Muhammad Fahad
FA19-BSSE-0014
Am

Q1: Show, using the definition of the big-Oh, that the function f(n) = 0.5n + 255 is O(n)

Big-O(n)

n is valid for all value so,

g(n) = 225/0.5 = 510

g(n) = n. For all n > 510

g(n) > f(n) **Therefore, f(n) = O(n).**

Q2: Using the big-Oh notation, the worst-case running time of the following algorithm:

Big-O:

The worst case of the algorithm **n^3** because the three nested loop are working.

n (belong to outer loop**) * n (**belong to inner loop**) + n (**belong to mood condition**)**

$O (n^2+n)$ so $O(n^2)$.

Q3: Describe the worst case running time of the following (a, b and c) codes in "big-Oh" notation in terms of the variable n.

A) The worst case is O(n^4) => (n*n*n*n) => n^4 because of the nested loop.
B) The worst case is O(n) => (B and the function f3 are returning the values so the time complexity of returning the function is **O(n+n)** which is equal to **O(2n)**, so that removing constant so the **O(n)**)

Q4 Suppose you have a queue Q, which contains two elements in the following order: 5 4.

A)

Q.insert(3);
Q.insert(8);
Q.remove();
Q.remove();
Q.remove();

Q.insert(9);

5	**4**		
5	**4**	**3**	
5	**4**	**3**	**8**
4	**3**	**8**	
3	**8**		
8			
8	**9**		

B)

5	**4**	**3**		
5	**4**	**3**	**2**	
5	**4**	**3**	**2**	**1**

now print/pop the element and the output is reverse 1,2,3,4,5

C) Code file is attached

Q5: What will be output of the following programs?

The outer will run **< 3** and the inner loop will run **< I,**

Stack output will be

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A
B
A
C
A
B

Queue Output will be

b	a	c	a	b	a

Q6 Design and analyze an algorithm that for a given positive integer n counts the number of different ways to write n as a sum of 1, 2, 3, and 4. For examples, if n = 4, the output should be 8, as
Code:

```
class Counter {
    public int count(int key){
        int count = 0;
        for(int i = 1; i <= key; i++){
            for(int j = 1; j <= key; j++){
                for(int k = 1; k <= key; k++){
                    for(int m = 1; m <= key; m++)
                        if(i + j + k + m == key)
                            count++;

                    if(i + j + k == key)
                        count++;
                    }
                if(i+j == key)
                    count++;
            }
            if(i == key)
                    count++;
        }
        return count;
    }
    public static void main(String[] args) {
        System.out.print((new counter()).count(4));
    }
}
```

output:

8

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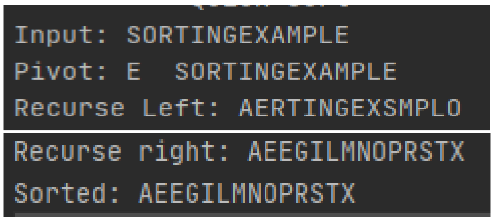
Q7: Write the code to satisfy the requirement, output should be as depicted in figure (attach screenshots of the program output in word file and submit code as separate file)
Output:



```
Input: SORTINGEXAMPLE
Pivot: E  SORTINGEXAMPLE
Recurse Left: AERTINGEXSMPLO
Recurse right: AEEGILMNOPRSTX
Sorted: AEEGILMNOPRSTX
```

Code:

```
public class Quicksort {
    static boolean print = true;
    static int pivot;
    public static void main(String[] args) {
        String temp = "SORTINGEXAMPLE";

        int[] arr = ConvertIntemp(temp);
        int low = 0;
        int high = arr.length-1;

        System.out.println("---------- Quick Sort ----------");
        System.out.println("Input: "+ temp);

        sort(arr,low,high);


        System.out.println("Sorted: "+ConvertInString(arr));
    }

    static int[] ConvertIntemp(String temp){
        int[] arr = new int[temp.length()];

        for (int i = 0; i < temp.length(); i++) {
           arr[i] = Integer.parseInt(String.valueOf((int) temp.charAt(i)));
        }

        return arr;
    }
    static String ConvertInString(int[] temp){
        String arr = "";

        for (int i = 0; i < temp.length; i++) {
            arr += String.valueOf((char) temp[i]);
        }

        return arr;
    }



    static void sort(int arr[], int low, int high){
        if (low < high){
```

