Programming Fundamentals 1

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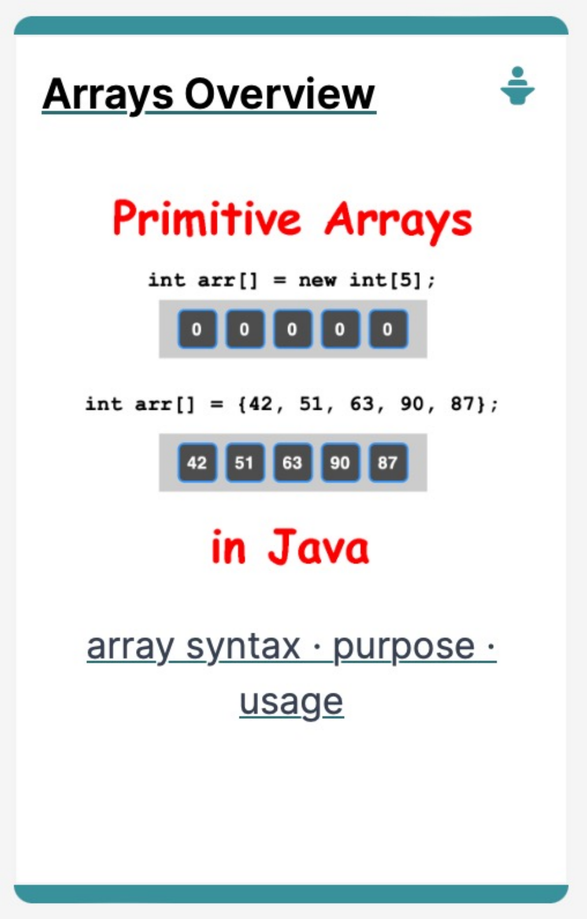
Primitive Arrays

A brief overview of Arrays in Java



Arrays Overview

Primitive Arrays

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

0	0	0	0	0

```
int arr[] = {42, 51, 63, 90, 87};
```

42	51	63	90	87

in Java

array syntax · purpose · usage

Agenda

- ❑Why Arrays?
- ❑Primitive Arrays
- ❑Array Syntax

Why Arrays?

Why arrays?

- We will look at different pieces of code to explain the concept.

- In each piece of code, we:
  - read in 10 numbers from the keyboard
  - add the numbers
  - print the sum of all the numbers.

Source: Reas & Fry (2014)

Adding 10 numbers

```
import java.util.Scanner;
 :
Scanner input = new Scanner(System.in);
 :
int n;
int sum = 0;

for (int i = 0; i<10; i++)  {
    n = input.nextInt();
    sum += n;
}

System.out.println("The sum of the values you typed in is : " + sum);
```

Reads in 10 numbers from the keyboard

Adding 10 numbers

```
import java.util.Scanner;
 :
Scanner input = new Scanner(System.in);
 :
int n;
int sum = 0;

for (int i = 0; i<10; i++)  {
    n = input.nextInt();
    sum += n;
}

System.out.println("The sum of the values you typed in is : " + sum);
```

As each number is entered, it is added to the value currently stored in **sum**.

Adding 10 numbers

```
import java.util.Scanner;
 :
Scanner input = new Scanner(System.in);
 :
int n;
int sum = 0;

for (int i = 0; i<10; i++)  {
    n = input.nextInt();
    sum += n;
}

System.out.println("The sum of the values you typed in is : " + sum);
```

When the 10 numbers have been read in, the **sum** of the 10 numbers is printed to the console.

Rule – Never lose input data

- Always try to **store** input data for later use

- In real-life systems,
  you nearly always need to use it again.

- The previous code has NOT done this.
  - Let’s try another way …

Remembering the Numbers

```
int n0,n1, n2, n3, n4, n5, n6, n7, n8, n9;
int sum = 0;

n0 = input.nextInt();
sum += n0;

n1 = input.nextInt();
//rest of code for n2 to n8

n9= input.nextInt();
sum += n9;

println("The sum of the values you typed in is : " + sum);
```

This works in the sense that we have retained the input data.

