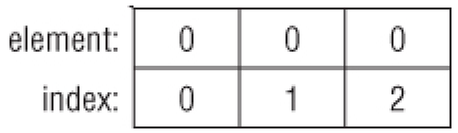
Module 5: Ammon Gruwell, Andrew Jensen

- Arrays
- Strings
- References vs. Primitives
- Equality
- Wrapper Classes
- Varargs

Arrays

- An Array is an ordered list of items that are all of the same type
    - {15, 31, 7}
    - {'a', 'g', 'x'}
- The items in the list are numbered starting at 0



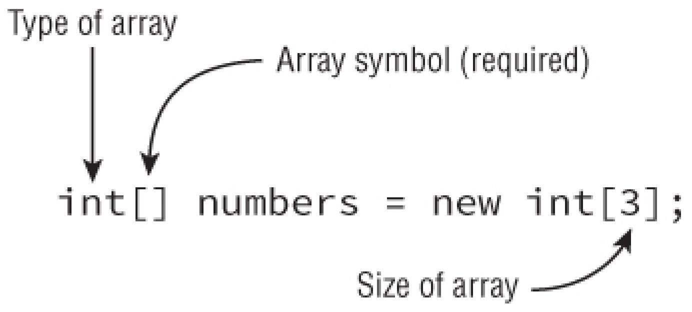
element:	0	0	0
index:	0	1	2

- Arrays initialize to 0
- Arrays may contain duplicates

Creating An Array

```
int[] numbers = new int[3];
```

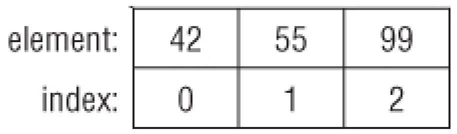
- Creates new array with three elements named "numbers"
- Each element is initialized to 0
- What type is the variable "numbers"?



Creating An Initialized Array

```java
int[] myNumbers = new int[] {42, 55, 99};
int[] numbers2 = {42, 55, 99};
```

- When initializing, we can leave off the "new int[]" part



element:	42	55	99
index:	0	1	2

Creating An Array: Syntax

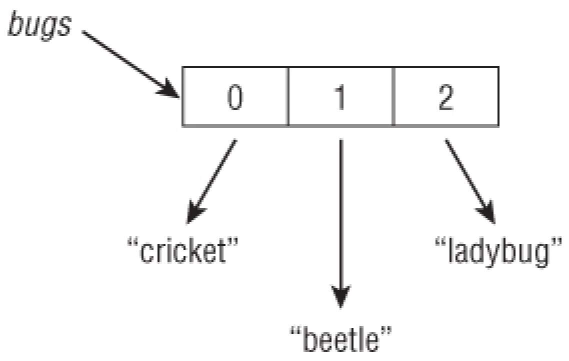
- Which of these is valid Java syntax?

```
int[] myArray1;
int [] myArray2;
int myArray3[];
int myArray4 [];
```

Creating An Array of Objects

```
String[] bugs = {"cricket", "beetle", "ladybug"};
```

- Array only contains references to the objects, not the objects themselves



- In the following example, what does each item in the list initialize to?

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

Using Arrays

- To access an item in an array we use the "varName[index]" notation
- We can get the size of an array using the "length" attribute

