DIVIDE AND CONQUER – LAB 02

EC 4070

DATA STRUCTURES AND ALGORITHMS

NAME	**: WIJAYAWARDHANA W.A.H.A.**
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SEMESTER	**: SEMESTER 04**
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01.

Code:-

```
public class RecursiveFunctions {
   // Triangular number
   public static int triangularNumber(int number)  // number variable is to provide the required
triangular number.
   {
      if(number == 1) // Factorial of 1 is 1.
      {
         return 1;
      }
      else   // If input is higher than one the recursive will call for summation of number.
      {
         return (number+triangularNumber(number-1));  // Recursively call triangularNumber
function.
      }
   }

   // Factorial.
   public static int factorial(int number) // Factorial method is here.
   {
      if(number > 1)  // Until 1 the recursive will run.
      {
         return (number * factorial(number -1));  // Recursively call the function.
      }
      else
      {
         return 1; // When it reaches 1 it will return 1.
      }
   }


   // Anagrams
   public static int anagramsMethod(String word , int n)  // Insert the word and calling the
method for anagrams.
   {
      if(word.length()==1)  // If the word only have 1 letter can not do any change.
      {
         return 1;
      }
      for(int i =0; i<word.length(); i++)
      {
         n++;
         return (anagramsMethod(word,n));
      }
```

```
        return 0;
    }

    // Towers of Hanoi
    public static void towersOfHanoi(int top,char from,char inter, char to , int n) // Calling the
method.
    {
        if(top == 1) // Check the changing disc is 1 or other.
        {
            System.out.println("Disk 1 From : "+from+" to " +to);
            n++;
        }
        else
        {
            n++;
            towersOfHanoi(top-1, from, to, inter,n);
            System.out.println("Disk "+top+" from : " + from +" to " + to);
            n++;
            towersOfHanoi(top-1, inter, from, to,n);
        }
    }
    public static void main(String[] args) {
        int n = triangularNumber(5);
        System.out.println(n);
        int m = factorial(5);
        System.out.println(m);
        int s = anagramsMethod("hour",0);
        System.out.println(s);
        towersOfHanoi(3, 'A', 'B', 'C',0);
    }
}
```

