AP Computer Science A: Array Creation and Access

CodeHS

Think Back To Our Trivia Class

In Unit 5, we looked at creating a trivia class with 5 questions:

```
private String q1 = "What country hosted the 2016 Summer Olympics?";

private String q2 ="Which NBA team plays its home games at Madison Square Gardens?";

private String q3 = "Ankara is the capital of which country?";

 private String q4 ="In nautical folklore, which ship is condemned to sail the seas
       for all eternity?";

private String q5 ="Which car manufacturer's name means \"to hear\"?";
```

What If We Wanted 100 Questions?

If we wanted 100 questions, would we have to create 100 different variables?

```
private String q1 = "What country hosted the 2016 Summer Olympics?";

private String q2 = "Which NBA team plays its home games at Madison Square Gardens?";

private String q3 = "Ankara is the capital of which country?";

 private String q4 = "In nautical folklore, which ship is condemned to sail the seas
       for all eternity?";

private String q5 = "Which car manufacturer's name means \"to hear\"?";

. . .

private String q100 = "Did I really just create 100 questions?";
```

Introducing Arrays

An **array** is an object that can store many values of the same type in a single variable.

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What is an array?

A simple way to think about an array is that an array is just a **list**. It may be a list of `ints` or a list of `Strings` or a list of anything you want! Here, it is a list of exam scores.

```
int[] scores
```

80	92	91	68	88

What is an array?

Definition: Arrays store a fixed number of elements of the same type in a single variable.

```
int[] scores
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What is an array?

Definition: Arrays store a **fixed** number of elements of the **same type** in a single variable. Once an array has been created, the size cannot change.