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```
            int pi = partition(arr, low, high);
            if(true){
                if(arr.length/2 <= low){
                    System.out.print("Recurse right: ");
                }else {
                    System.out.print("Recurse Left: ");
                }
                    System.out.print(ConvertInString(arr)+"\n");

            }

            sort(arr, low, pi-1);
            sort(arr, pi+1, high);
        }
    }

    static int partition(int arr[], int low, int high){
        pivot = arr[high];
        int i = (low-1); // index of smaller element

        if(print){
            print = false;
            System.out.println("Pivot: "+((char) pivot)+"  "+ConvertInString(arr));
        }

        for (int j=low; j<high; j++)
            if (arr[j] < pivot)
                i += swap(arr,i+1,j);


        return (i+swap(arr,i+1,high));
    }

    public static int swap(int arr[], int i, int j) {
        int temp = arr[i];
        arr[i] = arr[j];
        arr[j] = temp;

        return 1;
    }
}
```

____

Q8. Evaluate and write the result for the following given expression, take values for the operands (show detailed work/dry run)

i) abc*+de*f+g*+

Input	Postfix	Infix
abc*+de*f+g*+	bc*+de*f+g*+	A
abc*+de*f+g*+	c*+de*f+g*+	Ab

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Input	Postfix	Infix
abc*+de*f+g*+	*+de*f+g*+	Abc
abc*+de*f+g*+	+de*f+g*+	a(b*c)
abc*+de*f+g*+	de*f+g*+	(a+(b*c))
abc*+de*f+g*+	e*f+g*+	(a+(b*c))d
abc*+de*f+g*+	*f+g*+	(a+(b*c))de
abc*+de*f+g*+	f+g*+	(a+(b*c))(d*e)
abc*+de*f+g*+	+g*+	(a+(b*c))(d*e)f
abc*+de*f+g*+	g*+	(a+(b*c))((d*e)+f)
abc*+de*f+g*+	*+	(a+(b*c))((d*e)+f)g
abc*+de*f+g*+	+	(a+(b*c))(((d*e)+f)*g)
abc*+de*f+g*+		((a+(b*c))+(((d*e)+f)*g))

((a+(b*c))+(((d*e)+f)*g)) [Now put the value a=1,b=2,c=3,d=4,e=5,f=6,g=7

(1+(2*3))+(((4*5)+6)*7))
(1+6)+(20+6*7)
7+182
189

-+a*/bc^d

Input String	Prefix Expression	Stack (Infix)
-+a*/bc*def	-+a*/bc*de	f
-+a*/bc*def	-+a*/bc*d	fe
-+a*/bc*def	-+a*/bc*	fed
-+a*/bc*def	-+a*/bc	f(d*e)
-+a*/bc*def	-+a*/b	f(d*e)c
-+a*/bc*def	-+a*/	f(d*e)cb
-+a*/bc*def	-+a*	f(d*e)(b/c)
-+a*/bc*def	-+a	f((b/c)*(d*e))

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Input String	Prefix Expression	Stack (Infix)
-+a*/bc*def	-+	f((b/c)8(d^e))a
-+a*/bc*def	-	f(a+((b/c)8(d^e)))
-+a*/bc*def		((a+((b/c)*(d^e)))-f)

((a+((b/c)*(d^e)))-f) **[**Now put the value a=1,b=2,c=3,d=4,e=5,f=6]

((1+((2/3)*(4^5)))-6)
(1+((0.67)*(1024)))-6
(1+682.6)-6
683.6-6
Output: 677.6

C) (((A + B) * C) - ((D + E) / F))
Postfix: ab + c * de + f /-
Prefix: -*+abc/+def

Q9: Here is an array of ten integers:
5 3 8 9 1 7 0 2 6 4
a) Write the output of this array after the FIRST iteration of the selection sort.

