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Java Foundations

4-3

The String Class

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Objectives

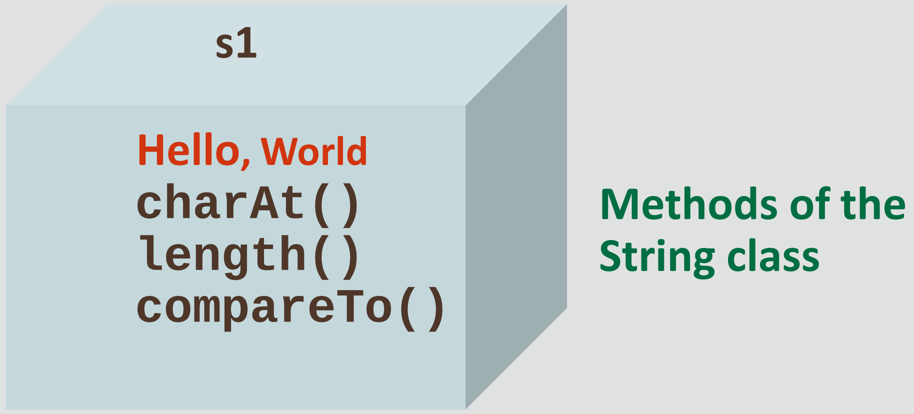
- This lesson covers the following objectives:
  - Locate the String class in the Java API documentation
  - Understand the methods of the String class
  - Compare two String objects lexicographically
  - Find the location of a substring in a String object
  - Extract a substring from a String object

What’s a String?

- A string is a sequence of characters including alphabet letters, special characters, and white space
- For example:
  - “How are you?” is a string that contains letters, white space, and a special character (‘?’)
- In Java, strings are not a primitive data type
- Instead, they are objects of the String class

Representing Strings in Java

- In Java, strings are objects of the class named java.lang.String
- Example:
  - String s1= “Hello, World”;



Representing Strings in Java

- A string in Java is more abstract
- That is, you aren’t supposed to know about its internal structure, which makes it easy to use
- Its methods allow a programmer to perform operations on it

Using the String Class

- The String class:
  - Is one of the many classes included in the Java class libraries.
  - Is part of java.lang.package
  - Provides you with the ability to hold a sequence of characters of data
- You will use the String class frequently throughout your programs
- Therefore, it’s important to understand some of the special characteristics of strings in Java

Documentation of the String Class

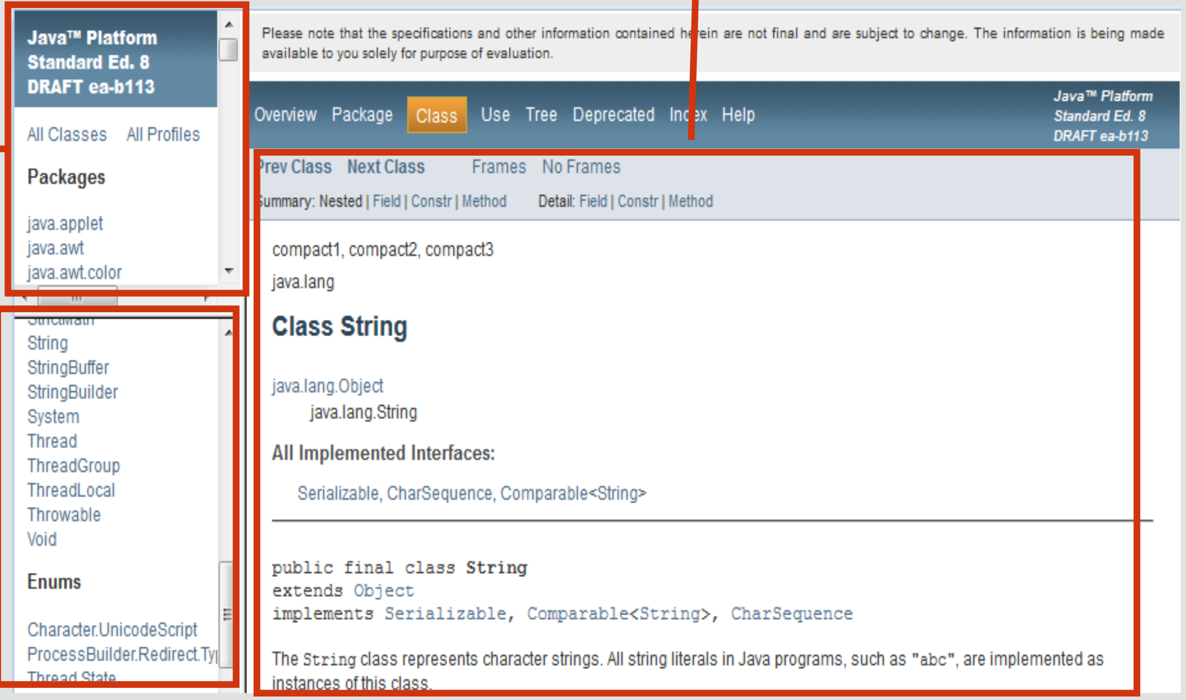
- You can access the documentation of the Java String class from here:
  - https://docs.oracle.com/javase/8/docs/api/