Remembering the Numbers

```
int n0,n1, n2, n3, n4, n5, n6, n7, n8, n9;
int sum = 0;

n0 = input.nextInt();
sum += n0;

n1 = input.nextInt();
//rest of code for n2 to n8

n9= input.nextInt();
sum += n9;

println("The sum of the values you typed in is
```

This works in the sense that we have retained the input data.

BUT…we no longer use loops.

Imagine the code if we had to read in 1,000 numbers?

We need a new approach…

This is where **data structures** come in!

We will now look at **arrays**.

Primitive Arrays

Arrays (fixed-size collections)

- ❑ Arrays are a way to collect associated values
- ❑ Programming languages usually offer a special fixed-size collection type: an *array*
- ❑ Java arrays can store
  - objects
  - primitive-type values
- ❑ Arrays use a special syntax

Primitive types

Primitive type

```
int num = 17;
```

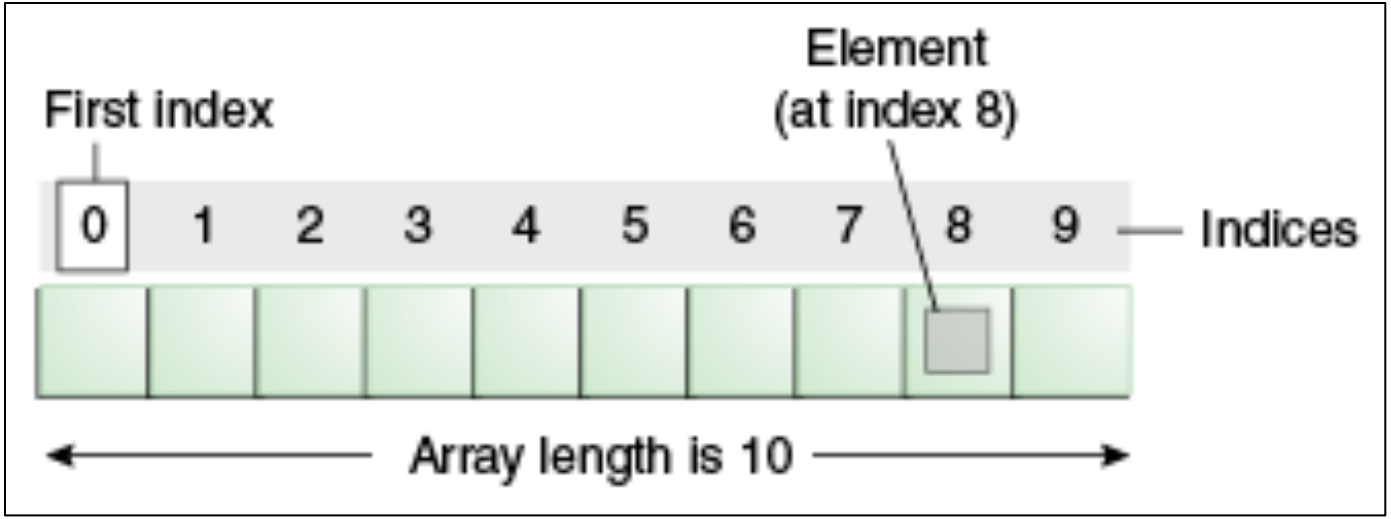
Directly stored in memory...

