Due: Activity (in-lab) Monday, October 10, 2016 by the end of lab

Goals:

By the end of this activity you should be able to do the following:

- Understand the basics of instantiating arrays and assigning / accessing array elements.
- How to iterate through arrays using loops.

Description:

In this activity, you will create a class called Scores that will hold an array of numerical values and provide methods that allow users to interact with the Scores class.

Directions:

Part 1: Scores – instance variable, constructor and method stubs

- Create a class called `Scores`.
  - Add an instance variable with the name `numbers` to your class that is an array of `int` values:

    ```
    private int[] numbers;
    ```

  - Add a constructor that has a parameter declared as an array of int values.

    ```
    public Scores(int[] numbersIn) {

    }
    ```

- Add <u>method stubs</u> for the following methods**. The first one is given; do the rest on your own**.
  - `findEvens`: no parameter, returns an array of `int` (all of the even-valued scores)

    ```
    public int[] findEvens() {
        return null;
    }
    ```

    An array is an object, so null is a placeholder return.

  - `findOdds`: no parameter, returns an array of ints (all of the odd-valued scores)
  - `calculateAverage`: no parameters; returns a double (the average of all scores)
  - `toString`: no parameters; returns a String containing all scores
  - `toStringInReverse`: no parameters; returns a String containing all scores in reverse order

Compile Scores and run the following in interactions. **Do not continue until your program compiles and the following code runs without error in interactions.**

```
▶ Scores s = new Scores(null);
▶ int[] evens = s.findEvens();
▶ int[] odds = s.findOdds();
▶ double avg = s.calculateAverage();
```

Part 2: Scores – completing the constructor

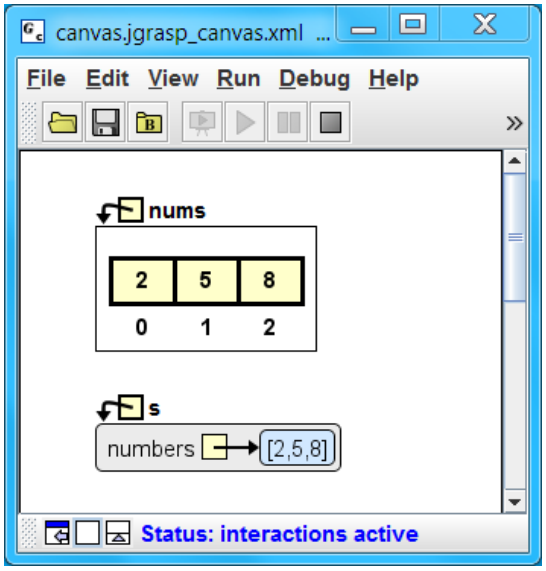
- In your constructor, add code that will set the value of `numbersIn` to `numbers`. **You access the entire array object using its variable name with no brackets.**

  `numbers = _____;`

- Compile Scores. In the interactions pane set up an array of int values using an initializer list and send it to the constructor of scores:

```
▶ int [] nums = {2, 5, 8};
▶ Scores s = new Scores(nums);
```

On the Workbench tab, click the Open New Viewer Canvas button, then drag the array `nums` and the Scores object `s` from the Workbench tab onto the canvas window. You should now be able to see the values of each of these items. To change the viewer for a variable on the canvas, select the viewer for the variable, then click the viewer menu button ▾ (at upper right of viewer frame), select "Viewer", then select the desired viewer from the list. You should experiment with different viewers. Below, the "Presentaton – Structure Identifier" viewer has been selected for `nums` and the "Basic" viewer has been selected for variable `s`. You should leave the canvas window open for the remainder of the activity since we will be adding other variables.



Canvas with int array *nums* and Scores *s*

Change the values in the int array `nums` using assignment statements in interactions as indicated below and you should see the viewer on the canvas updated as well. It should be obvious why the values in `nums` changed, but <u>why did the int array field in the Scores object `s` also change</u>?

```
▶ nums[0] = 9;
▶ nums[1] = 8;
▶ nums[2] = 7;
```

Part 3: Scores – toString and toStringInReverse methods

- The `toString` method will create a local `String` and then concatenate all of the values of numbers to the `String`.

```
public String toString() {

    String result = "";

    for (int i = 0; i < numbers.length; i++) {

    }

    return result;
}
```

- The variable `i` iterates from 0 the length of `numbers` - 1. Within the for loop above, add the number at each index to the result:

```
result += numbers[i] + "\t";
```

- Check the `toString` return in interactions:

```
▶ int[] nums = {2, 5, 8};
▶ Scores s = new Scores(nums);
▶ s
  2   5   8
```