Java Platform SE 8 Documentation for the String Class

Details about the class selected

Select All Classes or a particular package

The classes for the selected packages are listed here



Java™ Platform Standard Ed. 8 DRAFT ea-b113
All Classes All Profiles
Packages
java.applet
java.awt
java.awt.color
String
StringBuffer
StringBuilder
System
Thread
ThreadGroup
ThreadLocal
Throwable
Void
Enums
Character.UnicodeScript
ProcessBuilder.Redirect.Ty
Thread.State
Overview Package Class Use Tree Deprecated Index Help
Prev Class Next Class Frames No Frames
Summary: Nested | Field | Constr | Method Detail: Field | Constr | Method

Please note that the specifications and other information contained herein are not final and are subject to change. The information is being made available to you solely for purpose of evaluation.

compact1, compact2, compact3
java.lang

Class String

java.lang.Object
    java.lang.String

All Implemented Interfaces:

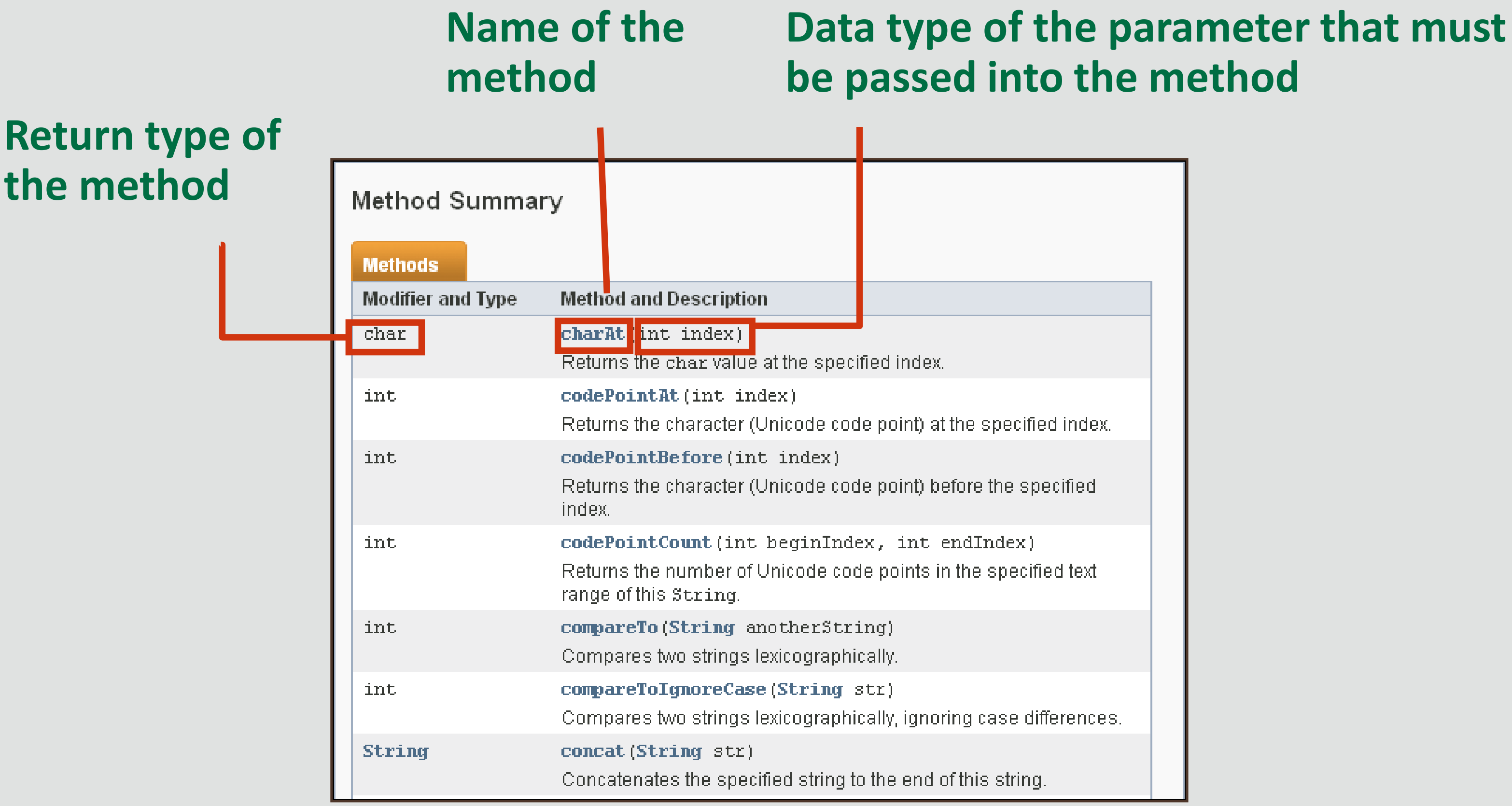
Serializable, CharSequence, Comparable<String>

```
public final class String
extends Object
implements Serializable, Comparable<String>, CharSequence
```

