Arrays

Primitive Arrays

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Topics List

- Why Arrays?
- What is an Array?
- Arrays and Methods

Why Arrays?

- Question?
  - If you needed to take in 10 numbers from the user how would you do it?

- Solution
  - Create 10 int variables.
  - Use JOptionPane to take in the 10 values and store them in each of the 10 variables.

Why Arrays?

- What happens when you need to take in 1000 numbers from the user?

```
int n0,n1, n2, n3, n4, n5, n6, n7, n8, n9;  //all the way to n999

n0 = Integer.parseInt (JOptionPane.showInputDialog("Please enter a number "));

n1 = Integer.parseInt (JOptionPane.showInputDialog("Please enter a number "));

//rest of code for n2 to n998

n999= Integer.parseInt(JOptionPane.showInputDialog("Please enter a number ",));
```

- Could you have used a loop?

Topics List

- Why Arrays?
- What is an Array?
- Arrays and Methods

What is an Array?

- An array is a data type that stores a collection of items.
- These items are sometimes referred to as the **elements** of the array.
- All elements must be of the same type **BUT** there is no restriction on which type this is.

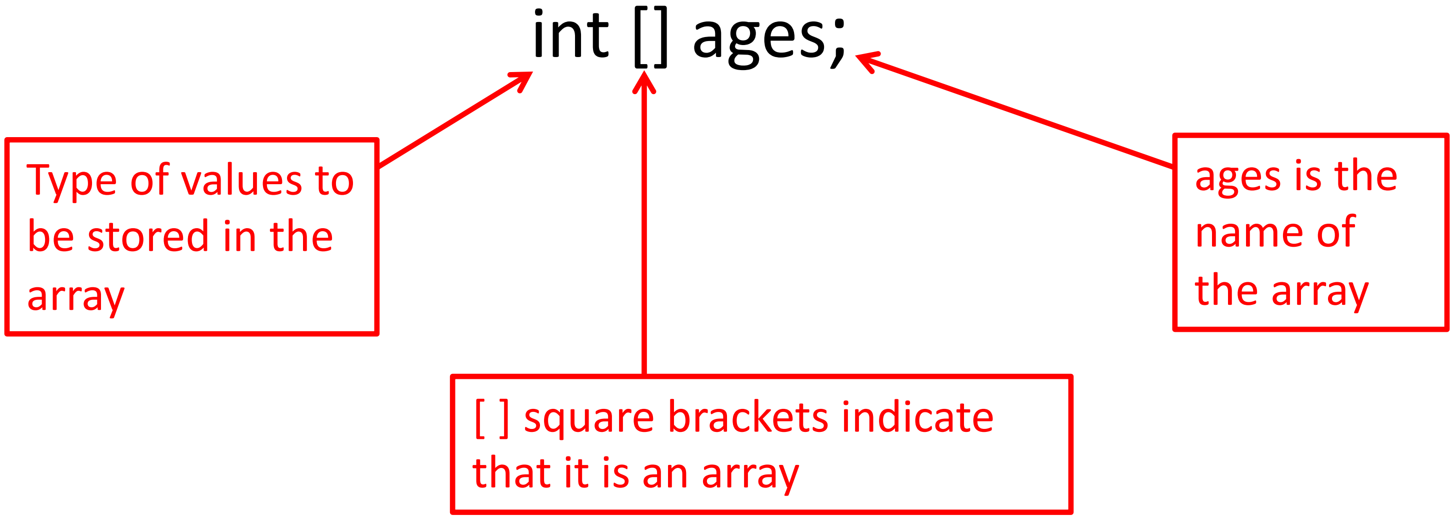
For example

- Arrays can be used to hold a collection of int values
- or a collection of char values
- BUT they cannot be used to hold a mixture of int and char values.

What is an Array?

Declaring an Array

- To declare an array we need to know the type of values we want to store and give the array a name.
- Example: an array to hold a collection of integer variables:



```
int [] ages;
```

Type of values to be stored in the array

[ ] square brackets indicate that it is an array

ages is the name of the array

What is an Array?

- We then need to specify the size of the array i.e. the number of values that will be stored in the array.

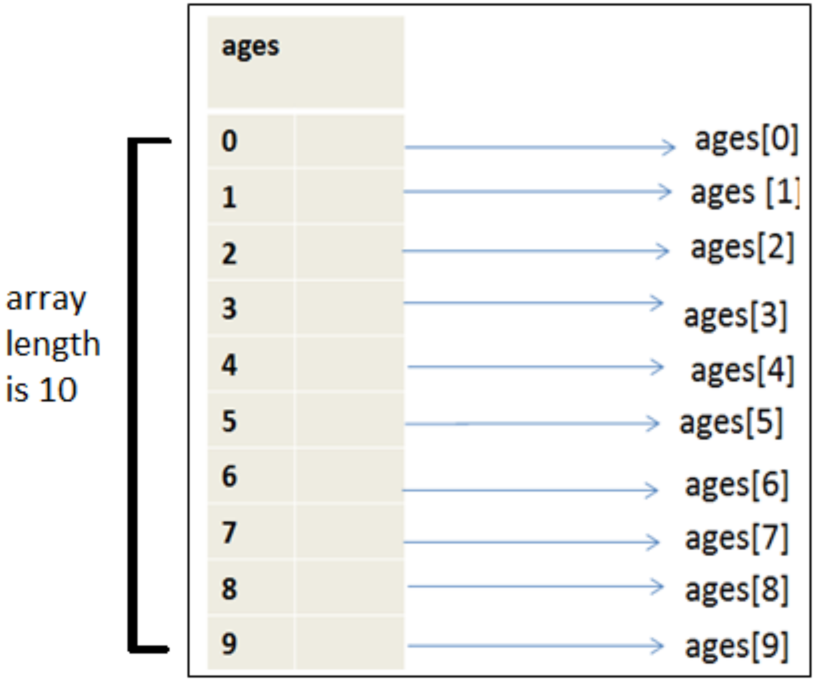
```
int [] ages;
                // creates an integer array called ages
ages = new int[10];
               // creates space for 10 integer
              // elements to be stored in the array called ages
```

What is an Array?

- Or you can do this in one line.

- So instead of

```
int [] ages;
ages = new int[10];
```

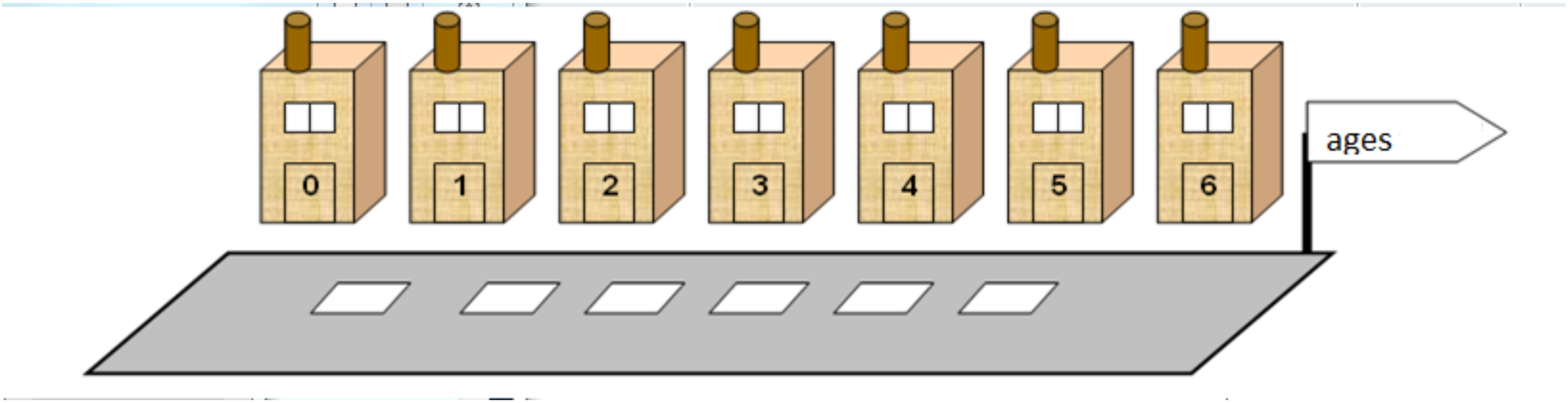


- You could say

```
int [] ages = new int[10];
```

What is an Array?