Outputs:-

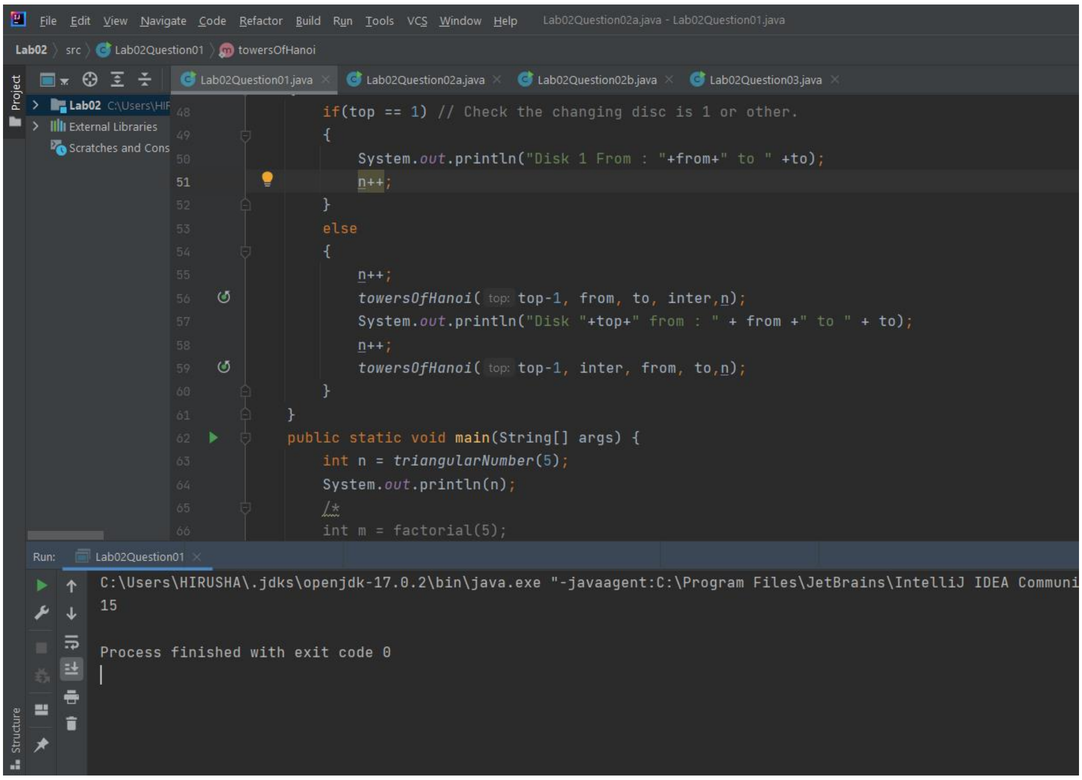


FIGURE 01 – TRIANGULAR NUMBER OUTPUT

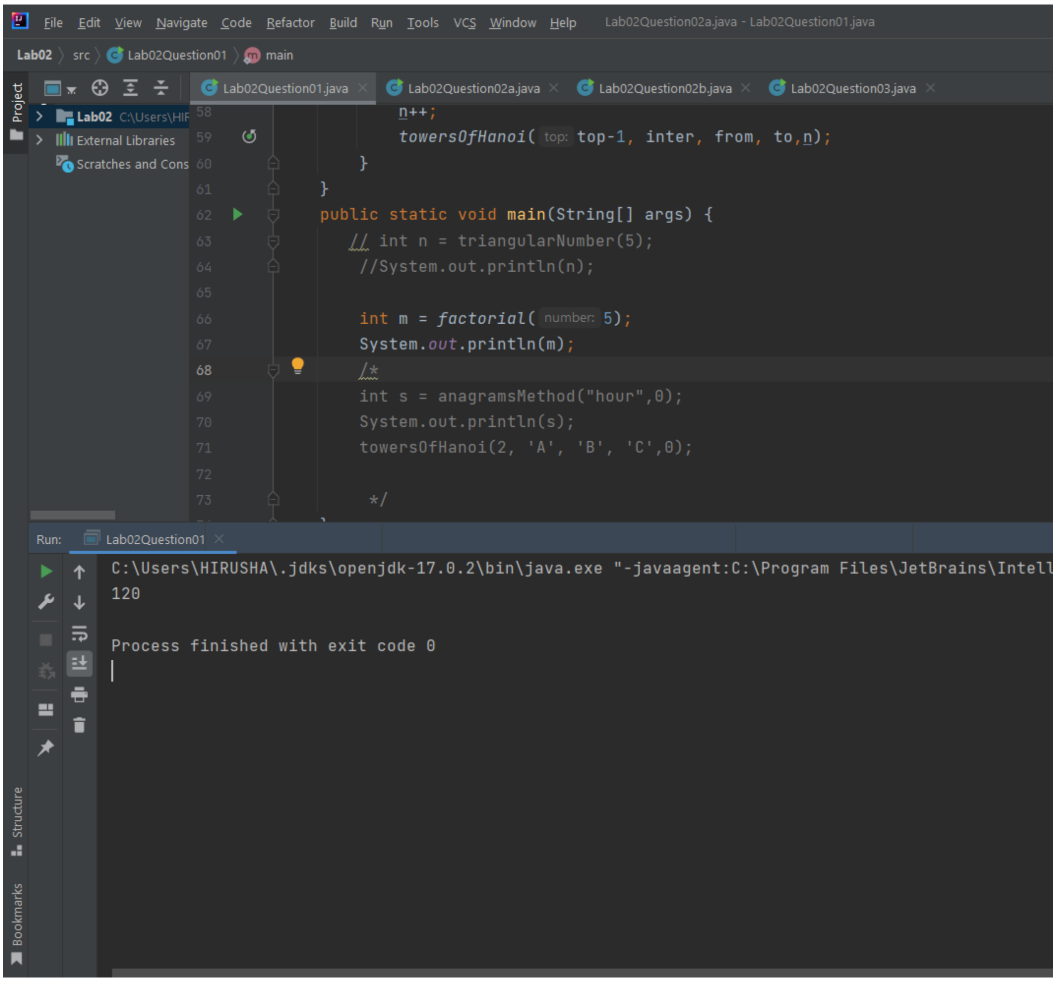


FIGURE 02 – FACTORIAL OUTPUT

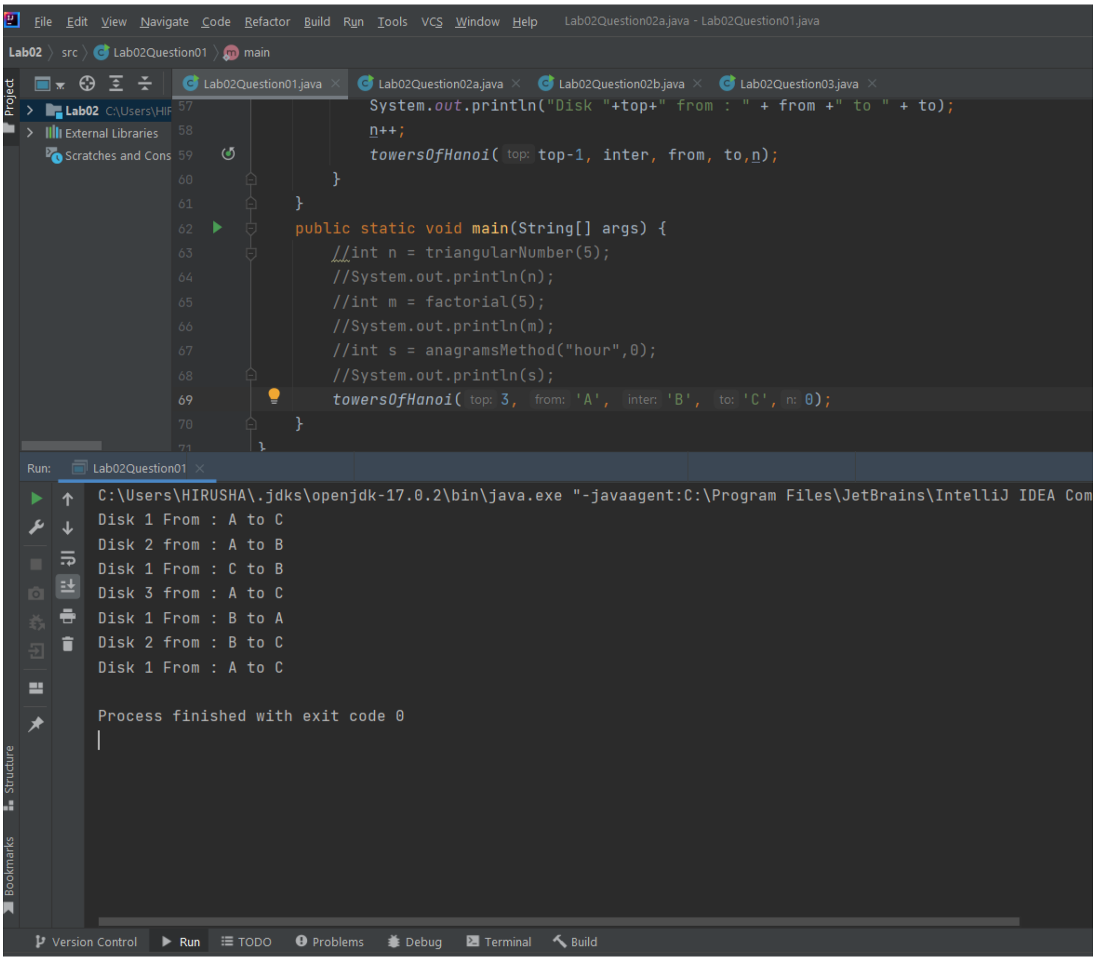


FIGURE 03 – TOWERS OF HANOI OUTPUT

02.
a.
Code:

```
public class BinarySearchUsingLoop {
   public static int binarySearch(long searchKey,int[] numberArray) // Binary search method.
   {
      int lowerBoundOfSearch = 0;    // Lower bound define and assign.
      int upperBoundOfSearch = numberArray.length-1; // Upper bound define and assign.
      int checkingIndex = 0;  // Checking index define and assign as 0.
      while(true)  // While condition runs true.
      {