```
import java.util.Arrays;
public class Main {
    public static void main(String[] args) {
        int array[] = {};

        Sorting ob = new Sorting();
        ob.SelectionSorting(array);
    }
}
class Sorting{

    void SelectionSorting(int arr[]){
        int length = arr.length,
            swap,
            countloop = 0;
        System.out.println("---------------------------------------- Selection Sorting ---------------------------------------- ");
        System.out.println(Arrays.toString(arr));

        for (int i = 0; i < (length-1); i++) {
            int minIndex = i;
```

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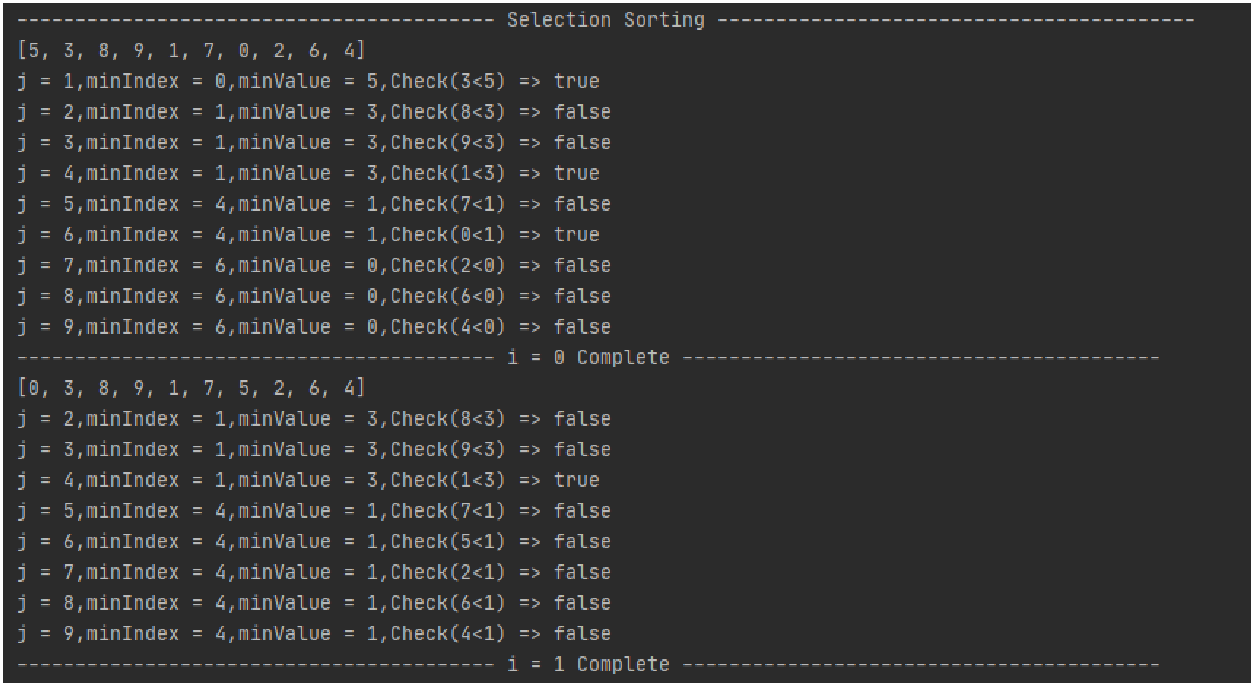
```
      for (int j = i+1; j < length; j++) {
        System.out.println("j = "+j+",minIndex = "+minIndex+",minValue = "+arr[minIndex]+",Check("+arr[j]+"<"+arr[minIndex]+") => "+(arr[j] < arr[minIndex]));
        if (arr[j] < arr[minIndex]) {
          minIndex = j;
        }
        countloop++;
      }
      swap = arr[minIndex];
      arr[minIndex] = arr[i];
      arr[i] = swap;
      System.out.println("----------------------------------------- i = "+i+" Complete ----------------------------------------- ");
      System.out.println(Arrays.toString(arr));