- The first element in the ages array is ages[0]
- The second element is ages [1] and so on.



- Very important that you remember the array starts at 0.

What is an Array? - Accessing Array Elements

Initialising the Array

- If you know all the values for the array you can create the array and give the values for the array in one statement.

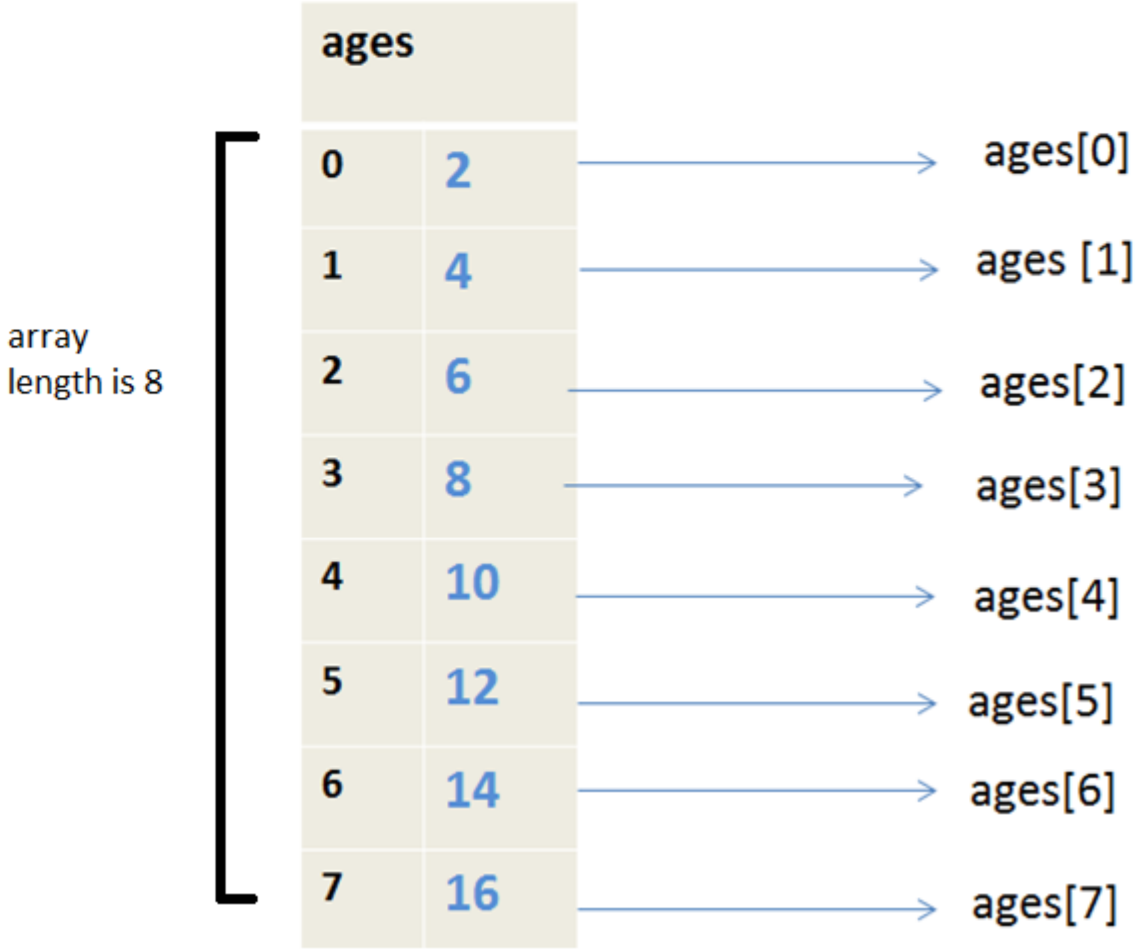
```
int [] ages = {2,4,6,8,10,12,14,16};
```

- This is the only instance in which ***all*** *the elements* of an array can be assigned explicitly by listing out the elements in a single assignment statement.

- We are implying that we know the value of each element in the array.

What is an Array? - Accessing Array Elements

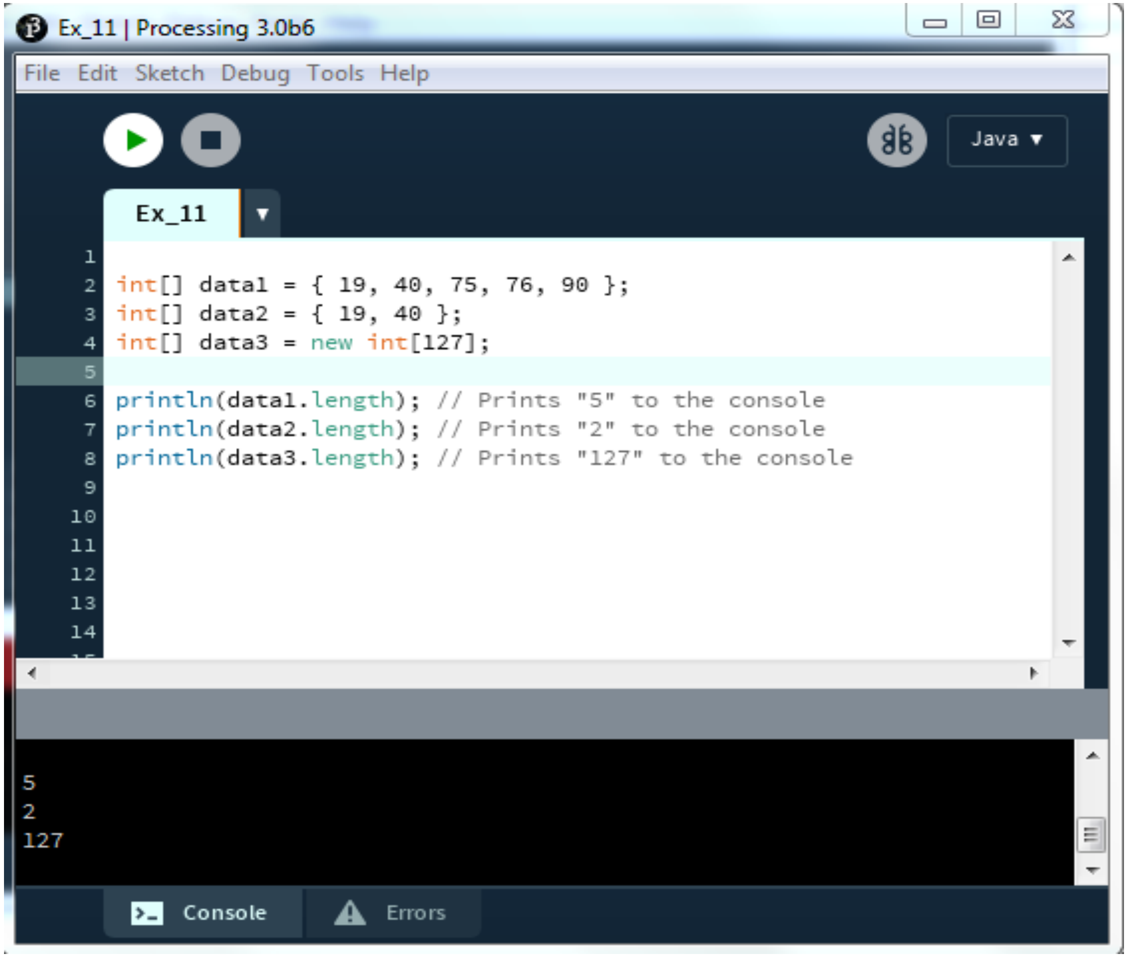
int [] ages = {2,4,6,8,10,12,14,16};