         checkingIndex = (lowerBoundOfSearch+upperBoundOfSearch)/2; // Setting middle index
for searching element.
         if(numberArray[checkingIndex] == searchKey)   // Check the middle element equal to
search element.
         {
            return  checkingIndex;     // Return the index after equal.
         }
         else if(lowerBoundOfSearch > upperBoundOfSearch)
         {
            return numberArray.length-1;
         }
         else          // If upper conditions are not true.
         {
            if(numberArray[checkingIndex] < searchKey)     // Check search element less than the
arrays checkingIndex element.
            {
               lowerBoundOfSearch = checkingIndex + 1;    // If it true search element at right side so
move to right side.
            }
            else
            {
               upperBoundOfSearch = checkingIndex -1;     // If not search element is less so element
is at left side.
            }
         }
      }
   }
   public static void main(String[] args) {
      int[] numberArray = {3,56,32,33,45,90,190,564,908};  // Define sorted array for searching
element.
      int n = binarySearch(190, numberArray);      // Calling the binarySearch method.
      System.out.println("Index is : " + n);             // Print the index of searched element.
   }
}
```

Output:-

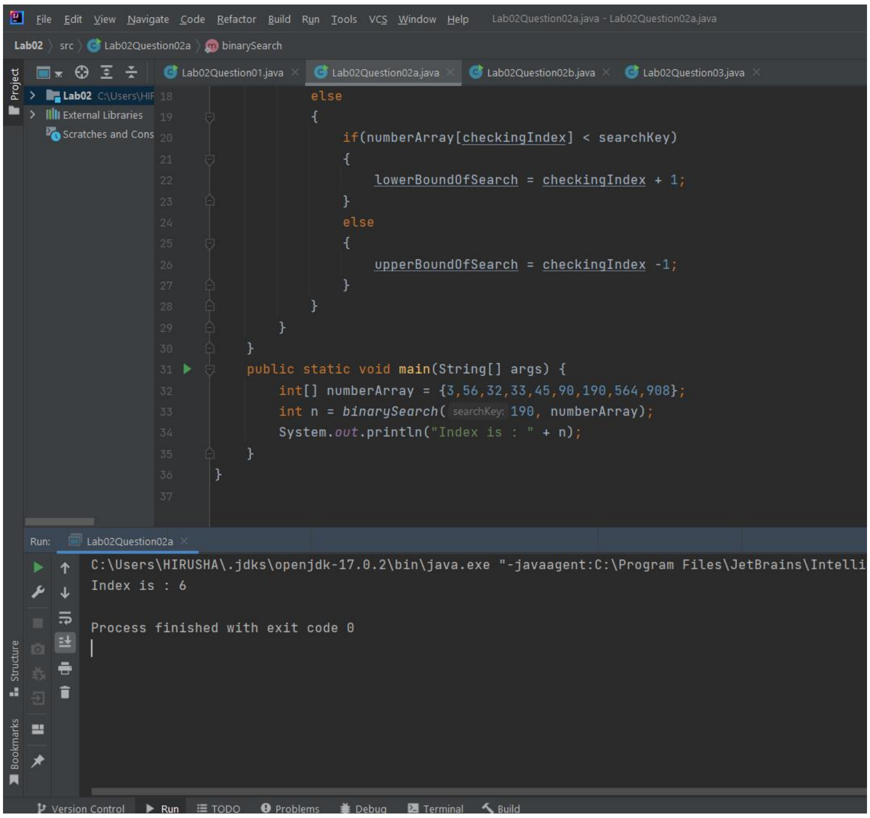


FIGURE 04 – BINARY SEARCH USING LOOP OUTPUT

b.