The `String` class represents character strings. All string literals in Java programs, such as `"abc"`, are implemented as instances of this class.

String Class Documentation: Method Summary

- `public int charAt(String str)`


Name of the method
Data type of the parameter that must be passed into the method
Return type of the method

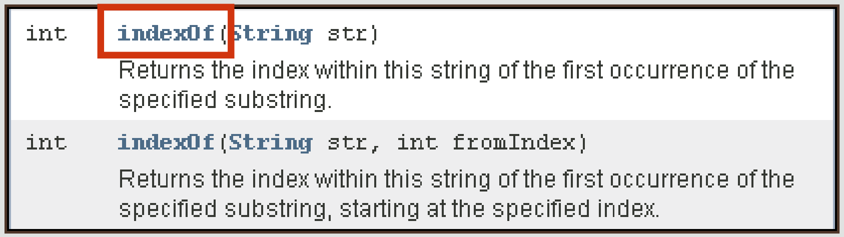
Method Summary

Methods

Modifier and Type	Method and Description
char	charAt(int index) Returns the char value at the specified index.
int	codePointAt(int index) Returns the character (Unicode code point) at the specified index.
int	codePointBefore(int index) Returns the character (Unicode code point) before the specified index.
int	codePointCount(int beginIndex, int endIndex) Returns the number of Unicode code points in the specified text range of this String.
int	compareTo(String anotherString) Compares two strings lexicographically.
int	compareToIgnoreCase(String str) Compares two strings lexicographically, ignoring case differences.
String	concat(String str) Concatenates the specified string to the end of this string.

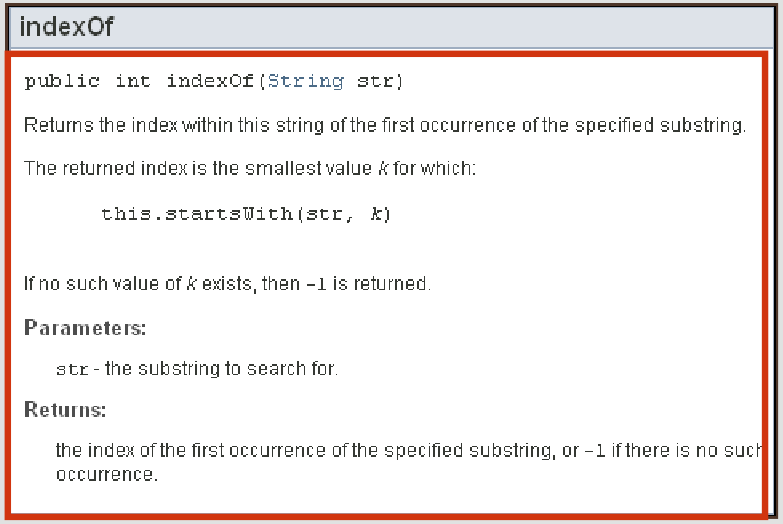
String Class Documentation: Method Detail