array length is 8

ages		
0	2	ages[0]
1	4	ages [1]
2	6	ages[2]
3	8	ages[3]
4	10	ages[4]
5	12	ages[5]
6	14	ages[6]
7	16	ages[7]

What is an Array? Length Attribute



```

int[] data1 = { 19, 40, 75, 76, 90 };
int[] data2 = { 19, 40 };
int[] data3 = new int[127];

println(data1.length); // Prints "5" to the console
println(data2.length); // Prints "2" to the console
println(data3.length); // Prints "127" to the console
```

```
5
2
127
```

What is an Array? - Accessing Array Elements

- Array can be used like any other variable of the given type in Java.

- The name of the array elements are ages[0], ages[1] etc.

- The assignment operator can be used to enter a value.

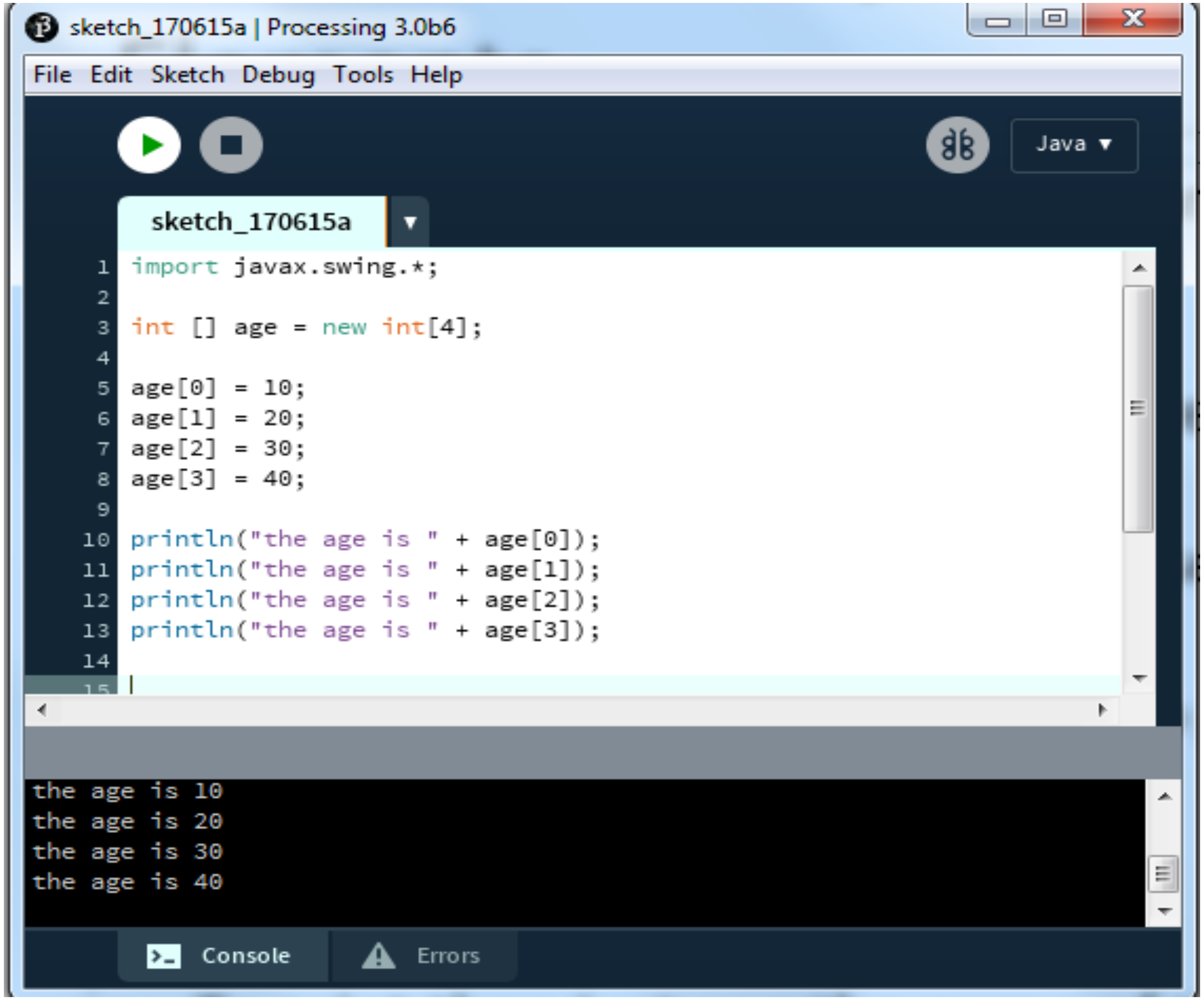
- You must specify which element to place the value in.

```
ages[0] = 21;
ages[1] = 51;
```

- To print then just use the name of the variable

```
println(ages[0]);
println(“The age  is “ + ages[0]);
```

What is an Array? - Accessing Array Elements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sketch_170615a
Console
Errors

```
import javax.swing.*;

int [] age = new int[4];

age[0] = 10;
age[1] = 20;
age[2] = 30;
age[3] = 40;

println("the age is " + age[0]);
println("the age is " + age[1]);
println("the age is " + age[2]);
println("the age is " + age[3]);
```

```
the age is 10
the age is 20
the age is 30
the age is 40
```