17

- We are now going to look at a **structure** that can **store many values** of the **same type**.
- Imagine a structure made up of sub-divisions or sections…
- Such a structure is called an **array** and would look like:

Array Syntax

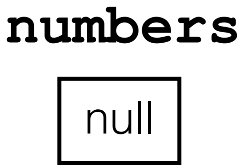
Structure of a primitive array



http://docs.oracle.com/javase/tutorial/java/nutsandbolts/arrays.html

Structure of a primitive array

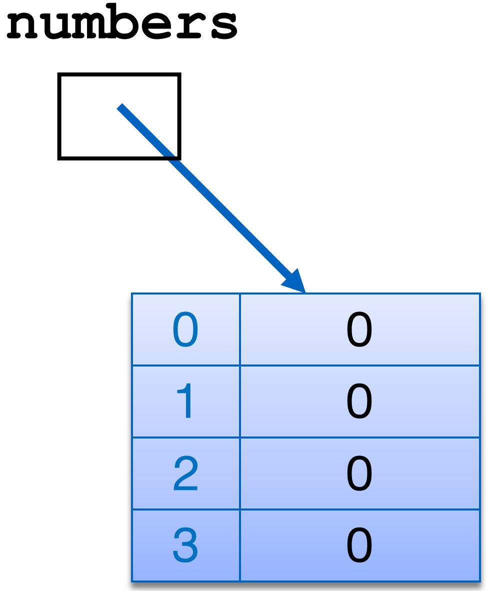
```
int[] numbers;
```



Structure of a primitive array

```
int[]  numbers;
```

```
numbers = new int[4];
```



0	0
1	0
2	0
3	0

Structure of a primitive array

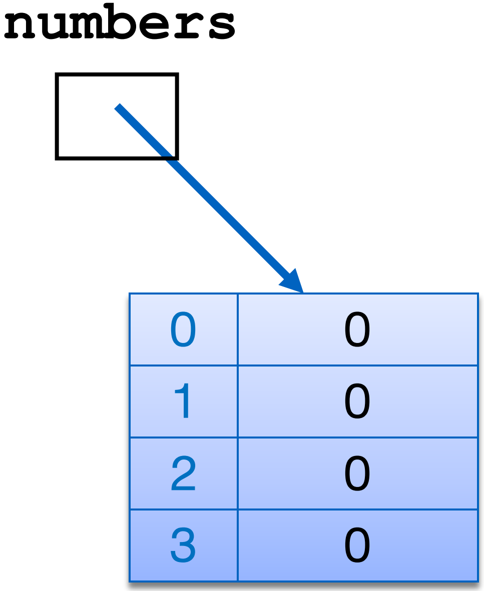
```
int[]  numbers;
```

```
numbers = new int[4];
```

We have declared an array of **int**, with a capacity of four.

Each element is of type int.

The array is called numbers.

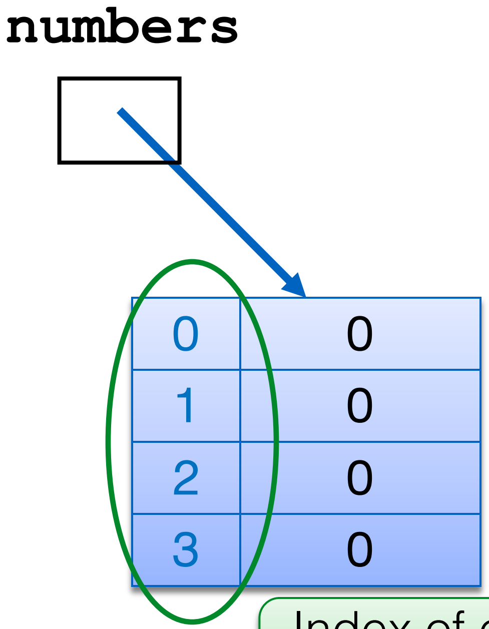


0	0
1	0
2	0
3	0

Structure of a primitive array

```
int[]  numbers;
```

```
numbers = new int[4];
```