    }

    System.out.println("Number of time value inner loop works: "+countloop);
  }
```

Output:



```
----------------------------------------- Selection Sorting -----------------------------------------
[5, 3, 8, 9, 1, 7, 0, 2, 6, 4]
j = 1,minIndex = 0,minValue = 5,Check(3<5) => true
j = 2,minIndex = 1,minValue = 3,Check(8<3) => false
j = 3,minIndex = 1,minValue = 3,Check(9<3) => false
j = 4,minIndex = 1,minValue = 3,Check(1<3) => true
j = 5,minIndex = 4,minValue = 1,Check(7<1) => false
j = 6,minIndex = 4,minValue = 1,Check(0<1) => true
j = 7,minIndex = 6,minValue = 0,Check(2<0) => false
j = 8,minIndex = 6,minValue = 0,Check(6<0) => false
j = 9,minIndex = 6,minValue = 0,Check(4<0) => false
----------------------------------------- i = 0 Complete -----------------------------------------
[0, 3, 8, 9, 1, 7, 5, 2, 6, 4]
j = 2,minIndex = 1,minValue = 3,Check(8<3) => false
j = 3,minIndex = 1,minValue = 3,Check(9<3) => false
j = 4,minIndex = 1,minValue = 3,Check(1<3) => true
j = 5,minIndex = 4,minValue = 1,Check(7<1) => false
j = 6,minIndex = 4,minValue = 1,Check(5<1) => false
j = 7,minIndex = 4,minValue = 1,Check(2<1) => false
j = 8,minIndex = 4,minValue = 1,Check(6<1) => false
j = 9,minIndex = 4,minValue = 1,Check(4<1) => false
----------------------------------------- i = 1 Complete -----------------------------------------
```

b) Then, write the output of this array after FIRST iteration of the loop in an insertion sort.