What is an Array? - Accessing Array Elements

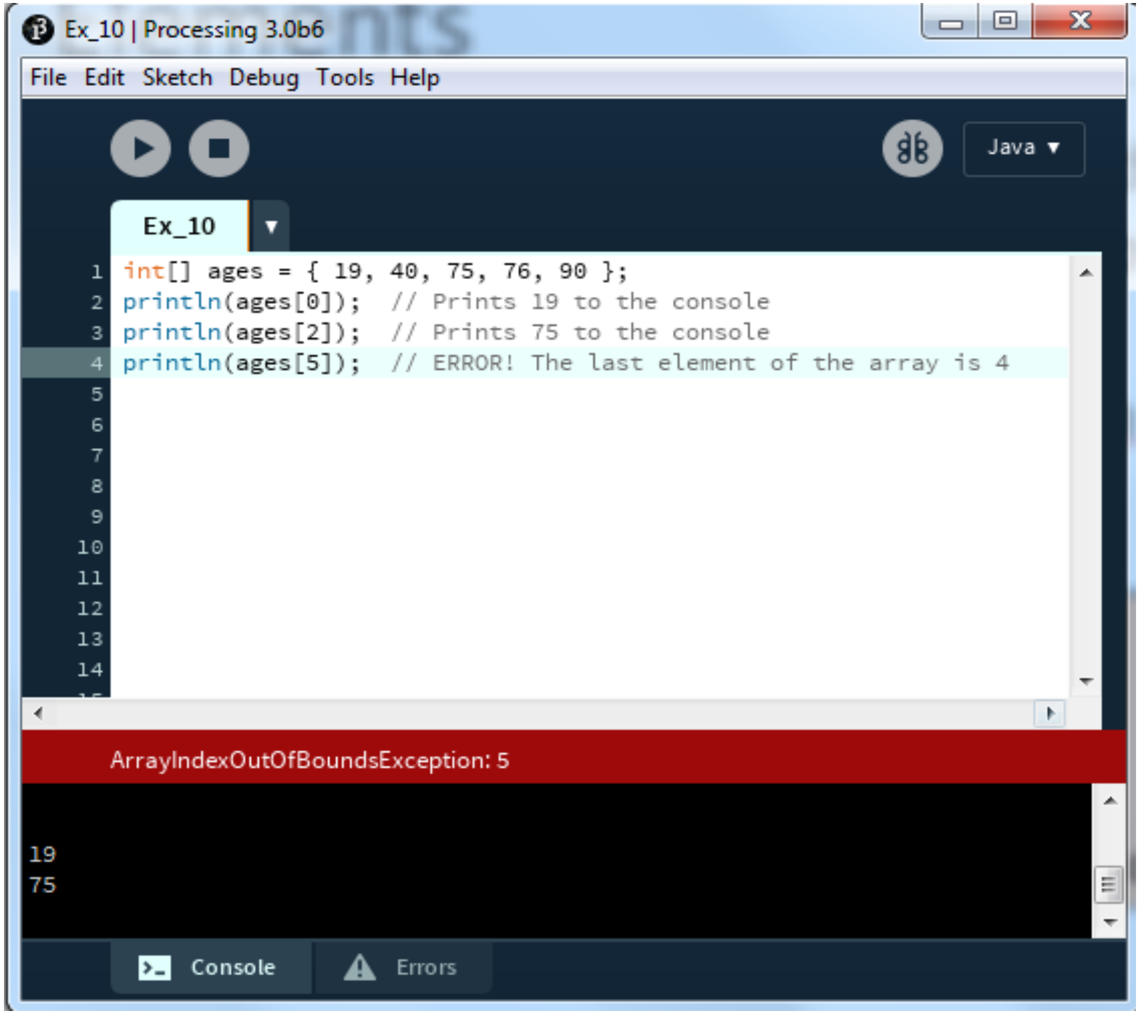
Q. What would happen if you tried to assign a value to or print out age[4]???

What is an Array? - Accessing Array Elements

- If you try to access a ,member of the array that lies outside of the array boundaries your program will terminate and gives you an ArrayIndexOutOfBoundsException error.

```
int[] ages = { 19, 40, 75, 76, 90 };
println(ages[0]);  // Prints 19 to the console
println(ages[2]);  // Prints 75 to the console
println(ages[5]);  // ERROR! The last element of the array is 4
```

What is an Array? - Accessing Array Elements



```
int[] ages = { 19, 40, 75, 76, 90 };
println(ages[0]);  // Prints 19 to the console
println(ages[2]);  // Prints 75 to the console
println(ages[5]);  // ERROR! The last element of the array is 4
```

ArrayIndexOutOfBoundsException: 5

```
19
75
```

What is an Array? - Accessing Array Elements

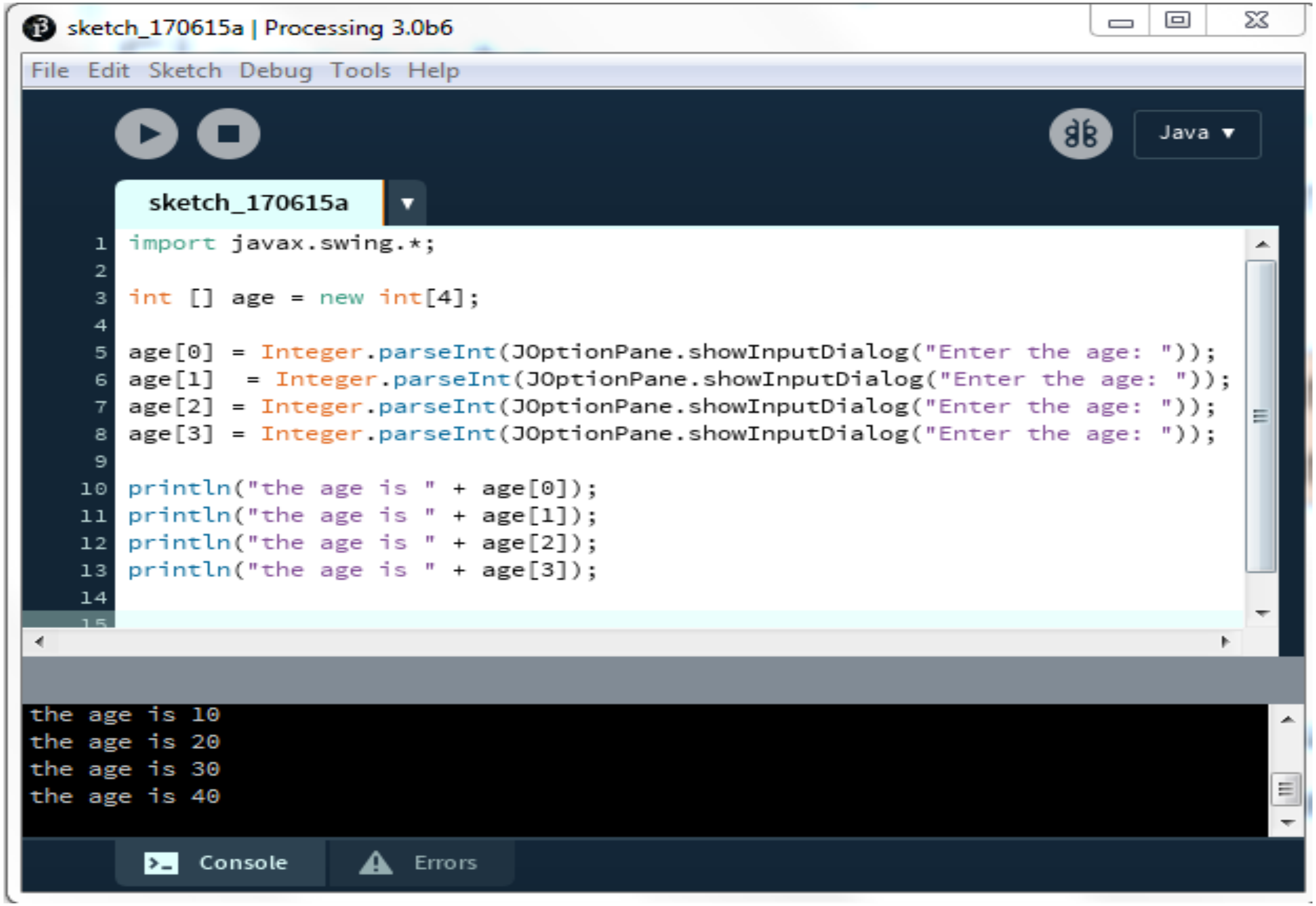
- Allowing the user of the program to enter the value of the temperatures:

```
age[0] =Integer.parseInt(JOptionPane.showInputDialog("Enter the age: "));
age[1] =Integer.parseInt(JOptionPane.showInputDialog("Enter the age: "));
```