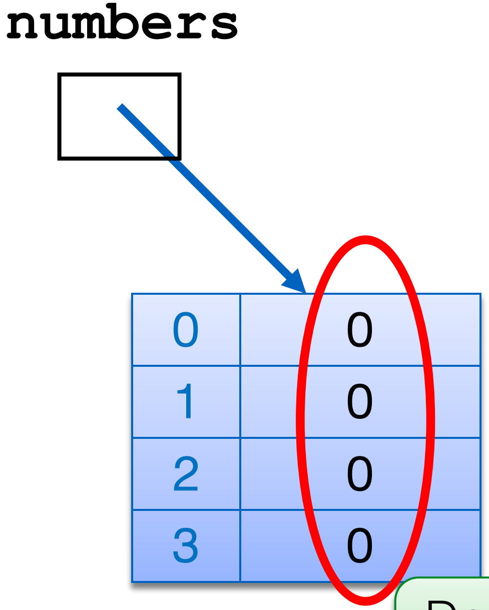
0	0
1	0
2	0
3	0

Index of each element in the array

Structure of a primitive array

```
int[]  numbers;
```

```
numbers = new int[4];
```



Default value for each element of type **int**.

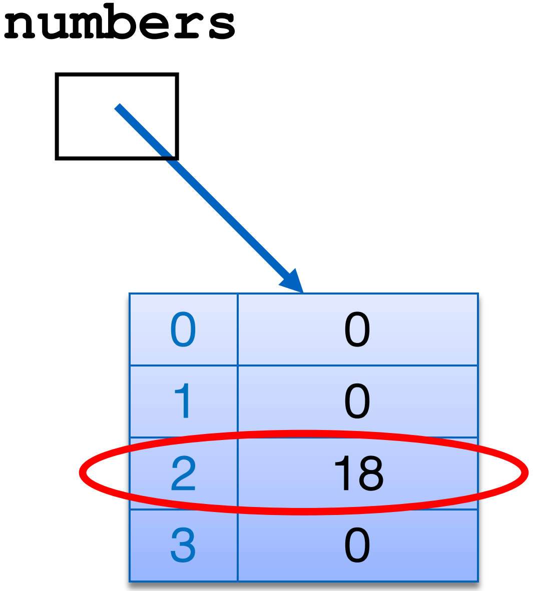
Structure of a primitive array

```
int[]  numbers;
```

```
numbers = new int[4];
```

```
numbers[2] = 18;
```

We are directly accessing the element at index **2** and setting it to a value of **18**.



0	0
1	0
2	18
3	0

Structure of a primitive array

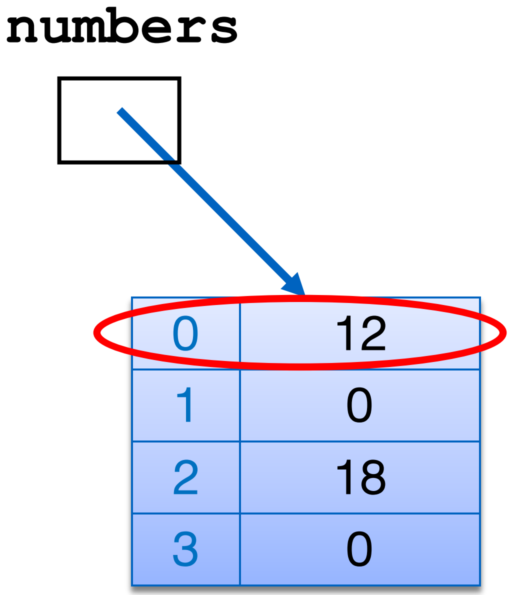
```
int[]  numbers;
```

```
numbers = new int[4];
```

```
numbers[2] = 18;
```

```
numbers[0] = 12;
```

We are setting the element at index **0** and to a value of **12**.



