Name : Siddhant Kotak

Student ID : 202201410

Course : IT 314 Software Engineering

Professor : Saurabh Tiwari

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Lab : Program Inspection, Debugging and Static Analysis

Array Sorting (Ascending order)

Given code :

```
// sorting the array in ascending order
import java.util.Scanner;
public class Ascending _Order
{
   public static void main(String[] args)
   {
      int n, temp;
      Scanner s = new Scanner(System.in);
      System.out.print("Enter no. of elements you want in array:");
      n = s.nextInt();
      int a[] = new int[n];
      System.out.println("Enter all the elements:");
      for (int i = 0; i < n; i++)
      {
         a[i] = s.nextInt();
      }
      for (int i = 0; i >= n; i++);
      {
         for (int j = i + 1; j < n; j++)
         {
            if (a[i] <= a[j])
            {
               temp = a[i];
               a[i] = a[j];
               a[j] = temp;
            }
         }
```

```
        }
        System.out.print("Ascending Order:");
        for (int i = 0; i < n - 1; i++)
        {
           System.out.print(a[i] + ",");
        }
        System.out.print(a[n - 1]);
    }
}
```

Input: Enter no. of elements you want in array: 5

Enter all elements:

1 12 2 9 7

1 2 7 9 12

Program Inspection of Array Sorting (Ascending Order):

1. **How many errors are there in the program? Mention the errors you have identified.**
   Errors identified: 4
   - **Error 1: Incorrect class name (Ascending _Order)**
     - **Category**: Syntax Error
     - The class name Ascending _Order contains a space between Ascending and _Order. This space is not allowed in Java class names. The class name should be AscendingOrder.
   - **Error 2: Incorrect loop condition in outer loop (should be i < n, not i >= n)**
     - **Category**: Logic Error
     - The condition in the outer loop for (int i = 0; i >= n; i++) is incorrect. The condition should be i < n, as the loop should iterate until i is less than n to avoid skipping elements.
   - **Error 3: Semicolon after the first for loop**
     - **Category**: Logic Error
     - The semicolon after the outer for loop for (int i = 0; i >= n; i++); causes the loop body to be skipped. The semicolon should be removed.
   - **Error 4: Incorrect sorting condition (<= should be >)**

- **Category**: Logic Error
- The condition if (a[i] <= a[j]) should be if (a[i] > a[j]) to sort the array in ascending order. The current condition swaps elements when a[i] is less than or equal to a[j], which will not sort the array correctly.

2. **Which category of program inspection would you find more effective?**

Most effective category: Logic Errors

- **Reason**: The primary issues in this code are logical, including the loop conditions and the comparison used for sorting. Detecting these errors early through inspection will ensure the sorting logic works as intended.

3. **Which type of error you are not able to identify using the program inspection?**

Missed error type: Performance or optimization issues for large arrays

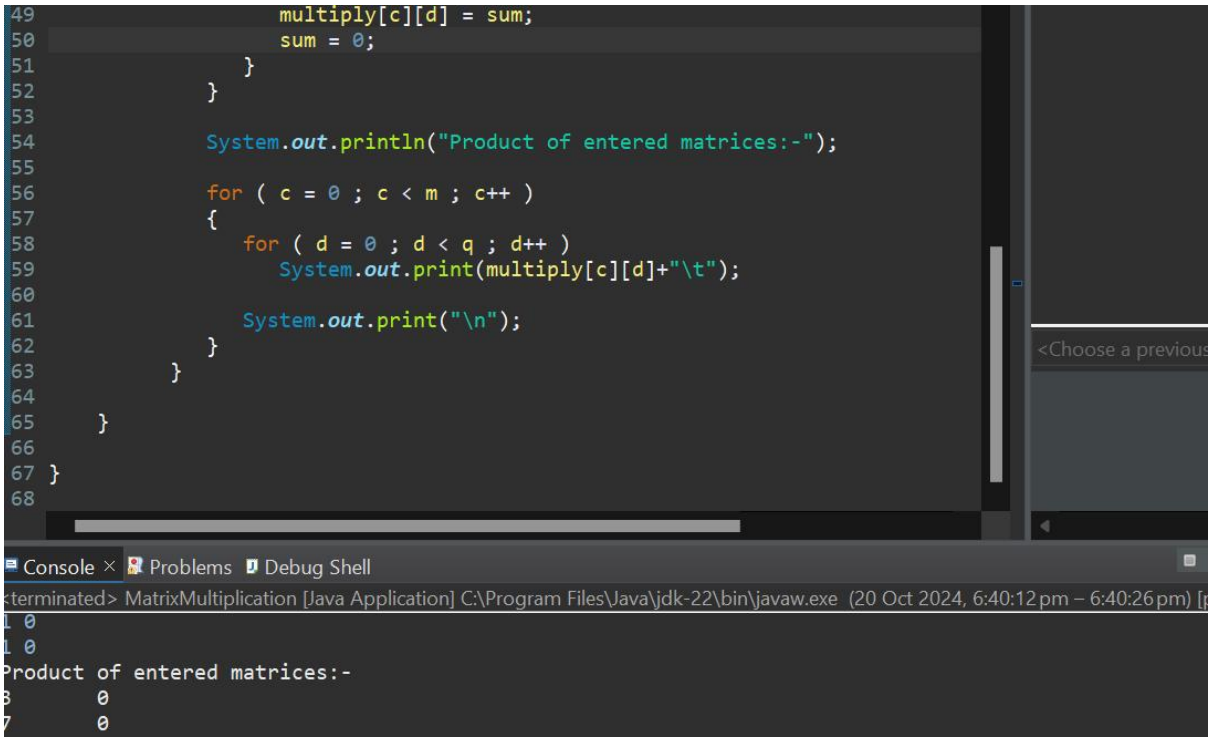
- **Reason**: Program inspection may not reveal performance-related issues or suggest optimizations for sorting algorithms (e.g., using a more efficient algorithm like quicksort or mergesort). These are typically identified through testing or profiling with large datasets.