```
class Sorting{

  void InsertionSorting(int arr[]) {
    int length = arr.length,
        countloop = 0;
    System.out.println("----------------------------------------- Insertion Sorting ----------------------------------------- ");
```

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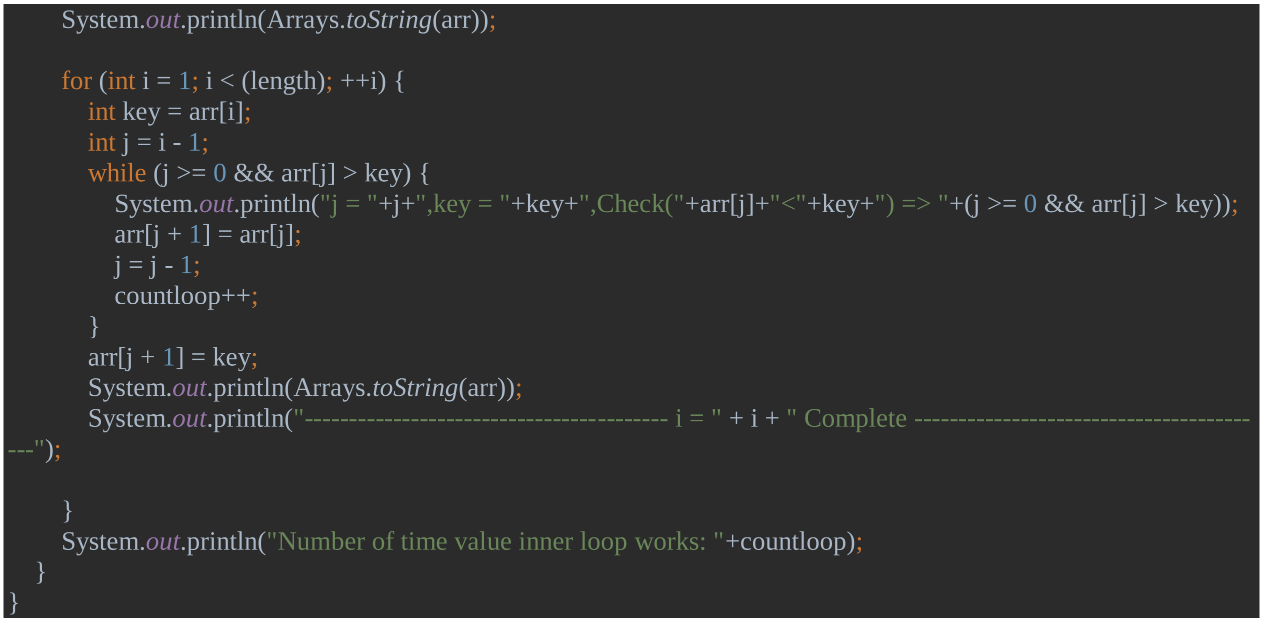
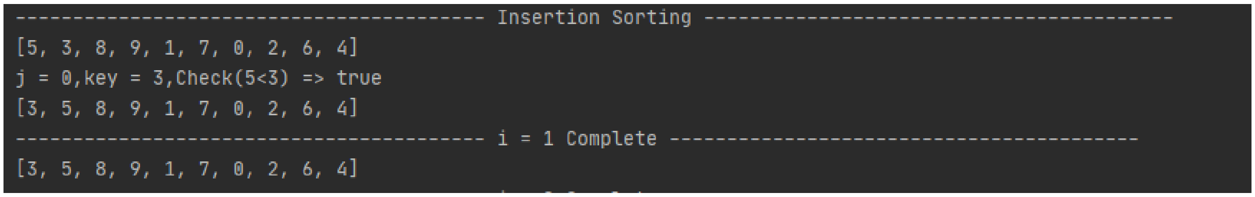


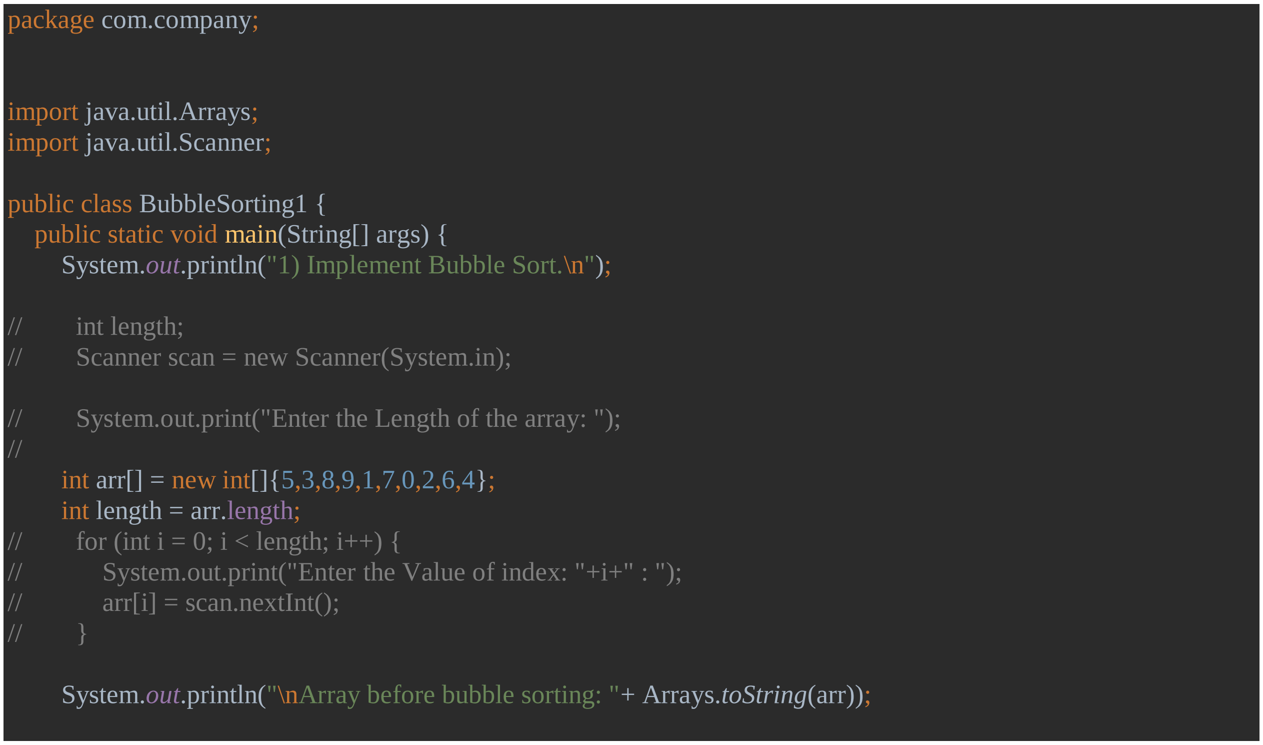
```
        System.out.println(Arrays.toString(arr));