- Then print them out:

```
println("the age is " + age[0]);
println("the age is " + age[1]);
```

What is an Array? - Accessing Array Elements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Errors

```
import javax.swing.*;

int [] age = new int[4];

age[0] = Integer.parseInt(JOptionPane.showInputDialog("Enter the age: "));
age[1]  = Integer.parseInt(JOptionPane.showInputDialog("Enter the age: "));
age[2] = Integer.parseInt(JOptionPane.showInputDialog("Enter the age: "));
age[3] = Integer.parseInt(JOptionPane.showInputDialog("Enter the age: "));

println("the age is " + age[0]);
println("the age is " + age[1]);
println("the age is " + age[2]);
println("the age is " + age[3]);
```

```
the age is 10
the age is 20
the age is 30
the age is 40
```

What is an Array? - Accessing Array Elements using for Loop

- This is fine if we need to take in a few ages but what if we wanted to take in many? Answer: We just a for loop.
- Now we only need to write the line of code that we are repeating once inside the for loop.

```
for(int i = 0; i < 4; i++)
{
  age[i] = Integer.parseInt(JOptionPane.showInputDialog("Enter the age: "));
}
```

```
for(int i = 0; i < 4; i++)
{
  println("the age is " + age[i]);
}
```

What is an Array? Length Attribute with for Loop

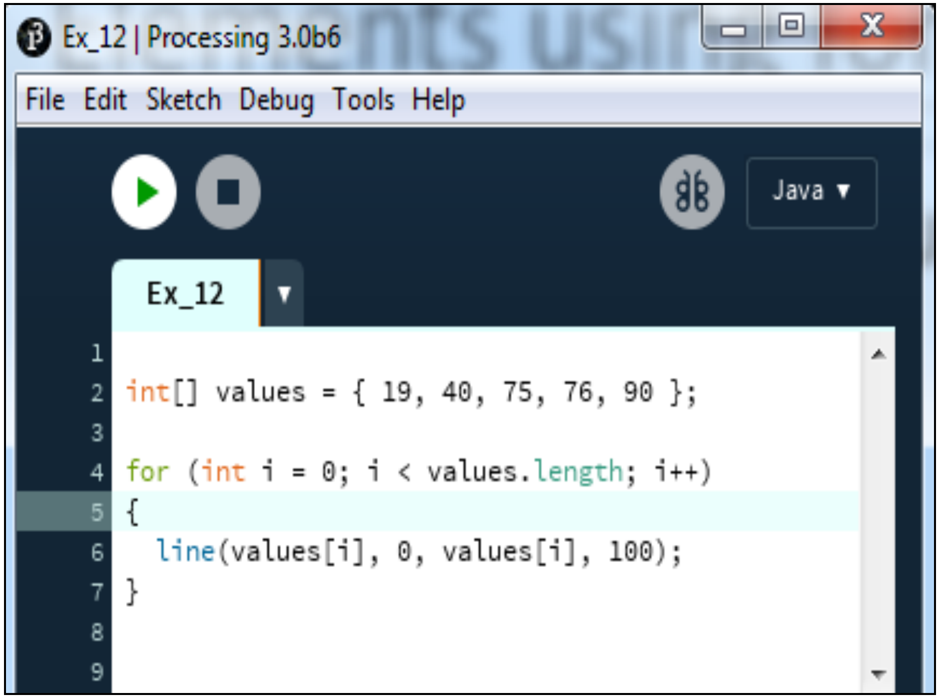
- The length attribute returns the size of an array.
- It is accessed by using the word length after the name of the array.

```
for(int i = 0; i < age.length; i++)
{
  age[i] = Integer.parseInt(JOptionPane.showInputDialog("Enter the age: "));
}
```

```
for(int i = 0; i < age.length; i++)
{
  println("the age is " + age[i]);
}
```

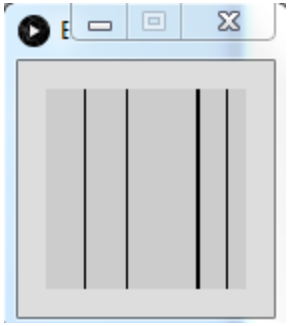
What is an Array? - Accessing Array Elements using for Loop

- Now we will use values in our arrays to print lines to the screen.

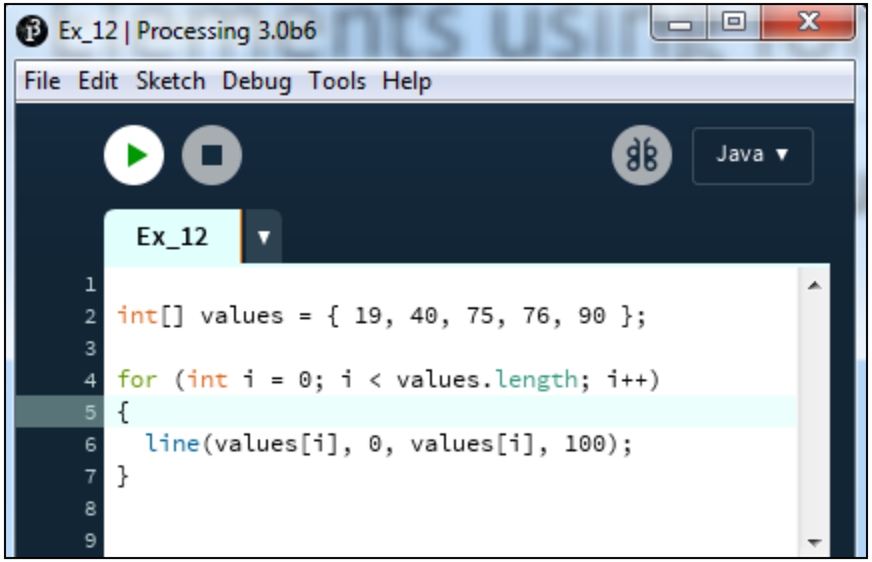


```
int[] values = { 19, 40, 75, 76, 90 };

for (int i = 0; i < values.length; i++)
{
  line(values[i], 0, values[i], 100);
}
```



What is an Array? - Accessing Array Elements using for Loop



```

int[] values = { 19, 40, 75, 76, 90 };

for (int i = 0; i < values.length; i++)
{
  line(values[i], 0, values[i], 100);
}
```

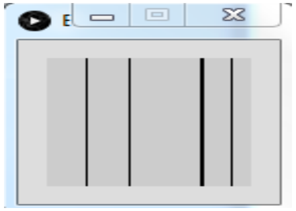
The **first** time the for loop executes **i is 0** therefore values[i] is values[0] which is 19 therefore prints a line with the parameters line(19,0,19,100) to the screen