```
int[] scores
```

0	1	2	3	4
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```
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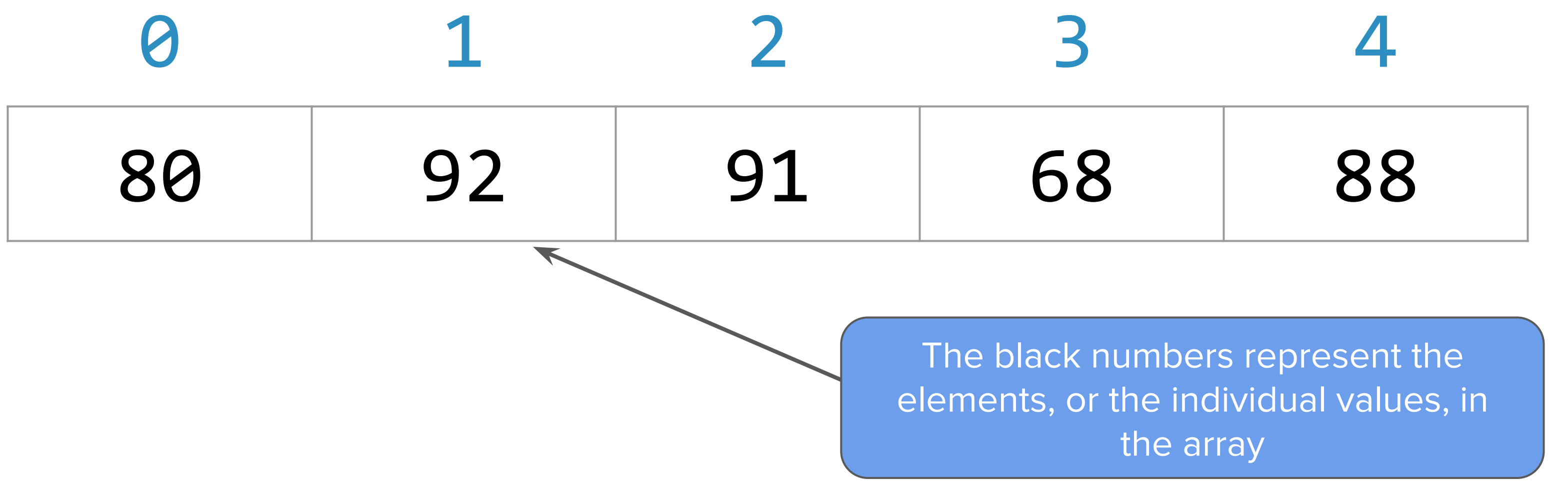

0	1	2	3	4
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The black numbers represent the elements, or the individual values, in the array

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```
int[] scores
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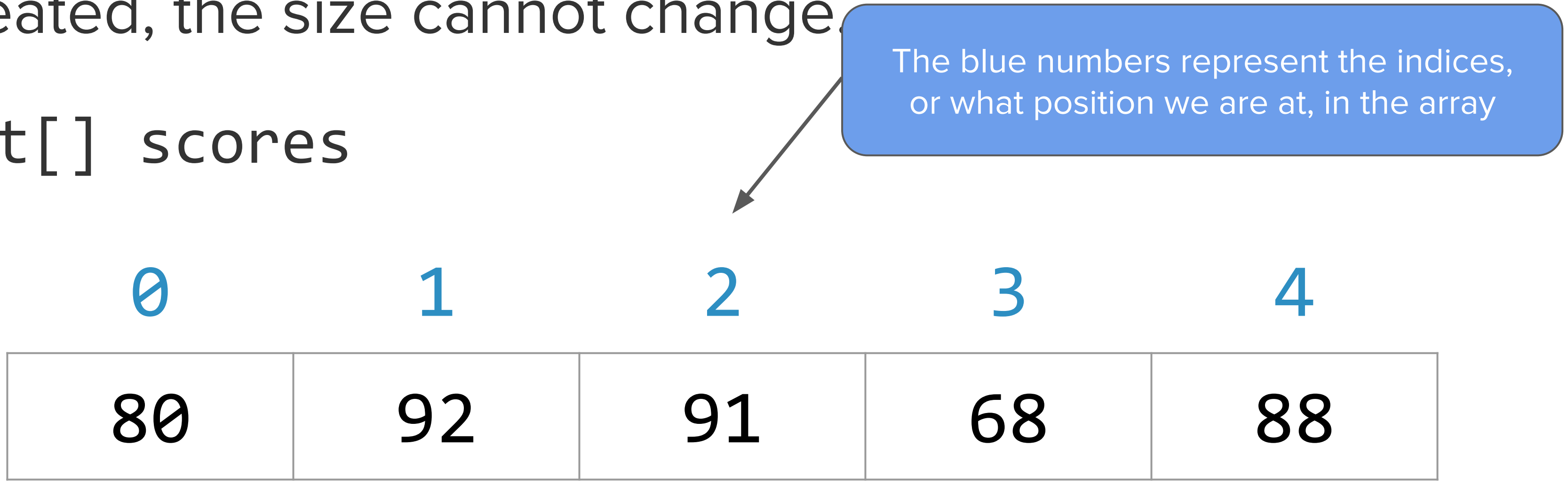
The blue numbers represent the indices, or what position we are at, in the array
0
1
2
3
4
80
92
91
68
88

Making an Array with Default Values

How to create an array:

```
int[] scores = new int[5];
```

0	1	2	3	4
0	0	0	0	0

Making an Array with Default Values

How to create an array:

Add empty square brackets [ ] after the type on the left side

```
int[] scores = new int[5];
```

0	1	2	3	4
0	0	0	0	0

Making an Array with Default Values

How to create an array:

Add empty square brackets [ ] after the type on the left side

```
int[] scores = new int[5];
```

Add square brackets [ ] with the number of elements in the array on the right side

0	1	2	3	4
0	0	0	0	0

Making an Array with Default Values

```
int[] scores = new int[5];
```

When you create an array in this manner, Java assigns default values to each member.

Type	Default Value
`int`	`0`
`double`	`0.0`
`boolean`	`false`
`Objects`	`null`

Making an Array with Initial Values

How to create an array with initializer list:

```
// Make a new int array and set the values
int[] scores = {80, 92, 91, 68, 88};
```

0	1	2	3	4
80	92	91	68	88

Making an Array with Initial Values

How to create an array with initializer list:

```
// Make a new int array and set the values

int[] scores = {80, 92, 91, 68, 88};
```

Initial values go inside curly brackets, separated by commas.

0	1	2	3	4
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Examples of Making Arrays

Examples of default value arrays:

```
//String list with 10 null elements

String[] str = new String[10];


//double list with 100 zeros

double[] nums = new double[100];
```

Examples of Making Arrays

Examples of initial value arrays:

```
//4 element String list

String[] greetings = {"Hello", "Hola", "Bonjour", "Ni hao"};


//List with 5 student items

Student[] class = {julian, larisa, amada, mikka, jay};
```

Making an Array of Any Type

How to create an array with default values:

```
Type[] variableName = new Type[numElements];
```

How to create an array with initial values:

```
Type[] variableName = { initial values list };
```

Getting Value at an Index

```
int[] scores = {80, 92, 91, 68, 88};
```

```
int idaScore = scores[2]; //idaScore now gets 91
```

0	1	2	3	4
80	92	91	68	88

Getting Value at an Index

```
int[] scores = {80, 92, 91, 68, 88};
```

Array variable name

```
int idaScore = scores[2]; //idaScore now gets 91
```

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Getting Value at an Index

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int[] scores = {80, 92, 91, 68, 88};
```

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int idaScore = scores[2]; //idaScore now gets 91
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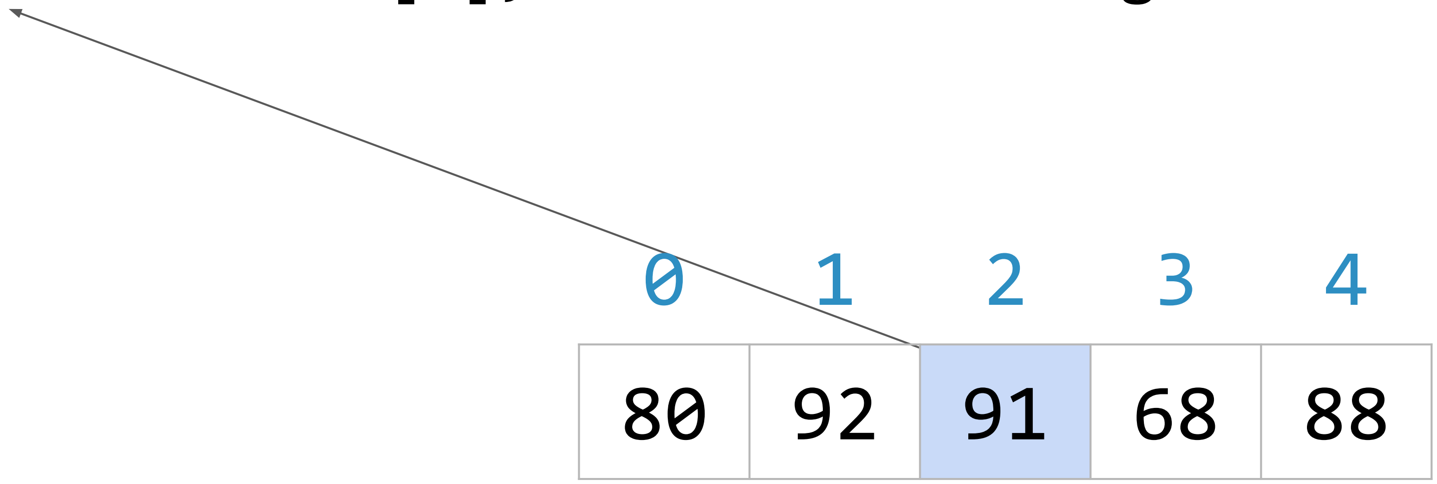
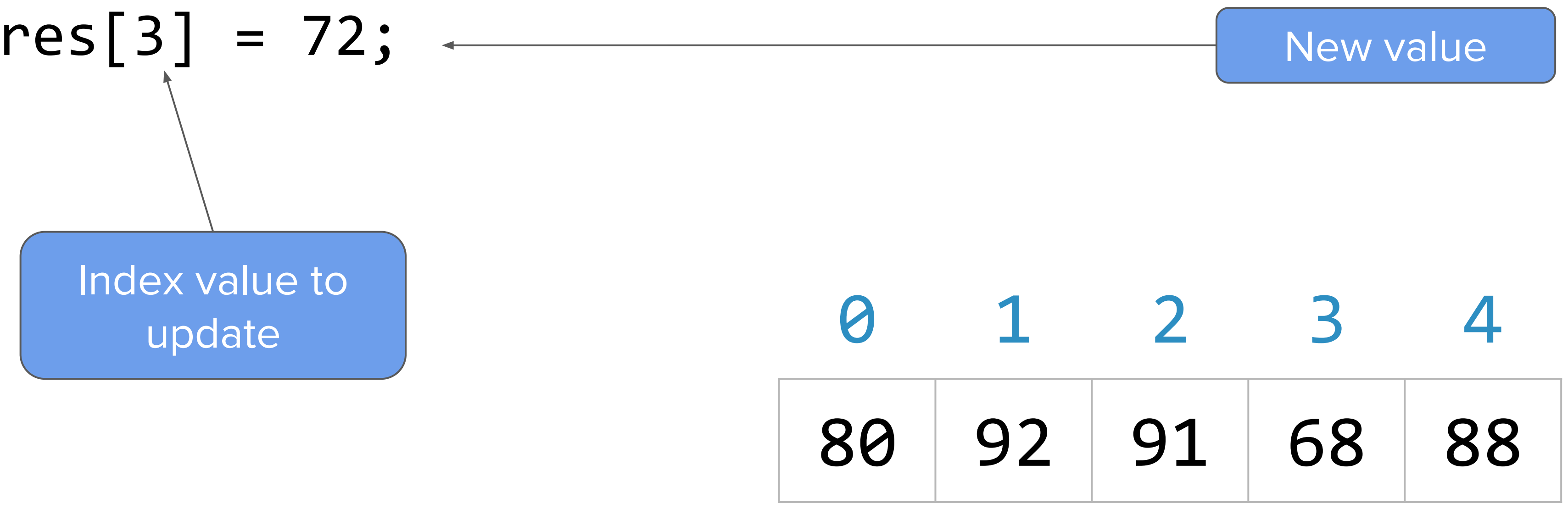