numbers

0	12
1	0
2	18
3	0

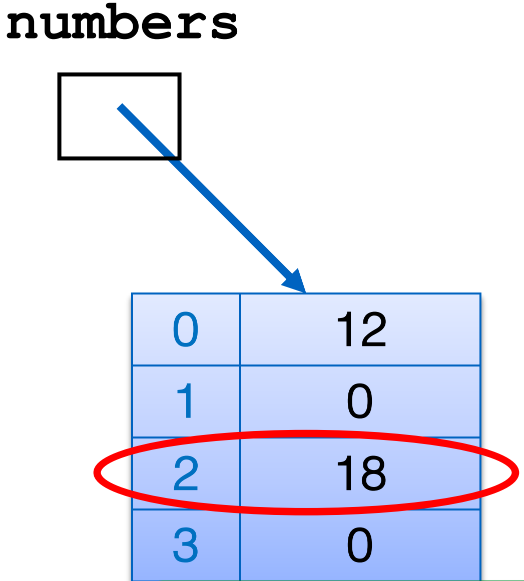
Structure of a primitive array

```
int[]  numbers;

numbers = new int[4];

numbers[2] = 18;
numbers[0] = 12;

print(numbers[2]);
```



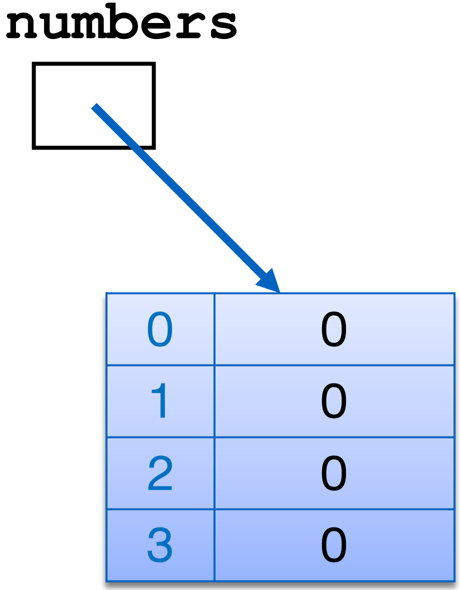
0	12
1	0
2	18
3	0

Here we are printing the contents of index location 2
i.e. 18 will be printed to the console.

Declaring a primitive array

```
int[] numbers;
//somecode
numbers = new int[4];
```

This is how we previously declared our array of four **int**, called **numbers**.



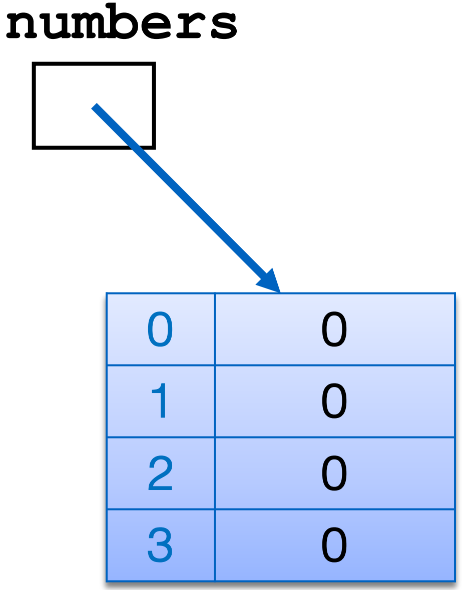
0	0
1	0
2	0
3	0

Declaring a primitive array

```
int[]  numbers;
//somecode
numbers = new int[4];
```

We can also declare it like this…

```
int[]  numbers = new int[4];
```



0	0
1	0
2	0
3	0

Returning to our method
that reads in, and sums, 10 numbers
(typed in from the keyboard)…

and converting it to use primitive
arrays…

Version that doesn’t save the numbers

```
import java.util.Scanner;
 :
Scanner input = new Scanner(System.in);
 :
int n;
int sum = 0;

for (int i = 0; i<10; i++)  {
    n = input.nextInt();
    sum += n;
}

System.out.println("The sum of the values you typed in is : " + sum);
```

Notice that,
each time a number is read in,
it overwrites the value stored in n.