The **second** time the for loop executes **i is 1** therefore values[i] is values[1] which is 40 therefore prints a line with the parameters line(40, 0, 40, 100) to the screen

The **third** time the for loop executes **i is 2** therefore values[i] is values[2] which is 75 therefore prints a line with the parameters line(75, 0, 75, 100) to the screen

The **fourth** time the for loop executes **i is 3** therefore values[i] is values[3] which is 76 therefore prints a line with the parameters line(76, 0, 76, 100) to the screen

The **fifth** time the for loop executes **i is 4** therefore values[i] is values[4] which is 90 therefore prints a line with the parameters line(90, 0, 90, 100) to the screen



Topics List

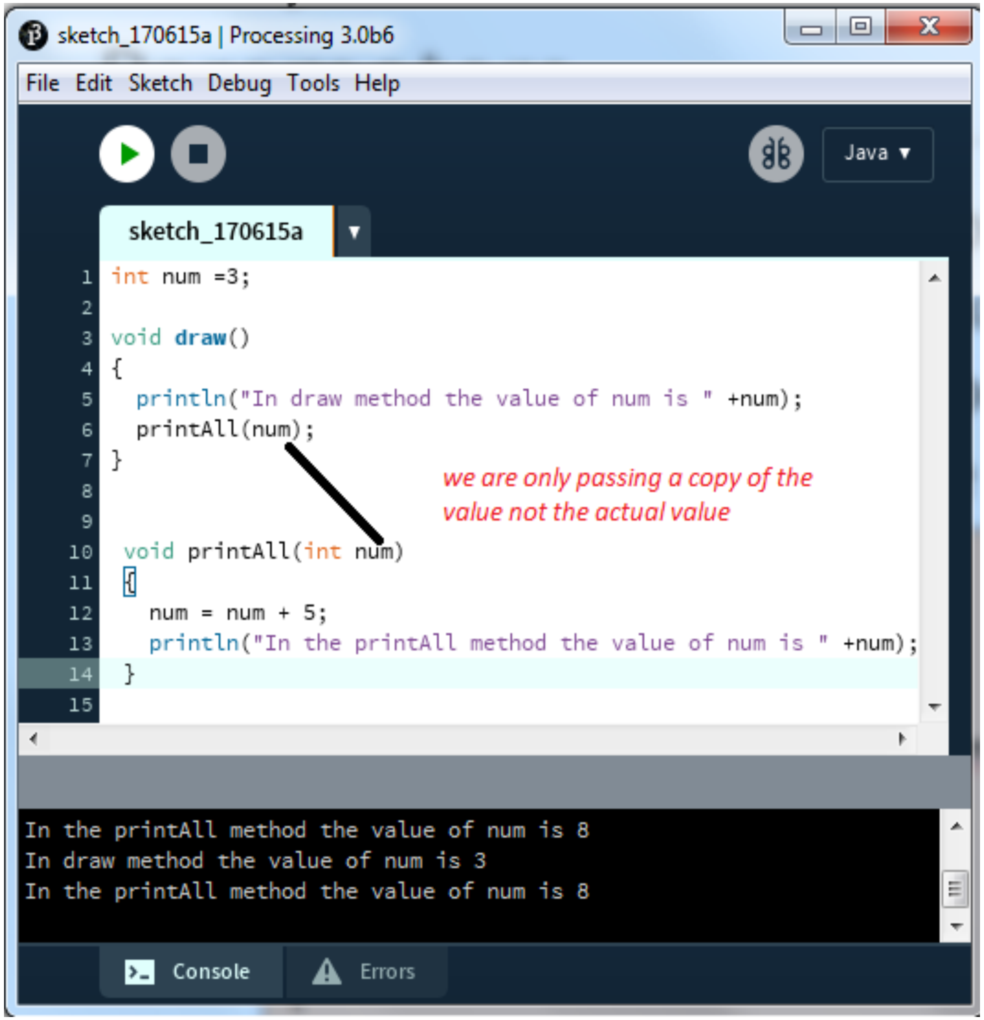
- Why Arrays?
- What is an Array?
- Arrays and Methods

Arrays and Methods - Passing Variables as Parameters

- Recap: When we send a variable into a method we are only sending in a copy of the variable. If we change the variable inside the new method it is passed to, we did not change the actual variable value.

```
int num =3;
void draw()
{
  println("In draw method the value of num is " +num);
  printAll(num);
}
 void printAll(int num)
 {
   num = num + 5;
   println("In the printAll method the value of num is " +num);
 }
```

Arrays and Methods - Passing Variables as Parameters



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Console
Errors

```
int num =3;

void draw()
{
  println("In draw method the value of num is " +num);
  printAll(num);
}


 void printAll(int num)
 {
   num = num + 5;
   println("In the printAll method the value of num is " +num);
 }

```

we are only passing a copy of the value not the actual value

```
In the printAll method the value of num is 8
In draw method the value of num is 3
In the printAll method the value of num is 8
```

The method draw executes and prints
In draw method the value of num is 3
It then calls the printAll method and send in 3 as the variable num.
The printAll method executes and the 5 is added to the new variable called num (which is 8) and then prints out 8.
The draw method executes again and prints
In draw method the value of num is 3 The printAll method executes and the 5 is added to the new variable called num (which is 8) and then prints out 8.

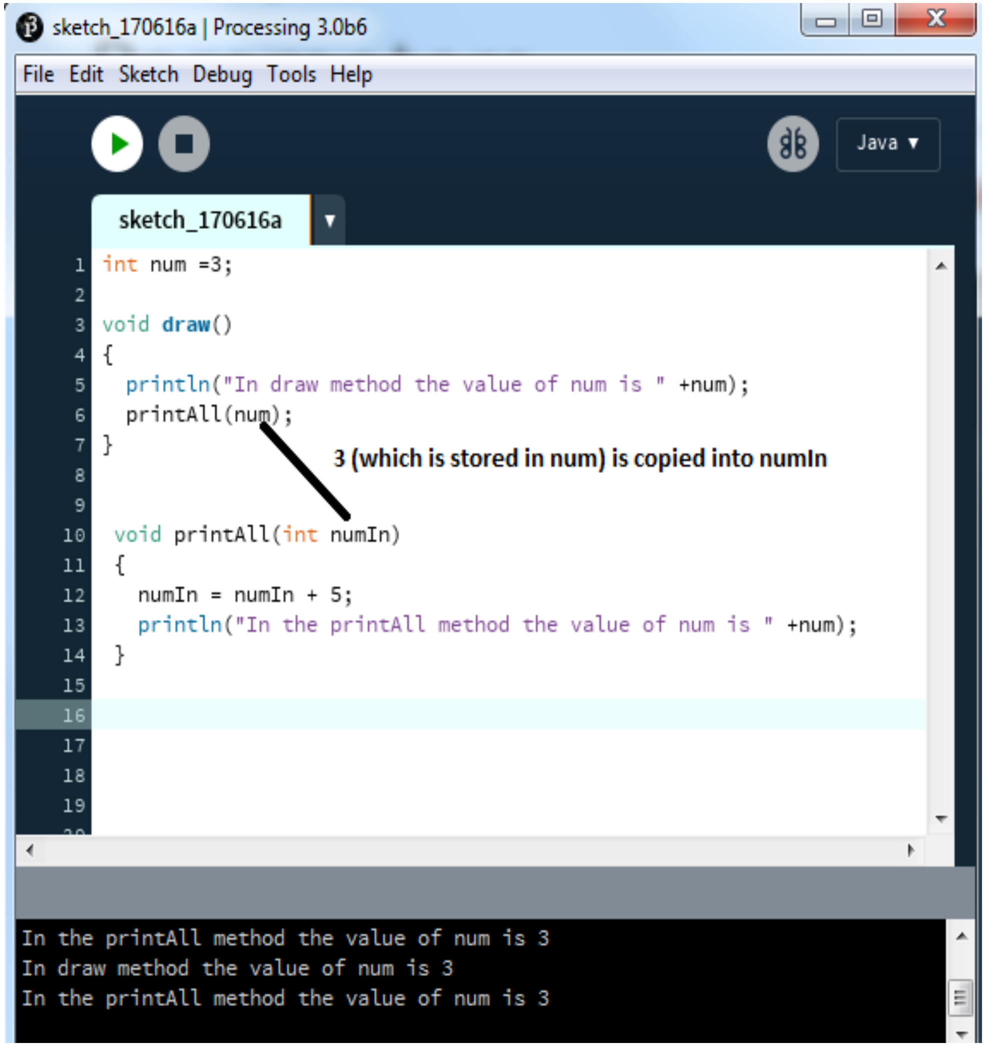
Only a copy is passed onto the new variable num in the printAll method. So when we make a change to this variable (making it 8) it does not change the original variable in draw (which is still 3)