Setting a Value at an Index

```
int[] scores = {80, 92, 91, 68, 88};
```

```
scores[3] = 72;
```



Setting a Value at an Index

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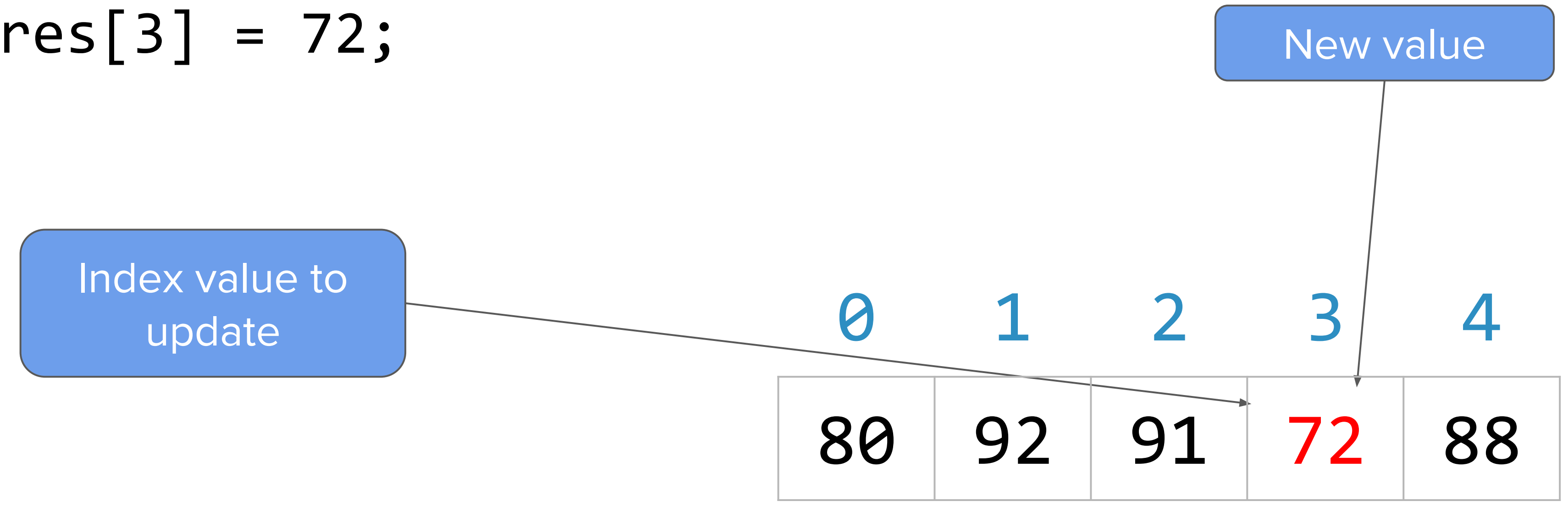