        for (int i = 1; i < (length); ++i) {
            int key = arr[i];
            int j = i - 1;
            while (j >= 0 && arr[j] > key) {
                System.out.println("j = "+j+",key = "+key+",Check("+arr[j]+"<"+key+") => "+(j >= 0 && arr[j] > key));
                arr[j + 1] = arr[j];
                j = j - 1;
                countloop++;
            }
            arr[j + 1] = key;
            System.out.println(Arrays.toString(arr));
            System.out.println("----------------------------------------- i = " + i + " Complete ----------------------------------------
---");

        }
        System.out.println("Number of time value inner loop works: "+countloop);
    }
}
```

output:



```
 ---------------------------------------- Insertion Sorting ----------------------------------------
 [5, 3, 8, 9, 1, 7, 0, 2, 6, 4]
 j = 0,key = 3,Check(5<3) => true
 [3, 5, 8, 9, 1, 7, 0, 2, 6, 4]
 ---------------------------------------- i = 1 Complete ----------------------------------------
 [3, 5, 8, 9, 1, 7, 0, 2, 6, 4]
```

c) Finally, sort the array using bubble sort.



```
package com.company;


import java.util.Arrays;
import java.util.Scanner;

public class BubbleSorting1 {
    public static void main(String[] args) {
        System.out.println("1) Implement Bubble Sort.\n");

//        int length;
//        Scanner scan = new Scanner(System.in);

//        System.out.print("Enter the Length of the array: ");
//
        int arr[] = new int[]{5,3,8,9,1,7,0,2,6,4};
        int length = arr.length;
//        for (int i = 0; i < length; i++) {
//            System.out.print("Enter the Value of index: "+i+" : ");
//            arr[i] = scan.nextInt();
//        }