Code:

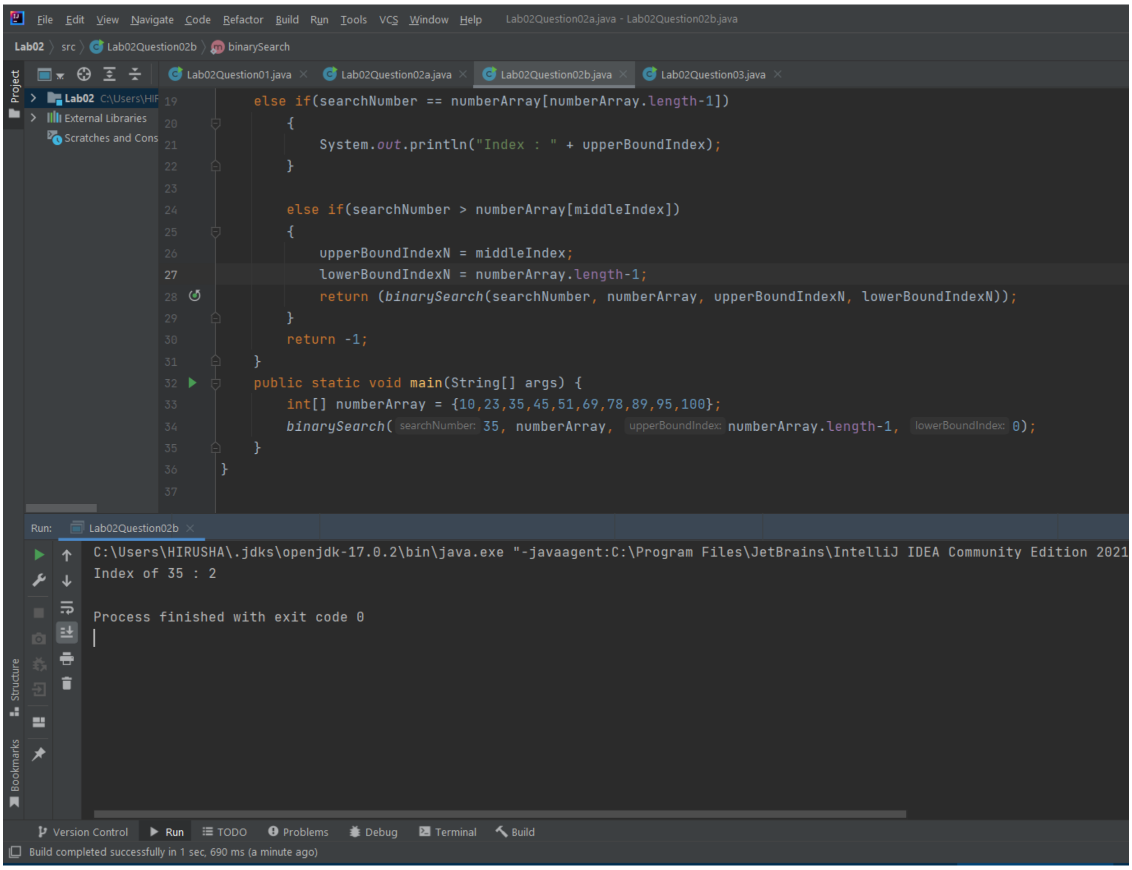
```
public class BinarySearchRecursive {
   // Binary searching method.
   public static int binarySearch(int searchNumber , int[] numberArray , int upperBoundIndex , int
lowerBoundIndex)
   {
      int middleIndex = (upperBoundIndex + lowerBoundIndex)/2;  // Define middleIndex
according to passed values.
      int upperBoundIndexN;       // Define new variable.
      int lowerBoundIndexN;
      if(searchNumber == numberArray[middleIndex])  // Check the search element equal to
middle index's element.
      {
         System.out.println("Index of " + searchNumber + " : " + middleIndex);  // If true that will
print and exit the code.
         return middleIndex;
      }
      else if(searchNumber < numberArray[middleIndex])   // If searchNumber less than
middleIndex's element that element should at left side of array.
      {
         upperBoundIndexN = 0;                // Define variable according to the identification of
element value.
         lowerBoundIndexN = middleIndex;
         return (binarySearch(searchNumber, numberArray, upperBoundIndexN,
lowerBoundIndexN));   // Recall the method.
      }

             else if(searchNumber == numberArray[numberArray.length-1])
      {
         System.out.println("Index : " + upperBoundIndex);
      }

      else if(searchNumber > numberArray[middleIndex])   // If searchNumber higher than
middleIndex's element that element should at right side of array.
      {
         upperBoundIndexN = middleIndex;   // Define variable according to the identification of
element value.
         lowerBoundIndexN = numberArray.length-1;
         return (binarySearch(searchNumber, numberArray, upperBoundIndexN,
lowerBoundIndexN));   // Recall the method.
      }
      return -1;
   }
   public static void main(String[] args) {
```

```
        int[] numberArray = {10,23,35,45,51,69,78,89,95,100};       // Define the sorted array for
searching.
        binarySearch(35, numberArray, numberArray.length-1, 0);  // Calling binarySearch method.
    }
}
```