It doesn’t remember
the individual numbers typed in.

Using arrays to remember numbers

```
import java.util.Scanner;
 :
Scanner input = new Scanner(System.in);
 :
int numbers[] = new int[10];
int sum = 0;

//read in the data
for (int i = 0; i < 10 ; i ++)  {
        numbers[i] = input.readInt();
}

// now we sum the values
for (int i = 0; i < 10 ; i ++)   {
        sum += numbers[i];
}

println("The sum of the values you typed in is : " + sum);
```

Using an array
to store each value
that was entered.

Using arrays to remember numbers

```
import java.util.Scanner;
 :
Scanner input = new Scanner(System.in);
 :
int numbers[] = new int[10];
int sum = 0;

//read in the data
for (int i = 0; i < 10 ; i ++)  {       Loop 1
        numbers[i] = input.readInt();
}

// now we sum the values
for (int i = 0; i < 10 ; i ++)   {      Loop 2
        sum += numbers[i];
}

println("The sum of the values you typed in is : " + sum);
```

Q: Can we reduce the code to only have **one loop?**

Could we move the “sum” code into the first loop?

Using arrays to remember numbers

```
import java.util.Scanner;
 :
Scanner input = new Scanner(System.in);
 :
int numbers[] = new int[10];
int sum = 0;

//read in the data
for (int i = 0; i < 10 ; i ++)  {      Loop 1
      numbers[i] = input.readInt();
      sum += numbers[i];
}

println("The sum of the values you typed in is : " + sum);
```

A: *Yes*

Move the “sum” code into the first loop.

-> functionality doesn’t change

What if we wanted the user to decide how many numbers they wanted to sum?

```
import java.util.Scanner;
 :
Scanner input = new Scanner(System.in);
int sum = 0;

//Using the numData value to set the size of the array
int numbers[];
System.out.println(”How many numbers do you need?”);
int numData = input.nextInt();

numbers = new int [numData];

//read in the data and sum the values
for (int i = 0; i < numData ; i ++)  {
        numbers[i] = input.nextInt();
            sum += numbers[i];
 }

 println("The sum of the values you typed in is : " + sum);
```

1. Delcare **numbers** to be an array of type integer.
2. **numData** takes in the size.
3. Use numData to initialize the array with **new** specifying the size.

What type of data
can be stored
in a primitive array?

An array can store ANY TYPE of data.

Primitive Types

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

byte smallNumbers[] = new byte[4];

char characters[] = new char[26];
```

Object Types

```
String words = new String[30];