- The `toStringInReverse` method will be exactly the same as `toString`, but will iterate from the length of `numbers` - 1 to 0.
-

```
public String toStringInReverse() {

    String result = "";

    for (int i = numbers.length - 1; ______; ______) {
        result += numbers[i] + "\t";
    }

    return result;
}
```

Compile Scores and run the following code in the interactions pane. **Do not continue until the following code runs without error in interactions.**

```
▶ int[] nums = {2, 5, 8};
▶ Scores s = new Scores(nums);
▶ s.toStringInReverse()
  8   5   2
```

Part 4: Scores – findEvens and findOdds methods

- There are two parts to the `findEvens` method. First, count the number of evens in the array:

```
int numberEvens = 0;

for (int i = 0; i < numbers.length; i++) {
    if (numbers[________] % 2 == 0) {
        numberEvens++;
    }
}
```

- You will then need to create an array with the appropriate length to store the number of even numbers.

```
int[] evens = new int[numberEvens];
```

- Add the even numbers to the `evens` array. In the following loop, `i` represents the current index of `numbers` and `count` is the current index of `evens`.

```
int count = 0;
for (int i = 0; i < numbers.length; i++) {
    if (numbers[________] % 2 == 0) {
        evens[________] = numbers[________];
        count++;
    }
}
return evens;
```

- Compile `Scores` and test the return of `findEvens` by assigning it to an `int[] evens`. After the array `evens` has been assigned and it appears on the workbench, drag it onto your canvas window. The array does not have a `toString` method that includes the value at each index, so you will use a method from the `java.util.Arrays` class to display the array in interactions.

```
import java.util.Arrays;
int[] nums = {2, 5, 8, 1, 10};
Scores s = new Scores(nums);
int[] evens = s.findEvens();
evens // toString output of an array object (will vary)
[D@5abb7465
Arrays.toString(evens)
[2, 8, 10]
```

- **Create the `findOdds` method on your own. It will perform the exact same function as `findEvens`, but it will find all odd numbers in the array (i.e., the numbers that are not divisible by 2).** *Hint: the remainder when dividing by 2 is 1 rather than 0.*

- Test `findOdds` in the interactions pane. After the int array `odds` is created, be sure to drag it from the workbench to the canvas. **Do not continue until your output is correct.**

```
import java.util.Arrays;
int[] nums = {1, 5, 8, 3, 10};
Scores s = new Scores(nums);
int[] odds = s.findOdds();
Arrays.toString(odds)
[1, 5, 3]
```

Part 5: Scores - `calculateAverage` method

- First, find the sum of all values in the numbers array.

```
int sum = 0;

for (int i = 0; i < numbers.length; i++) {
    sum += numbers[i];
}
```

- Return the sum divided by the number of elements in the array. Remember that `sum` and `numbers.length` are both type `int` so <u>you need to do a cast before you divide</u>. For this activity, you can assume that `number.length` is not equal to zero.

```
return ____________ / ____________;
```

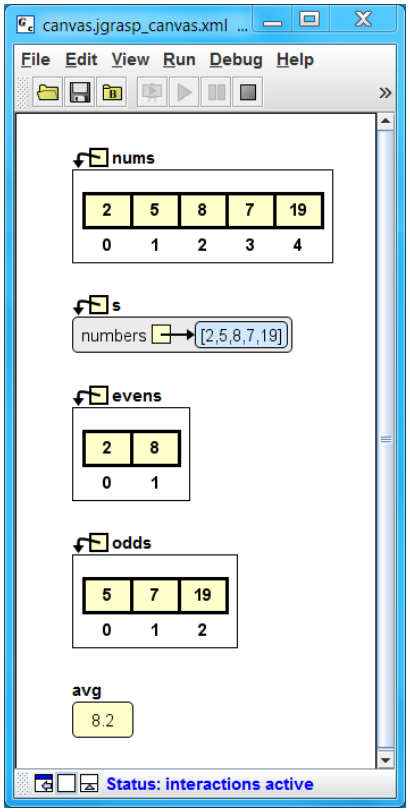
Compile `Scores` and run the following code in the interactions pane. Be sure to drag `avg` from the workbench onto the canvas

```
int[] nums = {2, 5, 8, 7, 19};
Scores s = new Scores(nums);
double avg = s.calculateAverage();
```

Now invoke the `findEvens` and `findOdds` method, assigning the results to `int[] evens` and `int[] odds` respectively as shown below.

```
int[] evens = s.findEvens();
int[] odds = s.findOdds();
```

Your canvas should show all of the current results as indicated in the figure at right.



The canvas after invoking the methods *findEvens*, *findOdds*, and *calculateAverage* on *s*

Your lab instructor will ask you to demonstrate all methods in the interactions pane with appropriate variables in the canvas window. You should ensure that your methods work with a different set of values for the int array `nums` than shown above.