
Arrays, Arrays,
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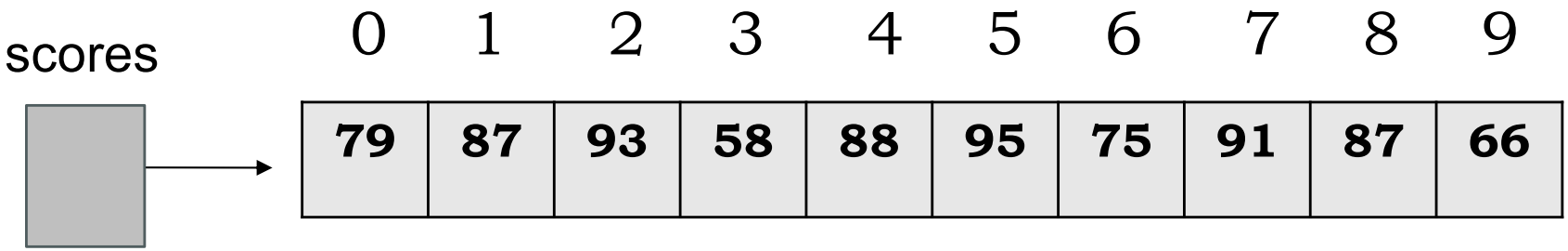
When you need to refer to a lot of similar items
using a single variable

Arrays stored contiguously

Here is an array of int

Each value has a numeric *index*

The entire array has a single name

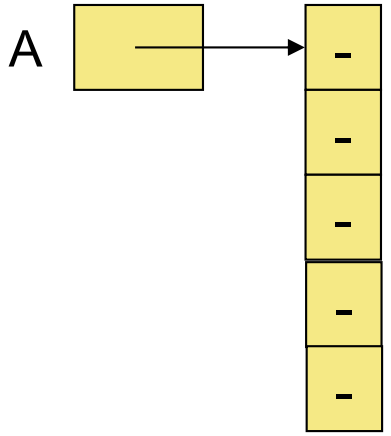


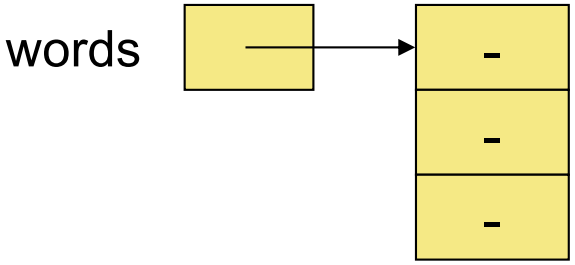
An array of size N is indexed from 0 to N-1
If you know the address of the 0-th item,
you know the address of all items
WHY ?

Not every array entry needs to have contents
We usually draw them horizontally or vertically

Declaration, Memory Allocation, Initialization

```
int[] A;          // declaration
A = new int[5]; // memory allocation

int[] arrayB = new int[5]; //both

char[] lettersArray = new char[5];

String[] words = new String[3];

  // declaration and initialization
  int[] arrayC = {1, 2, 3, 4};

char[] letterGrades = {'A', 'B', 'C', 'D', 'F'}

String[] wordArray = {"CS230", "Data", "Structures"};
```





Array Properties

- Array is an indexed and mutable collection.
  - We can directly change an element at *any* index.
- Arrays are homogeneous collections.
  All the elements of a Java array must have the same type.
- Arrays have a fixed length.
  Once an array is created, its length cannot be changed.
- For array `a` its length is given by `a.length`
- How do they differ from `String`s?

Arrays go well with for-loops

```
int[] arrayB = new int[5];
for (int i = 0; i < 5; i++) {
   arrayB[i] = 2*i;
}
```

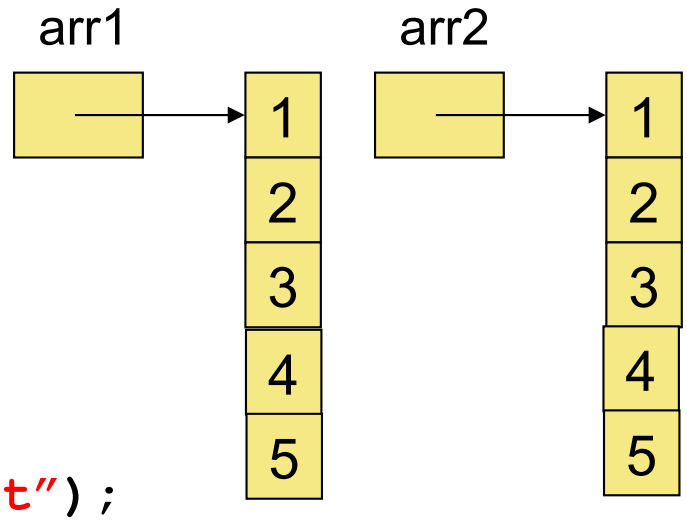
;

Copying and Comparing Arrays

When you access an array, you access it through a **reference**!

