**LAB # 04**

**Searching and sorting in a Linear Array**

**Object**

Implementing Binary Search and sorting mechanisms selection and insertion using ArrayList class.

**Theory**

**BINARY SEARCH**

A binary search comes with the prerequisite that the data must be sorted. Search a [sorted array](http://xw2k.nist.gov/dads/HTML/sortedarray.html) by repeatedly dividing the search interval in half. Low keep tracks of the beginning of half and high keeps track of ending of half.

**Algorithm for Binary Search**

1. [Initialize Variables] Set BEG := 0, END := BINARRAY.length – 1 AND

MID: = (BEG + END)/2

2. [Search for the ITEM]

Repeat while BEG <= END OR BINARRAY [MID]:≠ ITEM

If ITEM < BINARRAY [MID] Then

Set END: = MID – 1 and MID: = (BEG + END)/2

Else If ITEM > BINARRAY [MID] Then

Set BEG: = MID + 1 and MID: = (BEG + END)/2

Else If ITEM: = BINARRAY [MID] Then

Set ITLOC: = MID and Return ITLOC

[End of If Structure]

[End of Loop]

3. [Unsuccessful Search] Set ITLOC: = -1 and Return ITLOC

4. Exit

**SORTING**

Sorting algorithms simply puts elements (integers, numbers, strings, etc) of a list in a certain order (increasing, decreasing, lexicographical, etc). There are many different sorting algorithms, and each has its own advantages and limitations. We are considering Selection sort and Insertion sort.

**Algorithm for Selection Sort**

SELECTION (A, N)

This algorithm sorts the array A with N elements.

1. Repeat Step 2 and 3 for K=1 to N-1

2. Call MIN (A, K, N, LOC)

3. [Interchange A [K] and A [LOC]

Set TEMP: =A [K], A [K]:=A [LOC] and A [LOC]:=TEMP

[End of Step 1 loop]

4. Exit

**Algorithm for Insertion Sort**

InsertionSort (LA, N)

This algorithm sorts the array LA with N elements.

1. Set A [0] = -∞

2. Repeat Step 3-5 for k: =2-N

3. TEMP: =A[k] and PTR: =k-1

4. Repeat while TEMP < A [PTR]

a.Set A [PTR+1]:=A [PTR]

b.Set PTR: =PTR-1

[End of Step 4 loop]

5. Set A [PTR+1]:=TEMP

[End of Step 2 loop]

6. Return

**ARRAY CLASS FOR SEARCHING AND SORTING IN JAVA**

|  |  |  |
| --- | --- | --- |
| **Class Name : Array** |  | **Super Class:**  **Java.util Package** |
| **Responsibilities(Search)** | **Responsibilities(Sort)** | **Collaborations** |
| **static** [**int binarySearch**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_char.htm)  [**(char[] a, char key)**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_char.htm)  This method searches the specified array of chars for the specified value using the binary search algorithm. | [**static void sort(char[] a)**](http://www.tutorialspoint.com/java/util/arrays_sort_char.htm)  This method sorts the specified array of chars into ascending numerical order. |  |
| **Static** [**int binarySearch**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_char_index.htm)  [**(char[] a, int fromIndex, int toIndex, char key)**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_char_index.htm)  This method searches a range of the specified array of chars for the specified value using the binary search algorithm. | [**static void sort(char[] a, int fromIndex, int toIndex)**](http://www.tutorialspoint.com/java/util/arrays_sort_char_index.htm)  This method sorts the specified range of the specified array of chars into ascending numerical order. |  |
| [**static int binarySearch**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_double.htm)  [**(double[] a, double key)**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_double.htm)  This method searches the specified array of doubles for the specified value using the binary search algorithm. | [**static void sort(double[] a)**](http://www.tutorialspoint.com/java/util/arrays_sort_double.htm)  This method sorts the specified array of doubles into ascending numerical order. |  |
| [**static int binarySearch**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_double_index.htm)  [**(double[] a, int fromIndex, int toIndex, double key)**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_double_index.htm)  This method searches a range of the specified array of doubles for the specified value using the binary search algorithm. | [**static void sort(double[] a, int fromIndex, int toIndex)**](http://www.tutorialspoint.com/java/util/arrays_sort_double_index.htm)  This method sorts the specified range of the specified array of doubles into ascending numerical order. |  |
| [**static int binarySearch**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_float.htm)  [**(float[] a, float key)**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_float.htm)  This method searches the specified array of floats for the specified value using the binary search algorithm. | [**static void sort(float[] a)**](http://www.tutorialspoint.com/java/util/arrays_sort_float.htm)  This method sorts the specified array of floats into ascending numerical order. |  |
| [**static int binarySearch**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_float_index.htm)  [**(float[] a, int fromIndex, int toIndex, float key)**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_float_index.htm)  This method searches a range of the specified array of floats for the specified value using the binary search algorithm. | [**static void sort(float[] a, int fromIndex, int toIndex)**](http://www.tutorialspoint.com/java/util/arrays_sort_float_index.htm)  This method sorts the specified range of the specified array of floats into ascending numerical order. |  |
| [**static int binarySearch(int[] a, int fromIndex, int toIndex, int key)**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_int_index.htm)  This method searches a range of the specified array of ints for the specified value using the binary search algorithm | [**static void sort(int[] a)**](http://www.tutorialspoint.com/java/util/arrays_sort_int.htm)  This method sorts the specified array of ints into ascending numerical order. |  |
| [**static int binarySearch(int[] a, int key)**](http://www.tutorialspoint.com/java/util/arrays_binarysearch_int.htm)  This method searches the specified array of ints for the specified value using the binary search algorithm. | [**static void sort(int[] a, int fromIndex, int toIndex)**](http://www.tutorialspoint.com/java/util/arrays_sort_int_index.htm)  This method sorts the specified range of the specified array of ints into ascending numerical order. |  |

**Task**

1. Write a class ArraySearchSort that searches item in any primitive type array using binary search technique and sorts any array using sorting techniques.The methods should be static e.g public static int binarySearch(int item ,int arr[ ]), public static double binarySearch(double item ,double arr[ ]).Make Demo class and use the class to sort a char [ ] of 20 alphabets and then searches an alphabet input by user.
2. Write a program to search and sort in array using Array built-in class.
3. Write a overloaded function of public static int [] binarySearch(int item ,int arr[ ])in **ArraySearchSort** that finds all the all occurrences of item in array arr[].

(Hint: use BinarySerach technique to get location of first occurrence and then find remaining by checking left and right side elements)