Click here to get the detailed description of the method



int	indexOf(String str) Returns the index within this string of the first occurrence of the specified substring.
int	indexOf(String str, int fromIndex) Returns the index within this string of the first occurrence of the specified substring, starting at the specified index.

Detailed description of the indexOf() method



indexOf

```
public int indexOf(String str)
```

Returns the index within this string of the first occurrence of the specified substring.

The returned index is the smallest value *k* for which:

```
    this.startsWith(str, k)
```

If no such value of *k* exists, then -1 is returned.

Parameters:

str - the substring to search for.

Returns:

the index of the first occurrence of the specified substring, or -1 if there is no such occurrence.

Further details about parameters and return value are shown in the method list

String Methods: length

- You can compute the length of a string by using the length method defined in the String class:
  - Method: name.length()
  - Returns the length, or the number of characters, in name as an integer value
- Example:

```
String name = "Mike.W";
System.out.println(name.length()); //6
```

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Accessing Each Character in a String

- You can access each character in a string by its numerical index
- The first character of the string is at index 0, the next is at index 1, and so on
- For example:
- `String str = "Hello, World";`

H	e	l	l	o	,		W	o	r	l	d
0	1	2	3	4	5	6	7	8	9	10	11

  – str has 0 to 11 indexes; that is, between 0 to str.length()-1

String Methods: indexOf()

- Each character of a string has an index
- You can retrieve the index value of a character in the string by using the indexOf method:

Method	**Description**
`str.indexOf(char c)`	Returns the index value of the first occurrence of c in String str
`s1.indexOf(char c, int beginIdx)`	Returns the index value of the first occurrence of c in String s1, starting from beginIdx to the end of the string

String Methods: indexOf()

```
public static void main(String args[]){
       String phoneNum = "404-543-2345";
       int idx1 = phoneNum.indexOf('-');
       System.out.println("index of first dash: "+ idx1); //3
       int idx2 = phoneNum.indexOf('-’, indx1+1);
       System.out.println("second dash idx: "+ idx2); // 7
}//end method main
```

String Methods: charAt

- Returns the character of the string located at the index passed as the parameter
- Method: str.charAt(int index)

```
String str = "Susan";
System.out.println(str.charAt(0));  //S
System.out.println(str.charAt(3));  //a
```

String Methods: substring()

- You can extract a substring from a given string
- Java provides two methods for this operation:

Method	Description
`str.substring(int beginIdx)`	Returns the substring from beginIdx to the end of the string
`str.substring(int beginIdx, int endIdx)`	Returns the substring from beginIdx up to, but not including, endIdx

String Methods: substring()

```
public static void main(String args[]){
    String greeting = "Hello, World!";
    String sub = greeting.substring(0, 5); → "Hello"
    String w = greeting.substring(7, 11); → "Worl"
    String tail = greeting.substring(7); → "World!"
}//end method main
```

String Methods: replace()

- This method replaces all occurrences of matching characters in a string
- Method: replace(char oldChar,char newChar)
- Example:

```
public static void main(String args[]) {
    String str = "Using String replace to replace character";
    String newString = str.replace("r", "R");
    System.out.println(newString);
}//end method main
```

  - Output: Using String Replace to Replace ChaRacteR
  - All occurrences of a lowercase “r” are replaced with a capital "R"

String Methods: replaceFirst()

- This method replaces only the first occurrence of a matching character pattern in a string
- Method: replaceFirst(String pattern, String replacement)

String Methods: replaceFirst()

- Example:

```
public static void main(String args[]) {
    String replace = "String replace with replaceFirst";
    String newString = replace.replaceFirst("re", "RE");
    System.out.println(newString);
}//end method main
```