Spot spots[] = new Spot[20];
```

Do we have to use
all the elements in the array?

Do we have to use all elements in the array?

- No.

- But…this might cause logic errors,
  if we don’t take this into consideration
  in our coding.

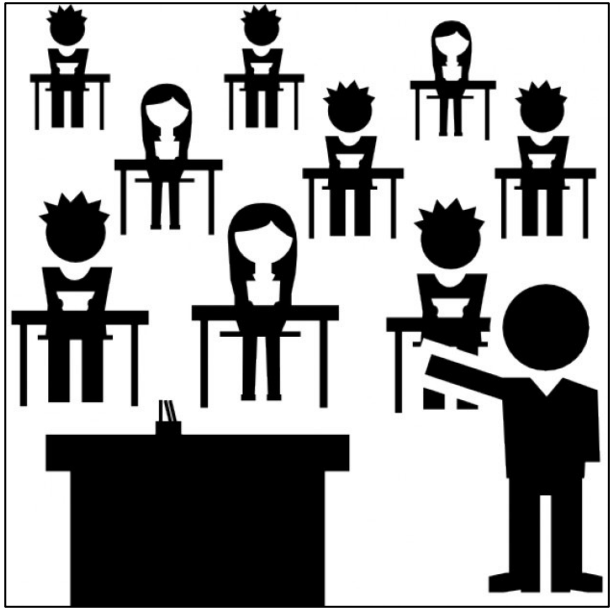
- Consider this scenario…

Scenario – exam results and average grade

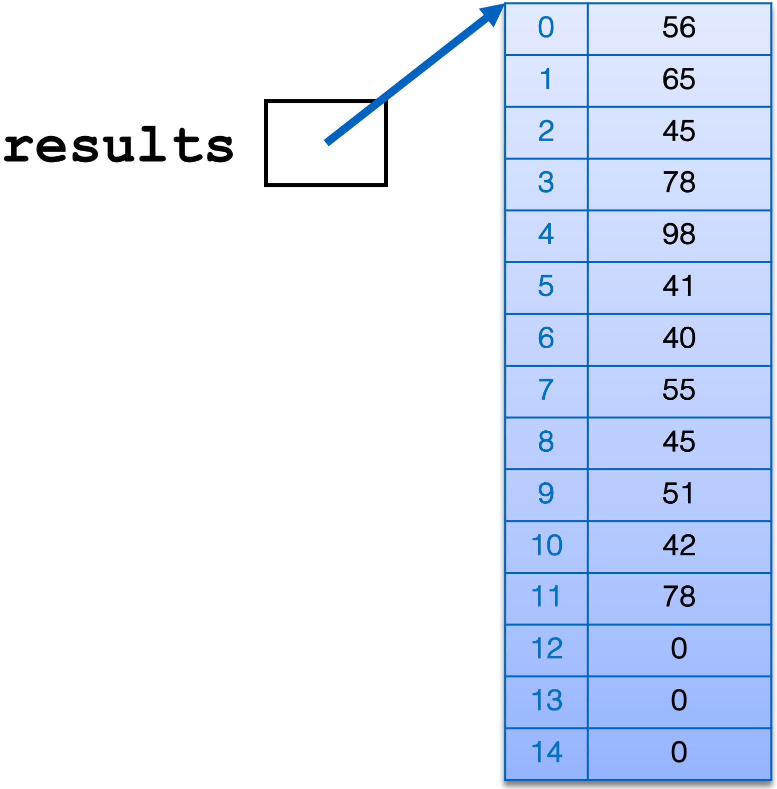
❑We have a class of 15 students.

❑They have a test coming up.

❑We want to store the results in an array and then find the average result.

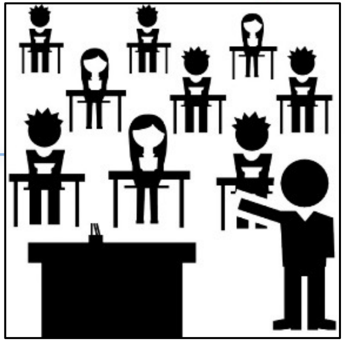


Average Grade



0	56
1	65
2	45
3	78
4	98
5	41
6	40
7	55
8	45
9	51
10	42
11	78
12	0
13	0
14	0

We create an array of int with a capacity of 15



Only 12 students sat the exam. Their results were recorded in the first 12 elements

To calculate the average result, divide by the number of **populated elements** - **NOT** the array capacity.

Do we have to use all elements in the array?

- If all elements in an array are NOT populated,
  we need to:
  - have another variable (e.g. int size)
    - containing the number of elements in the array **actually used**.
  - ensure size is used when processing the array
    - e.g.

```
for (int i= 0; i < size; i++)
```

- For now though,
  we assume that all elements of the array are populated and therefore ready to be processed.

Summary - Arrays

- Arrays are structures that can store many values of the same type
- Rule – Never lose input data
  - Arrays enable us to store the data efficiently
  - We can use loops with arrays
- Arrays can store ANY type
- Declaring arrays

```
int[] arryName;
//somecode
arryName = new int[4];
```

OR

```
int[] arryName= new int[4];
```

Questions?

Thanks.