Output:



<u>FIGURE 05 – BINARY SEARCH RECURSIVE METHOD OUTPUT</u>

03.
Merge sort
Code:

```
public class MergeSort {
   // Define required variables.
   int arraySize;
   int[] array = new int[arraySize];
   int lowerIndex;
   int upperIndex;
   int middleIndex;
   public void setElement(int[] array,int arraySize)   // Setting the array and array size.
   {
      this.arraySize = arraySize;
      this.array = array;
   }
   // Merge sort method for separating the element.
   public void mergeSort(int lowerIndex, int upperIndex)
   {
      this.lowerIndex = lowerIndex;   // Assign values into class variables.
      this.upperIndex = upperIndex;   // Assign values into class variables.
      if(lowerIndex < upperIndex)     // Check the condition is true until one element come to array
this will true.
      {
         int middle = (lowerIndex+upperIndex)/2;   // Define and assign middle index.
         mergeSort(lowerIndex,middle);            // Calling mergeSort method for left side of array.
         mergeSort(middle+1,upperIndex);  // mergeSort will call for right side of array.
         merge(lowerIndex,middle,upperIndex);      // After finishing dividing array to one element
the merge will call for combining the array.
      }
   }
   // Merge method for getting the sorted array.
   public void merge(int lowerIndex, int middleIndex, int upperIndex)
   {
      this.lowerIndex = lowerIndex;    // Assign values into class variables.
      this.middleIndex = middleIndex;  // Assign values into class variables.
      this.upperIndex = upperIndex;    // Assign values into class variables.
      int tempArray[] = new int[upperIndex-lowerIndex+1];  // Define temporary array to store
sorted element temporary.
      int i = lowerIndex;      // Setting values.
      int j = middleIndex+1;   // Setting values.
      for(int k = 0;    (i <=middleIndex)||(j<=upperIndex); k++)      // Setting values for temporary
array from unsorted array.
      {
         if(i > middleIndex)          // According to the value this will put values in sorted array.
         {
            tempArray[k] = array[j++];
```

```
            }
            else if(j > upperIndex)
            {
               tempArray[k] = array[i++];
            }
            else if(array[i] <= array[j])
            {
               tempArray[k] =array[i++];
            }
            else
            {
               tempArray[k] = array[j++];
            }
         }
         for(int index = lowerIndex; index <tempArray.length; index++)
         {
            array[index] = tempArray[index];   // Put the sorted elements into first array.
         }
      }

      public static void main(String[] args) {
         MergeSort newObject = new MergeSort();       // Define an object of the class.
         int[] arrayN = new int[]{12,89,65,34,1,66,78,99};  // Define an array for sorting.
         newObject.setElement(arrayN,arrayN.length);       // Calling setElement method for setting
   an array for sorting.
         newObject.mergeSort(0,arrayN.length-1);  // Call mergeSort method for sorting.
         for(int i =0; i< arrayN.length; i++)       // Print the sorted array.
         {
            System.out.print(arrayN[i]+" ");
         }
      }
   }
```