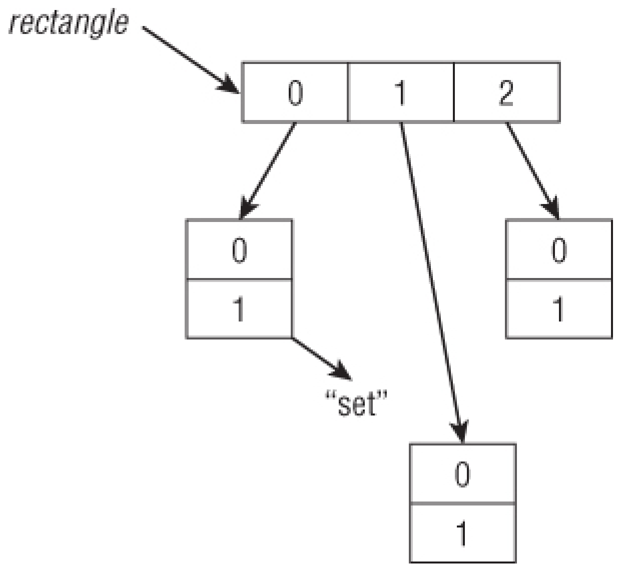
```java
String[] animals = {"tiger", "kangaroo", "shark"};
System.out.println(animals[0]); // tiger
System.out.println(animals[2]); // shark
System.out.println(animals.length); // 3
```

Practice!

- Open up Favorites.java

Multidimensional Arrays

- Arrays can have more than one dimension
- String[][] rectangle = new String[3][2];



Practice!

- Open up TwoDimArray.java

Strings

- A sequence of characters
- String myName = "Ammon";
    - Is this a primitive type?
    - If not, why no "new" keyword?

String Concatenation

- To combine two strings we use the + operator
- When strings are concatenated with numbers, the numbers are converted to strings

```
- System.out.print("abc" + "de"); //abcde
- System.out.print(99 + " red balloons"); //99 red balloons
- System.out.print(9 + 9 + " red balloons"); //18 red balloons
```

String Concatenation Rules

- Rules to follow when concatenating:
  - When "adding" two numbers use numeric addition
  - Use string concatenation otherwise
  - Go left to right

```java
int three = 3;
String four = "4";
System.out.println(1 + 2 + three + four);
```

String Immutability

- Mutable = changeable
- An immutable object is one that can't be changed once it is created
- Strings are immutable

String Immutability

- What does the following code print out?

```
String s1 = '1';
String s2 = s1.concat("2");
s2.concat("3");
System.out.println(s2);
```

String Comparison

```java
String a = "12345";
String b = "12345";

//How will the following variables be set?
boolean ref_equality = (a == b) ? true : false;
boolean val_equality = (a.equals(b)) ? true : false;
```

The String Pool

- In order to save memory, Java reuses string literals

```
String a = "Error";
String b = "Error";
```

- In this code the variables a and b will both point to a single copy of "Error" in the Java String Pool

String Methods

- length() - returns the length of a string
    - Don't confuse with the ".length" attribute of arrays

```
String axiom = "Java Rocks!";
System.out.print(axiom.length()); //11
```

- charAt(int index) - returns the character at the specified index

```
System.out.print(axiom.charAt(5)); //R
System.out.print(axiom.charAt(15)); //Error!
```

String Methods

- indexOf(char c) - returns the index of a given character or string
    - indexOf(String s)

```
String truth = "I love Java!";
System.out.print(truth.indexOf('v')); //4
System.out.print(truth.indexOf("Java")); //7
System.out.print(truth.indexOf("C++"); //-1
```

- substring(int start, int end) - returns part of a string
    - substring(int start)

```
System.out.print(truth.substring(7, 11) + " loves me");
//Java loves me
```

String Methods

- toLowerCase() - converts all letters in the string to lower case
    - toUpperCase()

```
String lie = "Java is Hard";
System.out.print(lie.toLowerCase()); //java is hard
System.out.print(lie.toUpperCase()); //JAVA IS HARD
```

- equals(String s) - checks value equality
    - equalsIgnoreCase(String s)

```
System.out.print(lie.equals("java is hard")); //false
System.out.print(lie.equalsIgnoreCase("java is hard")); //true
```

String Methods

- startsWith(String prefix) - indicates if the string starts with the given prefix
- endsWith(String suffix) - indicates if the string ends with the given suffix
- contains(String s) - indicates if the string contains the given substring
- replace(char c, char d) - replaces one char in the string with another
  - replace(String s, String t)
- trim() - trims off all whitespace before and after the string

String Method Chaining

- What does the following print out?