        System.out.println("\nArray before bubble sorting: "+ Arrays.toString(arr));

```

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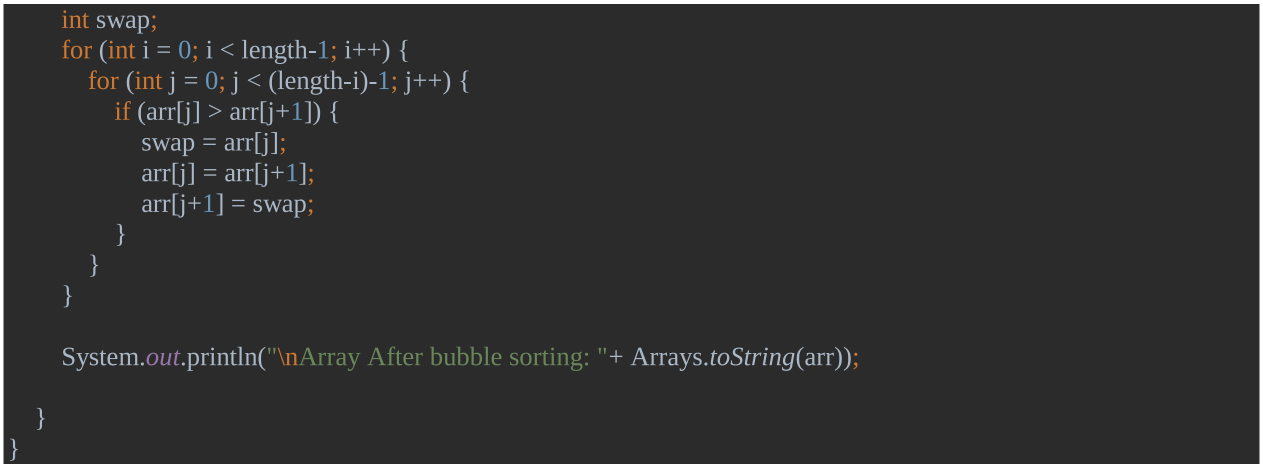
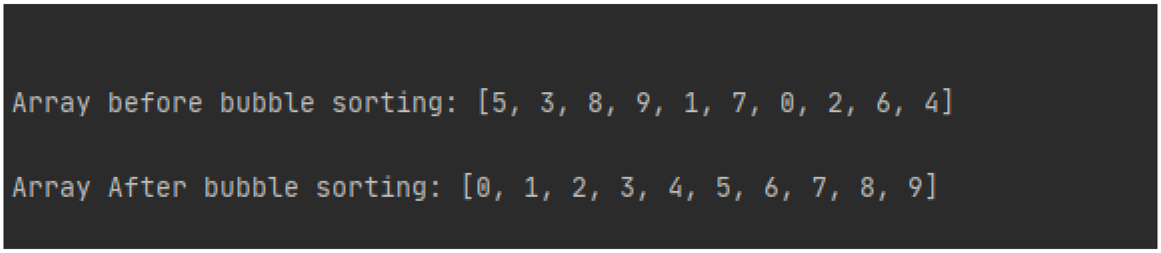


```
        int swap;
        for (int i = 0; i < length-1; i++) {
            for (int j = 0; j < (length-i)-1; j++) {
                if (arr[j] > arr[j+1]) {
                    swap = arr[j];
                    arr[j] = arr[j+1];
                    arr[j+1] = swap;
                }
            }
        }

        System.out.println("\nArray After bubble sorting: "+ Arrays.toString(arr));

    }
}
```

Output:



```
Array before bubble sorting: [5, 3, 8, 9, 1, 7, 0, 2, 6, 4]

Array After bubble sorting: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

Q10: Do as directed (Choose sorting algorithm wisely)

A)

0 1 2 3 4 5 6 7 8 42 24 6 17 30 13 90 47 2 {I =1}
0 1 2 3 4 5 6 7 8 42 24 6 17 30 13 90 47 2 {I =2}
0 1 2 3 4 5 6 7 8 42 24 6 17 30 13 90 47 2 {I =3}
0 1 2 3 4 5 6 7 8 42 24 6 17 30 13 90 47 2 {I =4}
0 1 2 3 4 5 6 7 8 42 24 6 17 30 13 90 47 2 {I =5}
0 1 2 3 4 5 6 7 8 42 24 6 17 30 13 90 47 2 {I =6}
0 1 2 3 4 5 6 7 8 42 24 6 17 30 13 90 47 2 {I =7}
It can be sort by insertion sort.

B) Selection sorting Methods
C) In this case, we use queue
D) Insertion Sort