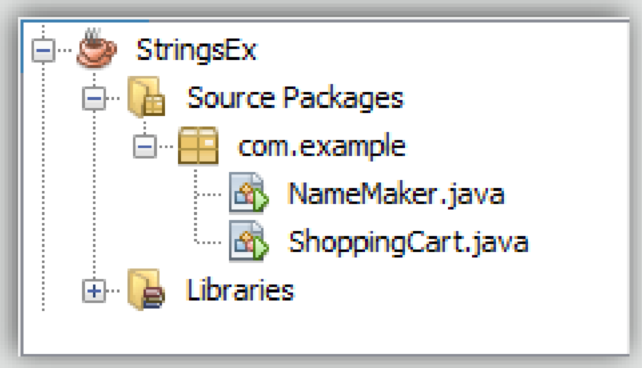
- Output:
  - String REplace with replaceFirst
- Only the first occurrence of "re" is replaced with "RE"
- The second occurrence isn’t changed

Exercise 1, Part 1

- Import and open the `StringsEx` project
- Examine `ShoppingCart.java`
- Perform the following:
  - Use the indexOf method to get the index for the space character (" ") within custName
  - Assign it to spaceIdx
  - Use the substring method and spaceIdx to get the first name portion of custName
  - Assign it to firstName and print firstName

Exercise 1, Part 2

- You might notice that this project has two .java files with main methods
  - This could seem like a contradiction because we said never to write more than one main method!



- Sometimes programmers do this when they're testing small bits of code and they want to keep all their files neatly in one project
  - Unfortunately, pressing run in NetBeans always runs the same file and never the others
  - You'll have to right-click the alternate file you want to run, a menu will appear with an option to run that file

Declaring and Creating a String

- You can instantiate strings in two ways:
- String literals:
  - Directly assign a string literal to a string reference

String Reference **String Literal**

```
String hisName = "Fred Smith";
```

- new operator:
  - Similar to any other class
  - Not commonly used and not recommended

```
String herName = new String("Anne Smith");
```

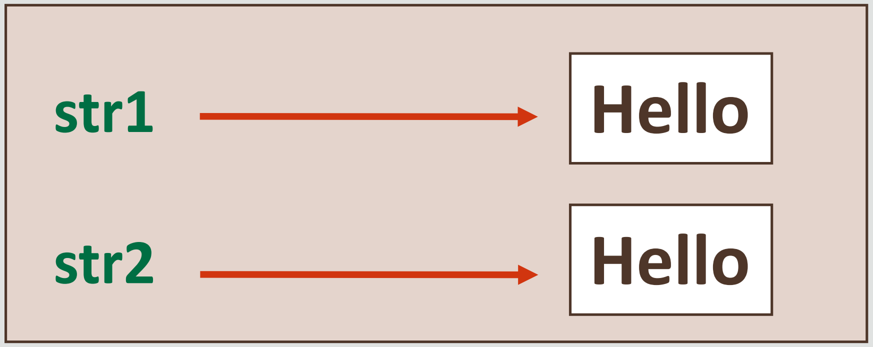
The new keyword

Strings Are Immutable

- A String object is immutable; that is, after a String object is created, its value can't be changed
- Because strings are immutable, Java can process them very efficiently
  - Consider the following:

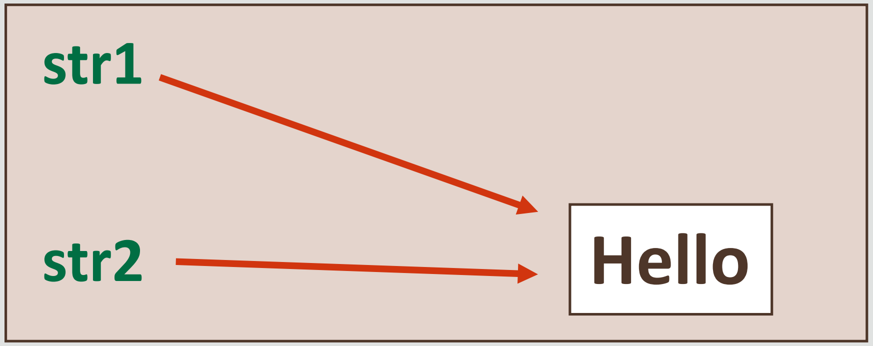
```
String str1 = "Hello";
String str2 = "Hello";
```