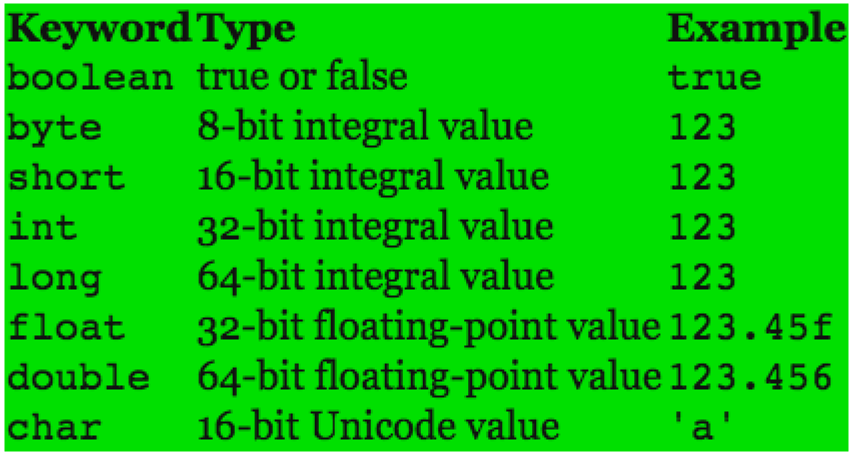
```
String result = " My Programs Never Have Bugs ".trim()
                 .toLowerCase().substring(3)
                 .replace("never", "always");
System.out.println(result);
```

Practice

- Open up Strings.java!

Primitives

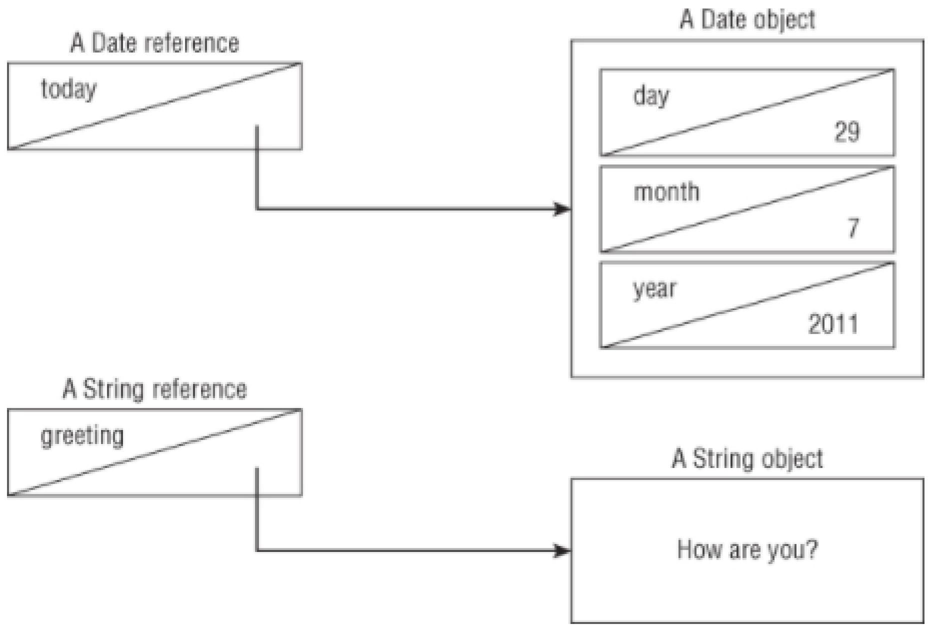
- Primitives are the basic building blocks of everything in Java
- A primitive value is held directly in memory
- It cannot be null
- It cannot have any methods