Arrays Start at Index 0!

Arrays start at index 0, not 1!

This is just like what we saw with Strings. In fact a String is nothing more than an Array of characters.

This is a source of a lot of bugs, so be careful!

0	1	2	3	4
80	92	91	68	88

Getting the Array Length

```
int[] scores = {80, 92, 91, 68, 88};

int length = scores.length; // gets value 5
```

Note: There are 5 elements, but the first index is 0 and the last index is 4!

0	1	2	3	4
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Getting the Array Length

```
int[] scores = {80, 92, 91, 68, 88};

int length = scores.length; // gets value 5
```

No ( ) for arrays!

Note: There are 5 elements, but the first index is 0 and the last index is 4!

0	1	2	3	4
80	92	91	68	88

Last Index of Array

If you want to get the last index of the array it is always at:

```
int lastIndex = array.length - 1;
```

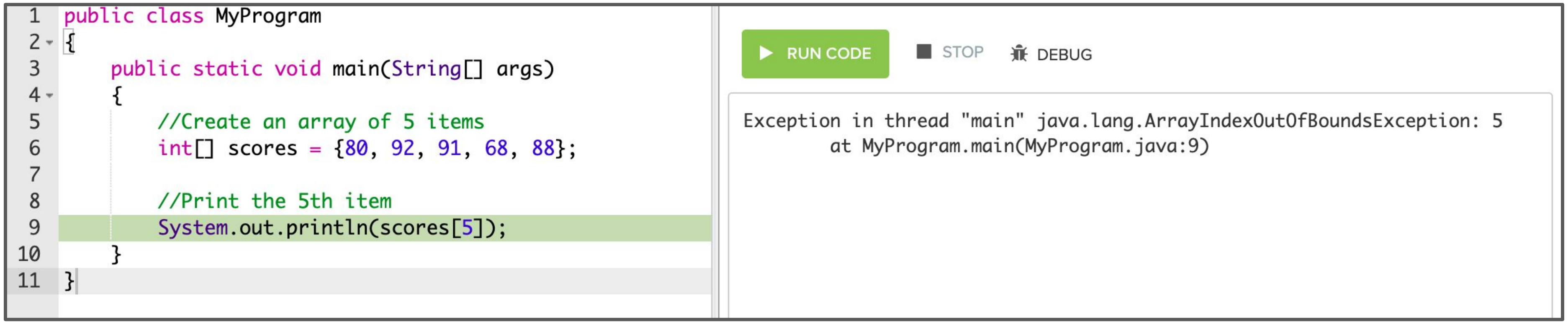
This is because arrays are 0 - indexed!

0	1	2	3	4
80	92	91	68	88

ArrayIndexOutOfBoundsException

If we try to access a value of our array outside the index value list, we get an ArrayIndexOutOfBoundsException.

```
int[] scores = {80, 92, 91, 68, 88};
```



```java
public class MyProgram
{
    public static void main(String[] args)
    {
        //Create an array of 5 items
        int[] scores = {80, 92, 91, 68, 88};

        //Print the 5th item
        System.out.println(scores[5]);
    }
}
```

```
Exception in thread "main" java.lang.ArrayIndexOutOfBoundsException: 5
        at MyProgram.main(MyProgram.java:9)
```