What is printed here?

```
int[] arr1 = {1, 2, 3, 4, 5};
int[] arr2 = {1, 2, 3, 4, 5};
if (arr1 == arr2)
    System.put.println("same");
else
    System.out.println("different");
```



What happens when you execute this line?

```
arr1 = arr2;
```

What Object does this behavior remind you of?

Practice!

How do we copy the contents of `arr1` into `arr2` that have the same length?

```
public static void copyArray(int [] arr1, int [] arr2)
// assume arr1.length == arr2.length
```

Answer:

```
{
    for (int i=0; i<arr1.length; i++)
        arr2[i] = arr1[i]);
}
```

Practice! Practice!

How do we check if two arrays `arr1` and `arr2` contain the same info??

```
public static boolean sameArrayInfo(int [] arr1, int [] arr2)
```

Answer:

```
{
    if (arr1.length != arr2.length) return false;
    for (int i=0; i<arr1.length; i++)
        if (arr1[i] != arr2[i]) return false;
    return true; // We did not find any difference
}
```

Arrays of Strings

- The elements of an array can be object references. E.g. references to String objects

```
String[] words = new String[5];
```

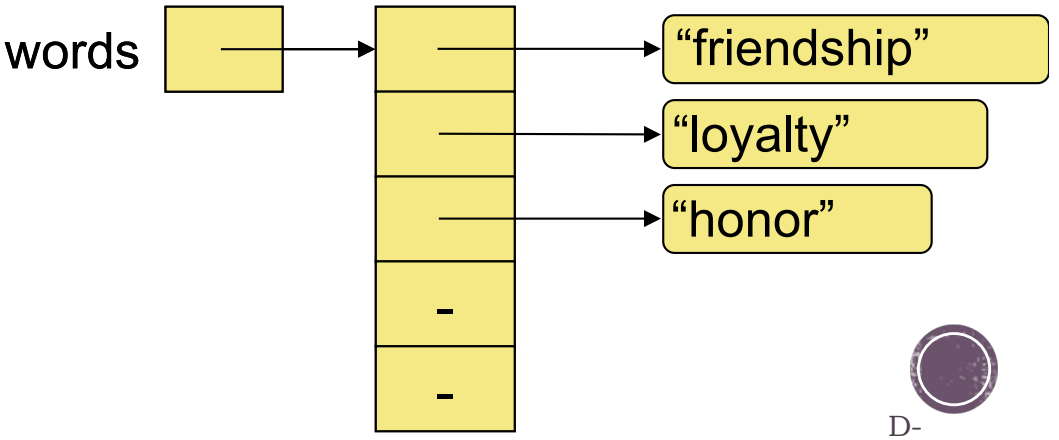
- Initially an array of objects holds **null** references, i.e.:

```
System.out.println (words[0].length());
```

- At this point, the above line would throw a **NullPointerException**

- Each object must be instantiated separately

```
words[1] = "loyalty";
words[0] = "friendship";
words[2] = "honor";
```



What about those args in main()?

- The **`String[] args`** input parameter in the **`main()`** method is Java's way to communicate with the outside world at the time of invocation
- The contents of array **`args`** (argument to the **`main()`** method are called **command-line arguments** and are provided when an application is run.

```
public class PlayGame {
   public static void main(String[] args) {
        String player1 = args[0];
        String player2 = args[1];
        System.out.print("Welcome to the game ");
        System.out.println(player1 + " and " + player2);
   }
}
```

```
>java PlayGame Jack Jill
```


