
Element found at index 49999

Time taken for searching : 32500 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3>

```

Element present at end:

```

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac2File1'
Enter Element To Find: 99999
Element found at index 99998

Time taken for searching : 41100 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3>

```

Element not present:

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac2File1'
Enter Element To Find: 1000000
Element not present

Time taken for searching : 40800 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> |
```

**For file 3 from Practical 2 (Random Repeated Numbers Sorted Output):**

```
Code: import java.io.*;
import java.util.ArrayList;
import java.util.List;
import java.util.Scanner;

public class BinarySearchPrac2File2 {
    public static void main(String[] args) throws IOException {
        Scanner scanner = new Scanner(System.in);
        FileReader f = new
FileReader("./randomRepeatedNumbersSortedOutput.txt");

        Scanner fileScanner = new Scanner(f);
        List<Integer> intArray = new ArrayList<Integer>(); // maximum of 100000
                                                                elements in the file
        while (fileScanner.hasNextInt()) {
            intArray.add(fileScanner.nextInt());
        }
        fileScanner.close();

        System.out.print("Enter Element To Find: ");
        int elementToFind = scanner.nextInt();

        long start = System.nanoTime();
        int result=binarySearch(intArray, elementToFind);
        long finish = System.nanoTime();
        if (result == -1){
            System.out.println("Element not present");
        }
        else{
            System.out.println("Element found at index " + result);
        }

        long timeElapsed = finish - start;
        System.out.println("\nTime taken for searching : " + timeElapsed + "
nanoseconds");

        scanner.close();
    }

    public static int binarySearch(List<Integer> intArray, int x){
        int startInt = 0;
        int endInt = intArray.size() - 1;
        while (startInt <= endInt) {
            int mid = (startInt + endInt) / 2;
            if (intArray.get(mid) == x) {
```



```

        return mid;
    } else if (intArray.get(mid) > x) {
        endInt = mid - 1;
    } else {
        startInt = mid + 1;
    }
}
return -1;
}
}

```

## Output:

Element present at beginning:

```

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac2File2'
Enter Element To Find: 42
Element found at index 40

Time taken for searching : 38400 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3>

```

Element present at middle:

```

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac2File2'
Enter Element To Find: 50000
Element found at index 49856

Time taken for searching : 33700 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3>

```

Element present at end:

```

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac2File2'
Enter Element To Find: 99999
Element found at index 99999

Time taken for searching : 38400 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3>

```

Element not present:

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> & 'C:\Program Files\Java\jre-1.8\bin\java.exe' '-
cp' 'C:\Users\MSI\AppData\Roaming\Code\User\workspaceStorage\737583ecb4530c0459ef9081aa9325d6\
redhat.java\jdt_ws\Practical_3_da3308f6\bin' 'BinarySearchPrac2File2'
Enter Element To Find: 1000000
Element not present

Time taken for searching : 40200 nanoseconds
PS D:\Work_Files\RCOEM\DAA_Lab\Practical_3> |
```

**Comparison between times taken:**

<b>File</b>	<b>Element At</b>	<b>Element</b>	<b>Found At Index</b>	<b>Time Taken (in nanoseconds)</b>
<b>File 1</b> From Practical 0 (Sequential unrepeated numbers)	Start	42	41	36100
	Middle	50000	49999	31600
	End	99999	99998	26000
	Not Found	1000000	-	29200
<b>File 2</b> From Practical 2 (Random Unrepeated Numbers Sorted Output)	Start	42	41	37900
	Middle	50000	49999	32500
	End	99999	99998	41100
	Not Found	1000000	-	40800
<b>File 3</b> From Practical 2 (Random Repeated Numbers Sorted Output)	Start	42	40	38400
	Middle	50000	49856	33700
	End	99999	99999	38400
	Not Found	1000000	-	40200