  - We expect this …



Strings Are Immutable

- But this is what happens …



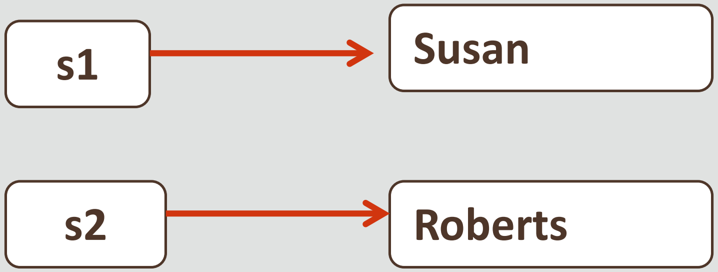
- The Java runtime system knows that the two strings are identical and allocates the same memory location for the two objects

Concatenating Strings

- In Java, string concatenation forms a new string that's the combination of multiple strings
- You can concatenate strings in Java two ways :
  - **+** string concatenation operator
  - **concat()** method

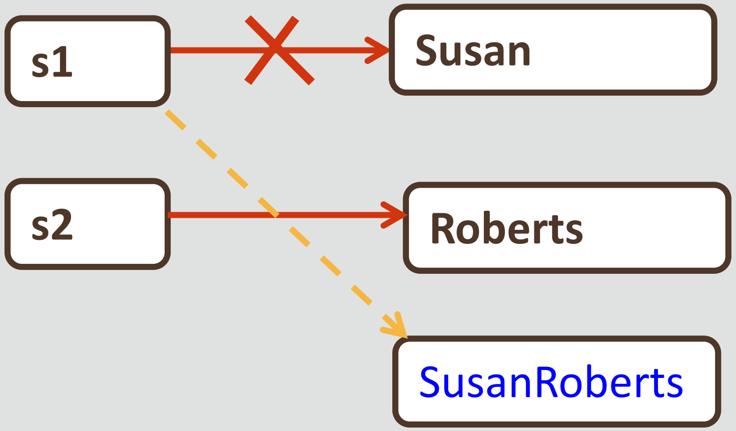
Using the + Operator (Before Concatenation)

```
public static void main(String args[]) {
    String s1 = "Susan";
    String s2 = "Roberts";
}//end method main
```



Using the + Operator (After Concatenation)

```
public static void main(String args[]) {
    String s1 = "Susan";
    String s2 = "Roberts";
   S1 = s1 + s2;
   System.out.println(s1);
}//end method main
```



Concatenating Non-String Data with String

- If one of the operands is a string, Java automatically converts non-string data types to strings prior to concatenation
- Example:

```
public static void main(String args[]) {
    String newString = "Learning Java" + 8;
    System.out.println(newString); // Learning Java 8

    System.out.println("Total : " + 8 + 8);//Total: 88
    System.out.println("Total : " + (8 + 8)) //Total: 16

    String numString1 = "8" + 8;
    System.out.println(newString1); // 88
}//end method main
```