Parameter
passing in Arrays

Parameter passing:
How methods communicate

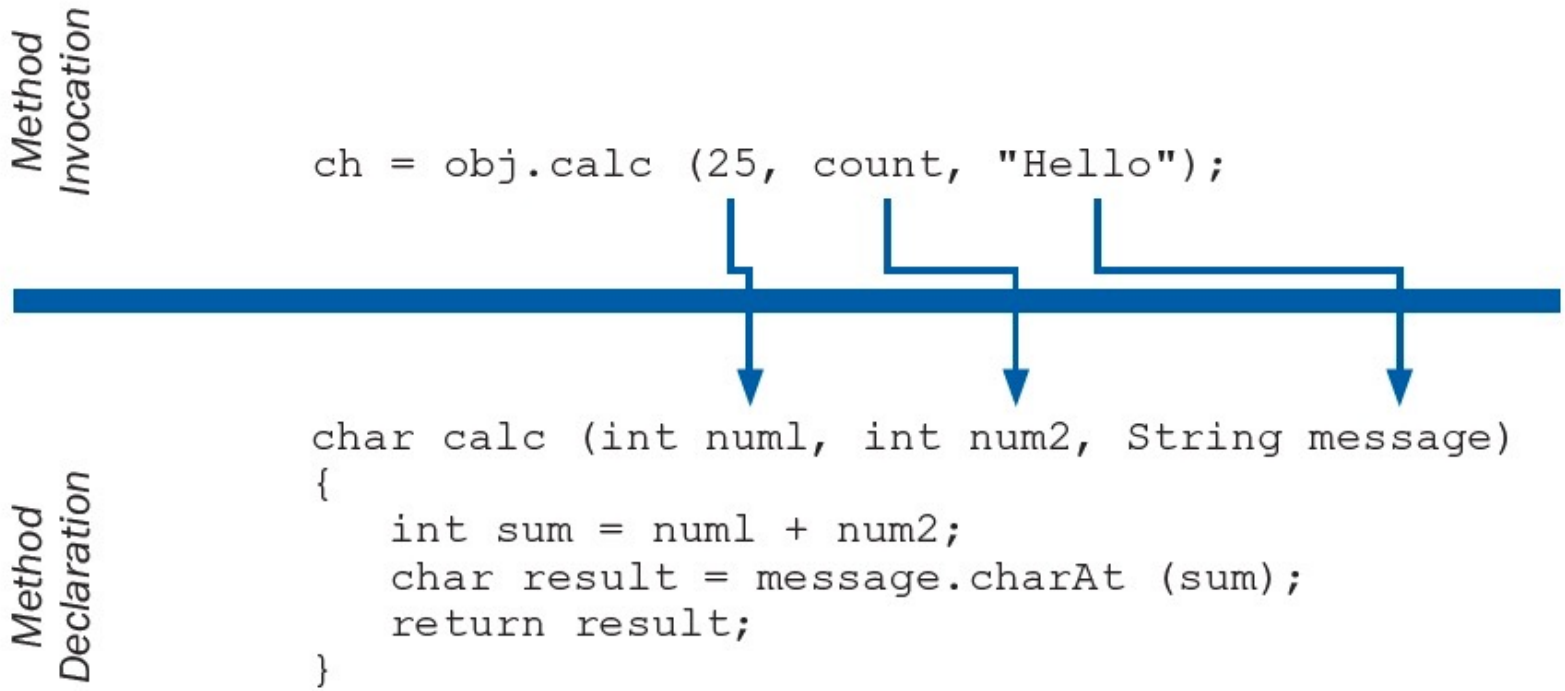


FIGURE 5.9 Passing parameters from the method invocation to the declaration

Arrays as parameters in methods for input and output

- An entire array can be passed as a parameter to a method

- Like any other object, the **reference** to the array is passed (NOT a copy of the array),
  making the formal and actual parameters **aliases** of each other

- Therefore, changing an array element within the method changes the original (called "by reference")

- This can also be a source of errors – be careful!

Methods can have arrays as input

```
//Compute the sum of the contents of an int[]
public static int sumElements (int[] numArray) {
 int sum = 0;
 for (int i = 0; i<numArray.length; i++)
      sum = sum + numArray[i];
 return sum;
}

//code in the driver (e.g. inside main() method)

int[] myData = {1, 2, 3, 4, 5};
int result = sumElements(myData);
```

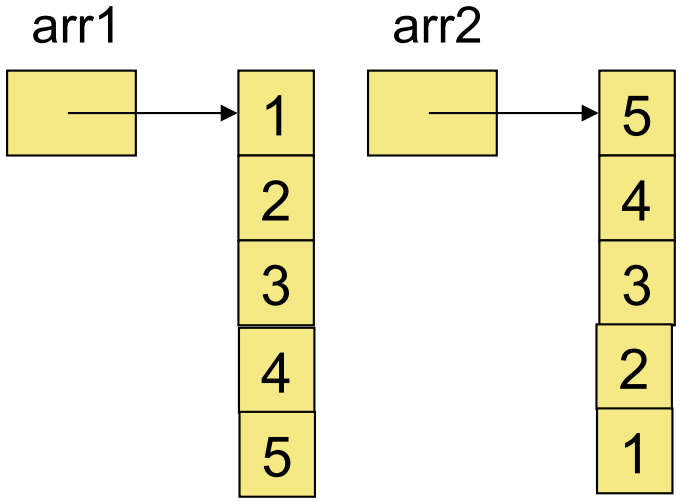
Methods can have arrays as output

```
//create an array and fill it up with its indices
public static int[] createNumArray (int size) {
   int[] newArray = new int[size];
   for (int i = 0; i<size; i++)
         newArray[i] = i;
   return newArray;
}

// code in the driver (e.g., inside main() method)

int[] arrayC = createNumArray(20);
```

Practice: Reverse an array!

Given an array `arr1` of int, create and return
a new array `arr2` that has its elements in reverse order

```
int [] arr2 = reverseArr(arr1);
```

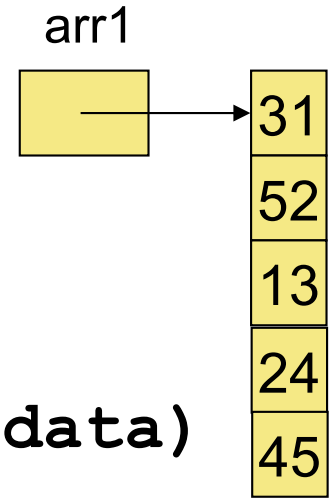



```
public static int[] reverseArr(int [] toReverse){




}
```

Practice: Compute average and maximum

Given the following array:

```
int[] arr1 = {31, 52, 13, 24, 45};
```



Write a function **`computeAverage(int[] data)`**

Write a function **`computeMaximum(int[] data)`**

Could you do them both at the same time? **`computeAvgMax()`**

What should your method return?