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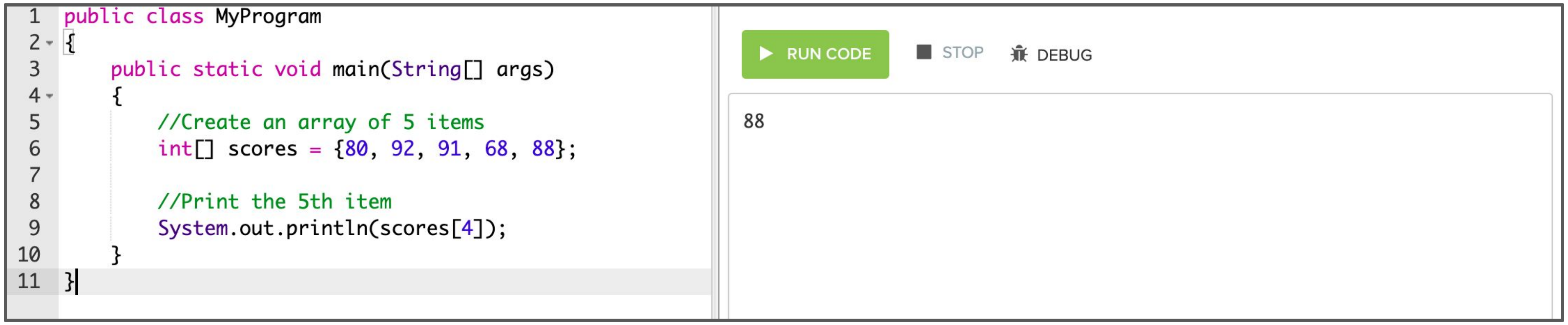
```
public class MyProgram
{
    public static void main(String[] args)
    {
        //Create an array of 5 items
        int[] scores = {80, 92, 91, 68, 88};

        //Print the 5th item
        System.out.println(scores[4]);
    }
}
```

```
88
```

Array Recap

- An array is an object that can store many values of the **same type**.

- Making an array requires declaring how many values the array can hold, and what type of values the array will hold.

- The array *type* and *capacity* **cannot change** once the array has been made.

Now It’s Your Turn!

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Concepts Learned this Lesson

Term	Definition
Array	Arrays are lists that store many values of the same type
Index	Array values are stored at a particular index and we access elements in the array by referencing this index value. Index values in Arrays start a 0.
array.length	Returns the length of the array
array[index]	Accesses an element in the array to either update or retrieve.

Standards Covered

- (LO) VAR-2.A Represent collections of related primitive or object reference data using one- dimensional (1D) array objects.
- (EK) VAR-2.A.1 The use of array objects allows multiple related items to be represented using a single variable.
- (EK) VAR-2.A.2 The size of an array is established at the time of creation and cannot be changed.
- (EK) VAR-2.A.3 Arrays can store either primitive data or object reference data.

Standards Covered

- (EK) VAR-2.A.4 When an array is created using the keyword new, all of its elements are initialized with a specific value based on the type of elements:
    - Elements of type int are initialized to 0
    - Elements of type double are initialized to 0.0
    - Elements of type boolean are initialized to false
    - Elements of a reference type are initialized to the reference value null. No objects are automatically created
- (EK) VAR-2.A.5 Initializer lists can be used to create and initialize arrays.
- (EK) VAR-2.A.6 Square brackets ([ ]) are used to access and modify an element in a 1D array using an index.
- (EK) VAR-2.A.7 The valid index values for an array are 0 through one less than the number of elements in the array, inclusive. Using an index value outside of this range will result in an ArrayIndexOutOfBoundsException being thrown.

Additional Notes: Arrays are Objects

Arrays in Java are objects, not primitives. This means when it is passed to a method you are getting the actual object, not a copy. Any change in the method, updates the original array.

```
public static void main(String[] args) {

  int[] numbers = {20, 30, 40, 50};
  changer(numbers);
  for (int num : numbers){
      System.out.println(num);
  }
}

public static void changer(int[] nums){
    nums[1] += 10;
}
```

Output:

```
20
40
40
50
```

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}
```

Change made in method

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Reflected here

Change made in method

Output:

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