4. **Is the program inspection technique worth applying?**

Applicability: Yes, the program inspection technique is worth applying.

- **Reason**: The inspection revealed critical syntax and logic errors that prevent the code from running correctly and sorting the array as intended. Identifying and fixing these errors early improves the reliability of the program.

Code Debugging



```java
package DebugSortingArray;
import java.util.Scanner;

public class SortingArray {

    public static void main(String[] args) {
        // TODO Auto-generated method stub
        int n, temp;
        Scanner s = new Scanner(System.in);
        System.out.print("Enter no. of elements you want in array:");
        n = s.nextInt();
        int a[] = new int[n];
        System.out.println("Enter all the elements:");
        for (int i = 0; i < n; i++)
        {
            a[i] = s.nextInt();
        }
        for (int i = 0; i < n; i++)
        {
            for (int j = i + 1; j < n; j++)
            {
                if (a[i] > a[j])
                {
                    temp = a[i];
                    a[i] = a[j];
                    a[j] = temp;
```

```java
                    a[i] = a[j];
                    a[j] = temp;
                }
            }
        }
        System.out.print("Ascending Order:");
        for (int i = 0; i < n - 1; i++)
        {
            System.out.print(a[i] + ",");
        }
        System.out.print(a[n - 1]);
    }

}
```

```
Console × Problems Debug Shell
<terminated> SortingArray [Java Application] C:\Program Files\Java\jdk-22\bin\javaw.exe (20 Oct 2024, 6:54:28 pm – 6:54:40 pm) [pid: 9080]
Enter no. of elements you want in array:5
Enter all the elements:
20 16 19 17 18
Ascending Order:16,17,18,19,20
```

Issues Identified

1. **Class Name Formatting:**
    - **Original Line:** public class Ascending _Order
    - **Correction:** Remove the space to make it public class AscendingOrder.
2. **Incorrect Loop Condition:**
    - **Original Line:** for (int i = 0; i >= n; i++);
    - **Correction:** Change the condition to i < n and remove the unnecessary semicolon to ensure proper iteration.

3. **Incorrect Sorting Condition:**
    - **Original Line:** if (a[i] <= a[j])
    - **Correction:** Change it to if (a[i] > a[j]) to ensure swapping happens only when the current element is greater than the next element.

Fixed Code

```
import java.util.Scanner;
public class AscendingOrder {
   public static void main(String[] args) {
      int n, temp;
      Scanner s = new Scanner(System.in);
      System.out.print("Enter no. of elements you want in array: ");
      n = s.nextInt();
      int a[] = new int[n];
      System.out.println("Enter all the elements: ");

      // Corrected input loop
      for (int i = 0; i < n; i++) {
         a[i] = s.nextInt();
      }

      // Corrected sorting loop
      for (int i = 0; i < n; i++) {
         for (int j = i + 1; j < n; j++) {
            if (a[i] > a[j]) {
               temp = a[i];
               a[i] = a[j];
               a[j] = temp;
            }
         }
      }
```

```
        // Print sorted array
        System.out.print("Ascending Order: ");
        for (int i = 0; i < n - 1; i++) {
            System.out.print(a[i] + ", ");
        }
        System.out.print(a[n - 1]); // Print the last element without a comma
        s.close(); // Close the scanner to avoid resource leaks
    }
}
```

Input and Output

Input:

Enter no. of elements you want in array: 5

Enter all the elements:

1

12

297

1

27912

Output:

Ascending Order: 1, 1, 12, 297, 27912