Name (print): ________________________________

• INSTRUCTIONS
  - Keep your eyes on your own paper and do your best to prevent anyone else from seeing your work.
  - Do NOT communicate with anyone other than the professor/proctor for ANY reason in ANY language in ANY manner.
  - This exam is closed notes, closed books, and no calculator.
  - Turn all mobile devices off and put them away now. You cannot have them on your desk.
  - Write neatly and clearly indicate your answers. What I cannot read, I will assume to be incorrect.
  - Stop writing when told to do so at the end of the exam. I will take 5 points off your exam if I have to tell you multiple times.
  - Academic misconduct will not be tolerated. Suspected academic misconduct will be immediately referred to the Emory Honor Council. Penalties for misconduct will be a zero on this exam, an F grade in the course, and/or other disciplinary action that may be applied by the Emory Honor Council.

• TIME: This exam has 6 questions on 9 pages including the title page. Please check to make sure all pages are included. You will have 50 minutes to complete this exam.

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I commit to uphold the ideals of honor and integrity by refusing to betray the trust bestowed upon me as a member of the Emory community. I have also read and understand the requirements and policies outlined above.

Signature: ________________________________

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1. (12 points) For each entry below, state whether the code is correct as written or has an error. If there is no error, write the output. If there is, show where the error is (you can circle the incorrect code) and explain why it is an error.

- Snippet 1

```java
1 int [] a = {2, 4, 6, 7};
2 for (int i = 0; i < a.length - 1; i++) {
3     System.out.println("Element + 2 = " + (a[i] + 2));
4 }
```

**Output or error:**

**Solution:**

Element + 2 = 4
Element + 2 = 6
Element + 2 = 8

- Snippet 2

```java
1 String str = "CS170";
2 char [] c = str.toCharArray();
3 for (int i = 0; i < c.length; i++) {
4     System.out.println(c[i]);
5 }
```

**Output or error:**

**Solution:**

C
S
1
7
0

- Snippet 3

```java
1 int [] array = new int[10];
2 array[9] = 20;
3 System.out.println((array[0] + array[5] + array[9]));
```

**Output or error:**

**Solution:**

20
• Snippet 4

```java
public static void main(String[] args) {
    String x = "World!";
    {
        int x = 20;
    }
    System.out.println(x);
}
```

Output or error:

**Solution:**
In line 4, variable `x` is already define (in line 2).

• Snippet 5

```java
int[] a = new int[];
int[] a = 10;
System.out.println((a[0] + 20));
```

Output or error:

**Solution:**
Length of an array `a` has not been defined.

• Snippet 6

```java
public static void cmp(int[] arr1, int[] arr2) {
    if (arr1.length == arr2.length) return 1;
    else return -1;
}
```

```java
public static void main(String[] args) {
    int[] ar = {1, 2, 3, 4};
    int[] ar2 = {1, 2, 3};
    int res = cmp(ar, ar2);
    System.out.println(res);
}
```

Output or error:

**Solution:** Method `cmp()` has the return type `void`, it cannot return any value.

2. (10 points) Consider the array:

{2, 4, 6, 10, 20, 25, 30, 40, 45, 4, 50, 70}
• (2 points) Is it possible to perform a linear search on this array? If not, explain why. If it is possible, search for the value 20 using a linear search and list the elements in order that we will inspect

**Solution:** It is possible. Inspected elements: 2, 4, 6, 10, 20 (return, found)

• (2 points) Is it possible to perform a binary search on this array? If not, explain why. If it is possible, search for the value 10 using a binary search and list the elements in order that we will inspect

**Solution:** It is not possible. The requirement for Binary Search is sorted array (in ascending order)

• (6 points) Consider the array:

\{5, 9, 1, 2, 20, 10, 3\}

Apply the selection sort on this array and show all sorting steps. First step has been done for you

Step 1: \{5, 9, 1, 2, 20, 10, 3\}
Step 2: \{1, 9, 5, 2, 20, 10, 3\}
Step 3: \{1, 2, 5, 9, 20, 10, 3\}
Step 4: \{1, 2, 3, 9, 20, 10, 5\}
Step 5: \{1, 2, 3, 5, 20, 10, 9\}
Step 6: \{1, 2, 3, 5, 9, 10, 20\}
Step 7: \{1, 2, 3, 5, 9, 10, 20\}

3. (20 points) Draw the array arr after the code below executes. Assume that each code snippet is executed separately.