Output:-

FIGURE 06 – MERGE SORT OUTPUT

Quick sort

Code:-

```
public class QuickSort {
   int arraySize;  // Define arraySize.
   int[] arrayElement = new int[arraySize];  // Define array for element.
   public int partition(int[] arrayElement, int lowerIndex, int higherIndex)
   {
      this.arrayElement = arrayElement;   // Class object assign for method calling array.
      int pivotElement = arrayElement[higherIndex];   // Assign pivot element as last element.
      int i = lowerIndex - 1;
      for(int j = lowerIndex; j <= higherIndex-1; j++)
      {
         if(arrayElement[j] < pivotElement)   // Check pivot element less than element.
         {
            i++;
            swapElement(i,j);     // If condition true swap will do.
         }
      }
      swapElement(i+1,higherIndex);   // Otherwise that is the highest value then it will swap.
      return(i+1);
   }


   public void swapElement(int swapElement01 , int swapElement02)   // Swap elements method.
   {
      int temporaryElement = arrayElement[swapElement01];    // Store in temporary value
before swap.
      arrayElement[swapElement01] = arrayElement[swapElement02];  // Swap elements.
      arrayElement[swapElement02] = temporaryElement;     // Swap elements.
   }


   // Quick sort method.
   public void quickSort(int[] arrayElement , int lowerElement , int higherElement)
   {
      this.arrayElement = arrayElement;  // Assign the array in class.
      if(lowerElement < higherElement)   //  Condition check high or low.
      {
         int partitionElement = partition(arrayElement,lowerElement,higherElement);  // Call
partitionElement method.
         quickSort(arrayElement,lowerElement,partitionElement-1);        // Call quick sort method
for left part.
         quickSort(arrayElement,partitionElement+1,higherElement);        // Call quick sort method
for right part.
      }
```

```
    }
    public void printArray(int array[])
    {
        for(int i =0;i<array.length;i++)
        {
            System.out.print(array[i]+" "); // Print array element.
        }
  }
    public static void main(String[] args) {
        int newArray[]= {23,45,12,78,56,79,90};
        QuickSort newObject = new QuickSort();   // Create object of QuickSort.
        newObject.quickSort(newArray,0,newArray.length-1);  // Calling quickSort method.
        newObject.printArray(newArray);      // Calling printArray method.
    }
}
```

Output:-

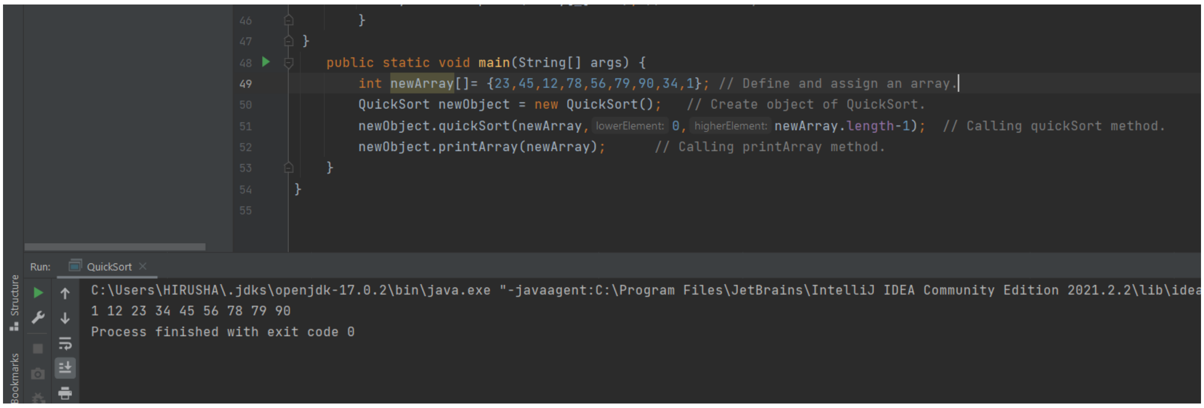


FIGURE 07 – QUICK SORT OUTPUT