Arrays and Methods -Passing Arrays as Parameters

- When we pass an array as a parameter to a method we are passing the **ACTUAL** array.

- Therefore if we make a change to the array in any of the other methods we change the actual contents of the array (unlike with a variable).

Arrays and Methods -Passing Arrays as Parameters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Java ▾
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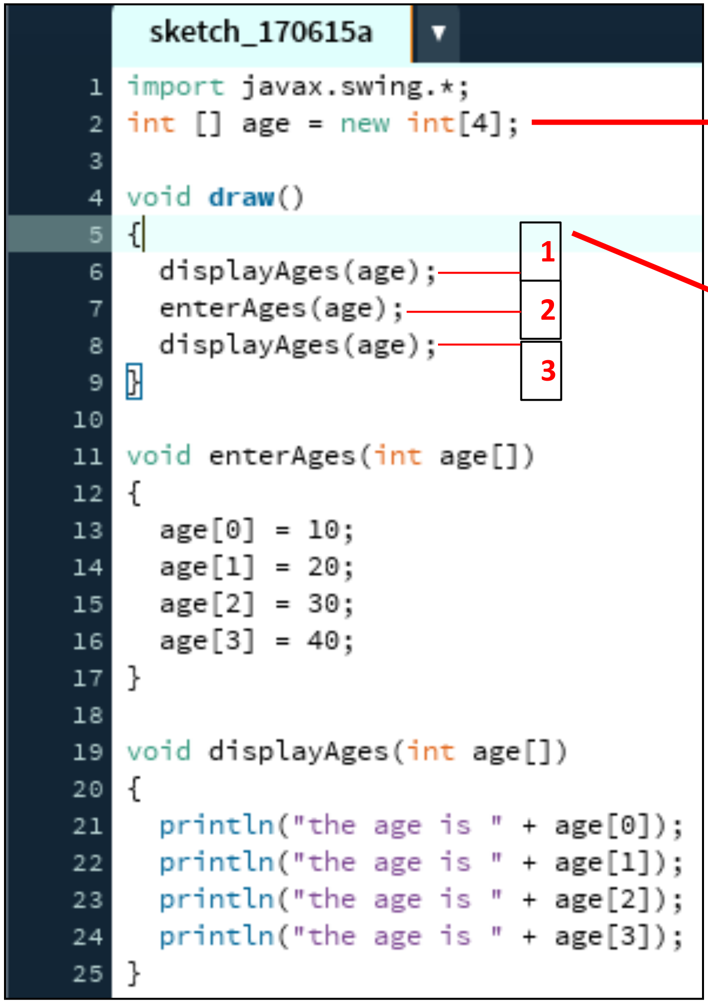
```
int num =3;

void draw()
{
  println("In draw method the value of num is " +num);
  printAll(num);
}


 void printAll(int numIn)
 {
   numIn = numIn + 5;
   println("In the printAll method the value of num is " +num);
 }
```

3 (which is stored in num) is copied into numIn

```
In the printAll method the value of num is 3
In draw method the value of num is 3
In the printAll method the value of num is 3
```

- In the printAll method we could have used the parameter name numIn. It would have worked the same as the previous example.
- In this case 3 is copied onto numIn and then used in the same way as before.

Arrays and Methods -Passing Arrays as Parameters

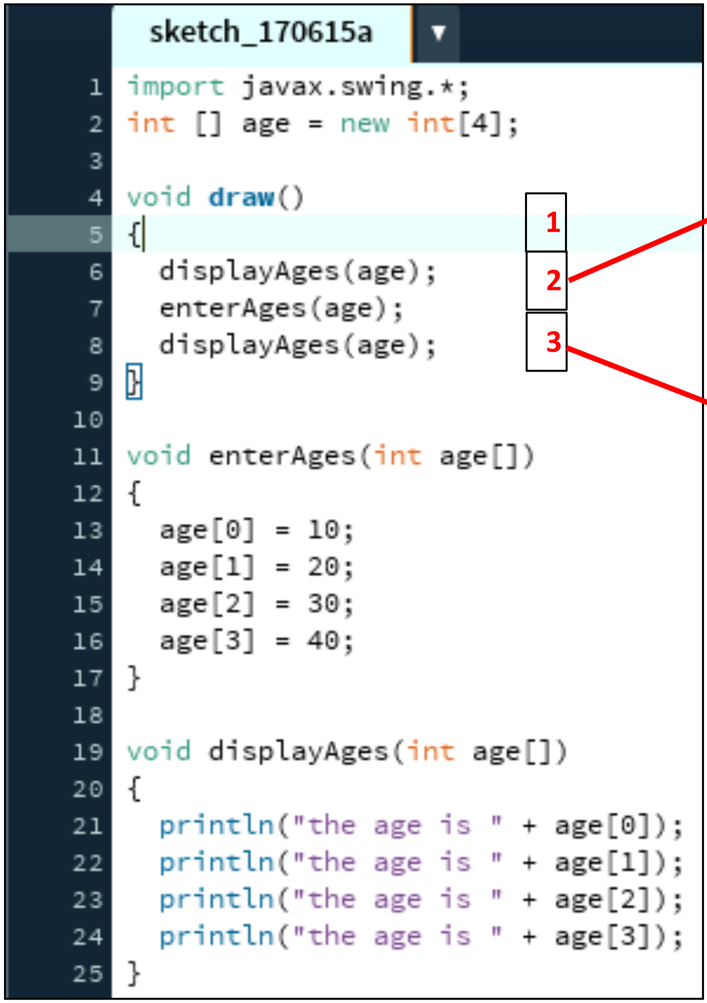


```
import javax.swing.*;
int [] age = new int[4];

void draw()
{
  displayAges(age);
  enterAges(age);
  displayAges(age);
}

void enterAges(int age[])
{
  age[0] = 10;
  age[1] = 20;
  age[2] = 30;
  age[3] = 40;
}

void displayAges(int age[])
{
  println("the age is " + age[0]);
  println("the age is " + age[1]);
  println("the age is " + age[2]);
  println("the age is " + age[3]);
}
```

The array called age is created with no new values entered

1. The displayAges method is called and it sends in the array called age as its parameter (which has no values entered). The job of this method is to print out what is stored in each element of the array.
The age is 0
The age is 0
The age is 0
The age is 0
is printed to the screen

Arrays and Methods -Passing Arrays as Parameters



```
import javax.swing.*;
int [] age = new int[4];

void draw()
{
  displayAges(age);
  enterAges(age);
  displayAges(age);
}

void enterAges(int age[])
{
  age[0] = 10;
  age[1] = 20;
  age[2] = 30;
  age[3] = 40;
}

void displayAges(int age[])
{
  println("the age is " + age[0]);
  println("the age is " + age[1]);
  println("the age is " + age[2]);
  println("the age is " + age[3]);
}
```

2. The enterAges method is called and it sends in the array called age as its parameter. The job of this method is to enter in the values 10, 20, 30, 40 to the elements in the array.