Keyword	Type	Example
`boolean`	true or false	`true`
`byte`	8-bit integral value	`123`
`short`	16-bit integral value	`123`
`int`	32-bit integral value	`123`
`long`	64-bit integral value	`123`
`float`	32-bit floating-point value	`123.45f`
`double`	64-bit floating-point value	`123.456`
`char`	16-bit Unicode value	`'a'`

Reference Types

- A reference type holds the memory address of a Java object
- It can be set to null and can have methods



Value Equality vs. Identity Equality

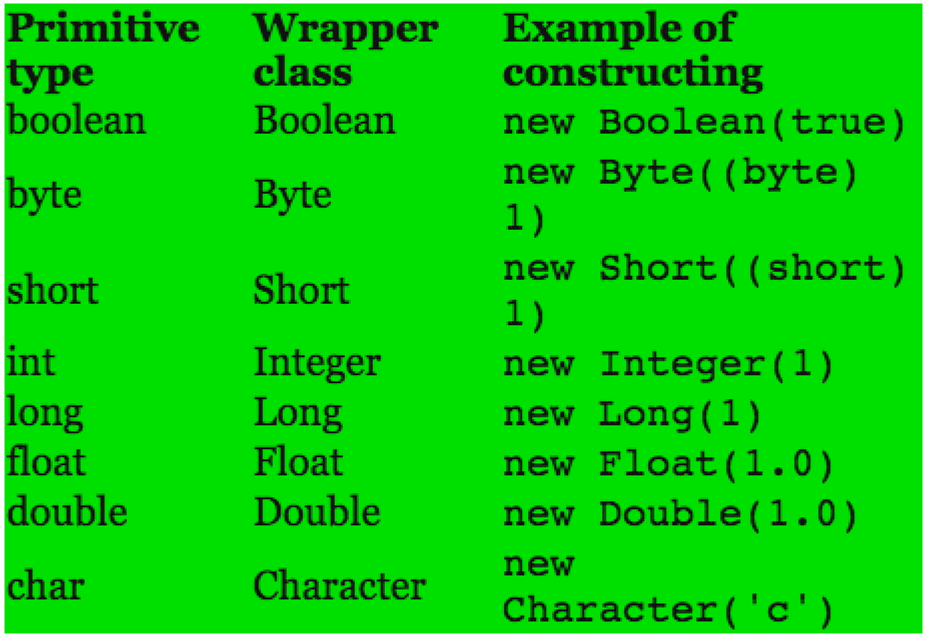
- When comparing numbers we use the == operator
- When comparing objects the == operator compares references and not the actual objects themselves.
- To compare the actual objects we override and use the equals() method

Example!

- Open up Duck.java

Wrapper Classes

- Frequently, Java data structures only accept objects
- If we want to store primitives in these containers then we have to wrap them in an object first
- Java has wrapper classes that correspond to each primitive type



Primitive type	Wrapper class	Example of constructing
boolean	Boolean	`new Boolean(true)`
byte	Byte	`new Byte((byte) 1)`
short	Short	`new Short((short) 1)`
int	Integer	`new Integer(1)`
long	Long	`new Long(1)`
float	Float	`new Float(1.0)`
double	Double	`new Double(1.0)`
char	Character	`new Character('c')`

Varargs

- Varargs is short for variable arguments
- It is a method paramater that can accept any number of items
- It can be treated much like an array by the called method
- A method may only have one varargs parameter and it must be last

```
public static void printNumbers(int... numbers){ //
  for(int i=0; i<numbers.length; i++){
    System.out.print(numbers[i] + " ");
  }
}
public static void main(String[] args){
  printNumbers(1); //1
  printNumbers(5, 3, 8); //5 3 8
}
```

References :

- OCA Java SE 8 Programmer I Study Guide
- https://docs.oracle.com/javase/tutorial/java/nutsandbolts/arrays.html
- https://docs.oracle.com/javase/tutorial/java/data/strings.html

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That's All For Today!