- **Snippet 1**

```
1 int [] arr = {1, 4, 7, 10, 13};
2 for (int i = 0; i < arr.length - 1; i++) {
3     arr[i] = arr[i+1] * 2;
4 }
```

**Solution:** 8, 14, 20, 26, 13

- **Snippet 2**

```
1 int [] a = {4, 0, 20, 100, -40};
2 int [] b = {-20, 0, 10, 2, 1};
3 int [] arr = new int[a.length];
4 for (int i = 0; i < arr.length; i++){
5     if (a[i] == b[i])
6         arr[i] = a[i];
7 }
```

**Solution:** 8, 14, 20, 26, 13
7    arr[i] = 0;
8    else if (a[i] > b[i])
9        arr[i] = 1;
10    else if (a[i] < b[i])
11        arr[i] = -1;
12 }

Solution: 1, 0, 1, 1, -1

• Snippet 3

1  int [][] A = {{1, 2, 3, 4},
2       {5, 6, 7, 8},
3       {9, 0, 1, 2}};
4
5  int [] arr = new int [A.length];
6  for (int i = 0; i < A.length; i++) {
7      int sum = 0;
8      for (int j = 0; j < A[i].length; j++) {
9          sum += A[i][j];
10      }
11      arr[i] = sum;
12  }

Solution: 10, 26, 12

• Snippet 4

1  int [] A = {1, 3, 5, 10, 20};
2  int [] B = {0, 20, 5, 7, 30};
3  int [] arr = new int [A.length + B.length];
4
5  int j = 0;
6  for (int i = 0; i < A.length; i++) {
7      if (A[i] > B[i]) {
8          arr[j++] = B[i];
9          arr[j++] = A[i];
10      }
11      else {
12          arr[j++] = A[i];
13          arr[j++] = B[i];
14      }
15  }

Solution: 0, 1, 3, 20, 5, 5, 7, 10, 20, 30
4. (16 points) Consider the following program:

```java
public class Exam1{
    public static int x = 10;
    public static void resInt(int x, int val){
        System.out.println(x); // Position 3
        x = val;
    }
    public static void setInt(int y){
        System.out.println(x); // Position 6
        System.out.println(Exam1.x); // Position 7
        System.out.println(num); // Position 8
        y = 0;
    }
    public static void main(String [] args){
        int num = 100;
        String str = "Happy world!";
        System.out.println(x); // Position 1
        System.out.println(str); // Position 2
        resInt(num, 20);
        System.out.println(num); // Position 4
        {
            String CS = "Computer Science";
            System.out.println(str); // Position 5;
        }
        setInt(num);
        System.out.println(CS); // Position 9
        System.out.println(Exam1.x); // Position 10
    }
}
```

1. (10 points) Determine what would be printed in the following positions. If a variable cannot be printed, write SCOPING ERROR

- Position 1: 10
- Position 2: Happy World!
- Position 3: 100
- Position 4: 100
- Position 5: Happy World!
- Position 6: 10
- Position 7: 10
- Position 8: Scoping Error
- Position 9: Scoping Error
- Position 10: 10
2. (2 points) What line number is the class variable defined on? What is the scope of the class variables?

Solution: 2, the entire class

3. (2 points) What type of variable(s) does the method restInt take as an input? (parameters)

Solution: Two integers

4. (2 points) What type of variable does setInt return?

Solution: void (it does not return a value)

5. (20 points) Write the following methods:

- Write a method called oddsAverage that, given an array of integers arr will return an average (double) of all odd numbers in this array. For example:
  - oddsAverage({1, 7, 10, 20, 5}) returns 4.33 \((1 + 7 + 5) / 3.0 = 4.33\),
  - oddsAverage({1, 3, 7, 9, 5}) returns 5.0 \((1 + 3 + 7 + 9 + 5) / 5.0 = 5.0\)

Solution:

```java
public static double oddsAverage(int[] arr){
    double sum = 0;
    int numbers = 0;

    for (int i = 0; i < arr.length; i++){
        if (arr[i] % 2 != 0){
            sum += arr[i];
            numbers++;
        }
    }

    if (sum == 0.0) return 0;
    else return (sum/numbers);
}
```
• Write a method called betweenRange that, given an array of integers arr and two integers: start and end will return an integer that is the number of elements in the array that are in the range <start; end> (greater than or equal to start and less than or equal to end).

For example:
betweenRange({1, 4, 10, 20, 5}, 2, 10) returns 3 (elements 4, 10 and 5 in <2, 10>),
betweenRange({1, 4, 7, 8}, 10, 12) returns 0 (no elements in <10; 12>).

Solution:

```java
public static int betweenRange(int[] arr, int start, int end) {
    int numbersBetween = 0;
    for (int i = 0; i < arr.length; i++) {
        if (arr[i] >= start && arr[i] <= end) {
            numbersBetween++;
        }
    }
    return numbersBetween;
}
```
6. (22 points) Write a method called `largestAverage` that, given a two dimensional array `arr` will return a row index with the largest average of elements. For example, if `arr` is:

\[
\begin{bmatrix}
2 & 5 & 1 & 7 \\
10 & 0 & 1 & 2 \\
5 & 6 & 7 & 1 \\
10 & 4 & 2 & 1 \\
\end{bmatrix}
\]

the method should return 2 (row 2: \((5 + 6 + 7 + 1) / 4 = 4.75\)), which has the largest average of all rows.

**Solution:**

```java
public static double largestAverage(int[] arr) {
    int maxRow = -1;
    double largestAverage = 0;

    for (int i = 0; i < arr.length; i++) {
        double sum = 0;
        for (int j = 0; j < arr[i].length; j++) {
            sum += arr[i][j];
        }

        if ((sum / arr[i].length) > largestAverage) {
            largestAverage = (sum / arr[i].length);
            maxRow = i;
        }
    }

    return maxRow;
}
```