3. The displayAges method is called a second time and it sends in the array called age as its parameter (which has values entered this time). The job of this method is to print out what is stored in each element of the array.
The age is 10
The age is 20
The age is 30
The age is 40
is printed to the screen

It is now clear that the **ACTUAL** array was send into each method and not just a copy

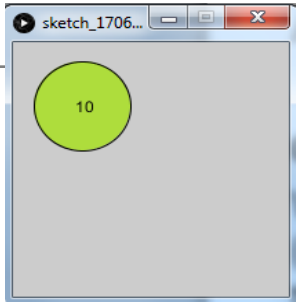
Arrays and Methods – Example 5.1

Find the maximum number in an array using a method

```
int findMax(int nums[])
{
  int max = nums[0];;
  for(int i = 0; i < nums.length; i++)
  {
    if(nums[i] > max)
    {
       max = nums[i];
    }
  }

  return max;
}
```

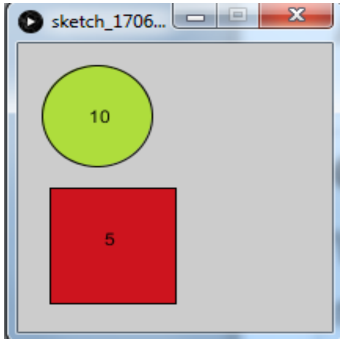
1. We set the variable max to the first element in the array.
2. We then use a for loop to go through every element in the array.
3. If the element we are checking (nums[i]) is greater than the variable max we set max to that value (If not we do nothing)
4. The loop goes around until it is finished.
5. We then return whatever value is stored in max.

Arrays and Methods – Example 5.1



Question 1

Write a program that allows the user to enter in 10 numbers (using an array) in a method. It must then, using a method, find the largest number in the array and send this number back to where it was called from. It must then print this number in black in a green circle on the screen.



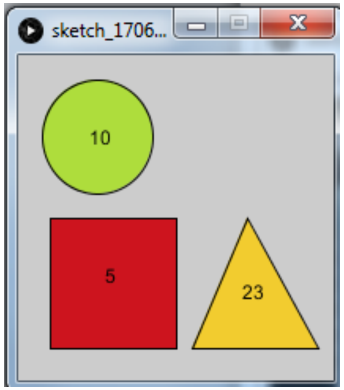
Question 1b

Now add a method that will find the minimum number and print this number in a black in a red square.

Arrays and Methods – Example 5.1

Question 1c

Now add a method that will find the total of all the numbers entered and print this number in a black in a yellow triangle.



Question 1d

Now add a method that will find where in the array a certain number is stored. Display the number of the location in a **blue** rectangle. How would we do this???

Arrays and Methods – Example 5.1 Find if a Number is Stored in the Array

As we are using methods we will need to write a method to do this. *What questions do we need to ask in order to do this??*

1. What name will we give the method?
2. What parameter list does the method need?
3. What return type does the method need?
4. What instructions does the method need?

Arrays and Methods – Example 5.1 Find if a Number is Stored in the Array

1. What name will we give the method

We will call the method contains

2. What parameter list does the method need?

The method needs access to the array to search (this is currently stored in the draw method).

3. What return type does the method need?

As it is searching for a number, the method will either find or not find the number so the return type will be the location where it is stored in the array so it will be an integer (i.e. location 0 or 1 or 2 …)

4. What instructions does the method need?

See next slide

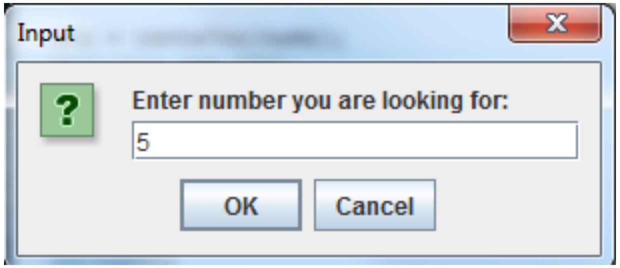
Arrays and Methods – Example 5.1 Find if a Number is Stored in the Array

4. What instructions does the method need?

- We will need to ask the user to enter the number they are searching for.
- We will need a for loop to search every element in the array.
- We will need an if statement to test if the element in the array is equal to the number value we are looking for and if it is equal it should return the location (number) of the array.
- Only when we are compared every element in the array against the value we are looking for will we then return a dummy value (what does this mean??)

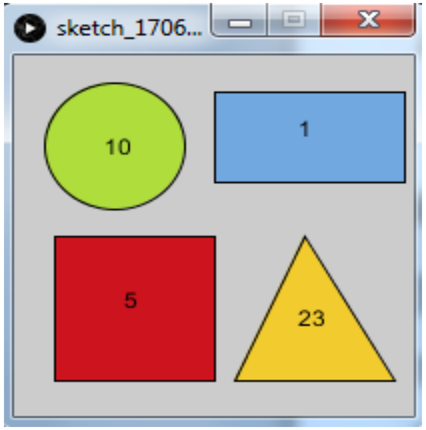
Now write the code (also what about just checking if the number is there or not)

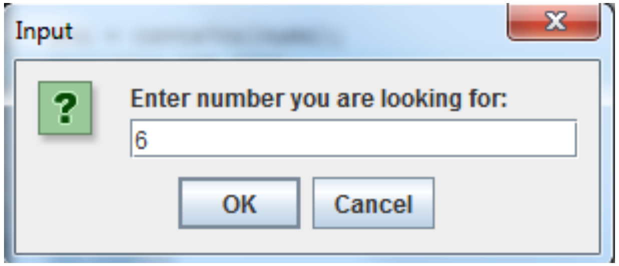
Arrays and Methods – Example 5.1 Find if a Number is Stored in the Array


Input

Enter number you are looking for:

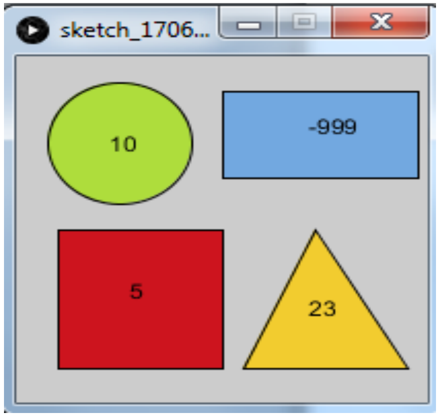
5




Input

Enter number you are looking for:

6



Questions?

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