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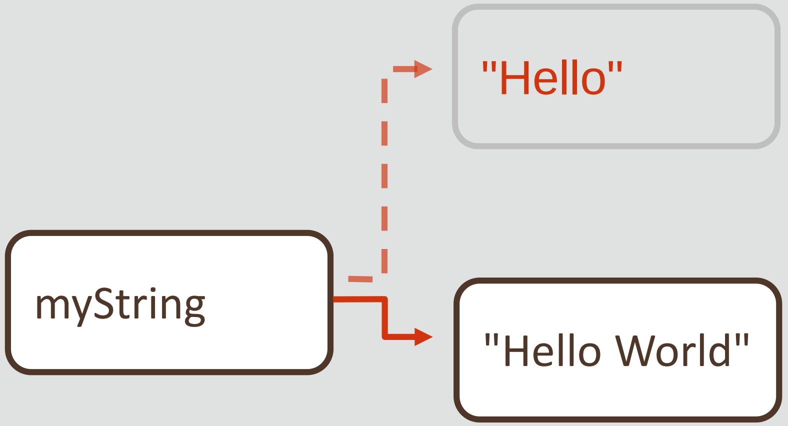
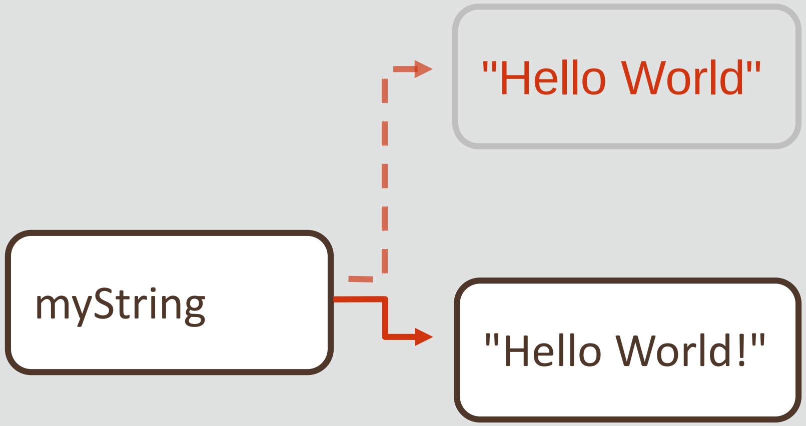
Using the concat() Method (Before Concatenation)

```
String myString = "Hello";
myString = myString.concat(" World");
```



Using the concat() Method (After Concatenation)

```
String myString = "Hello";
myString = myString.concat(" World");
myString = myString + "!"
```



Exercise 2

- Import and open the `StringsEx` project
- Examine `NameMaker.java`
- Perform the following:
  - Declare String variables: firstName, middleName, lastName, and fullName
  - Prompt users to enter their first, middle, and last names and read the names from the keyboard
  - Set and display the fullName as firstName+a blank char+middleName+a blank char+lastName

Exercise 2

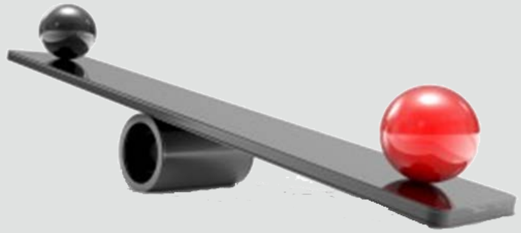
- Which do you think is preferable for this scenario?
- That is, the string concatenation operator or the concat() method?

What’s the Preferred Way to Concatenate Strings?

- As you observed in the previous exercise:
- + operator:
  - Can work between a string and a string, char, int, double or float data type value
  - Converts the value to its string representation before concatenation
- concat()method:
  - Can be called only on strings
  - Checks for data type compatibility, and a compile time error is produced if they don't match

How Do You Compare String Objects?

- You can compare two String objects by using the compareTo method
- This method compares based on the lexicographical order of strings
- Lexicographic comparisons are similar to the ordering found in a dictionary
- The strings are compared character by character until their order is determined or until they prove to be identical
- Syntax: **s1.compareTo(s2)**
- Returns an integer value that indicates the ordering of the two strings



Value Returned by compareTo()

- The integer value returned by the compareTo() method can be interpreted as follows:
  - Returns < 0 when then the string calling the method is lexicographically first
  - Returns == 0 when the two strings are lexicographically equivalent
  - Returns > 0 when the the parameter passed to the method is lexicographically first

Using the compareTo Method

- Let’s look at some examples:
  - "computer".compareTo("comparison")
    - Returns an integer > 0 because the "comparison" parameter is lexicographically first
  - "cab".compareTo("car")
    - Returns an integer < 0 because the “cab” string calling the method is lexicographically first
  - "car".compareTo("car")
    - Returns an integer equal to 0 because both are lexicographically equivalent

Using the compareTo method: Example

- Let's write a program to compare names by using the compareTo method:

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

    String s1 = "Susan";
    String s2 = "Susan";
    String s3 = "Robert";

    //Returns 0 because s1 is identical to s2
    System.out.println(s1.compareTo(s2)); //Output is 0

    //Returns >0 because ‘S’ follows‘R’
    System.out.println(s1.compareTo(s3)); // Output is 1

    //Returns <0 because ‘R’ precedes ‘S’
    System.out.println(s3.compareTo(s1)); // Output is -1
}//end method main
```

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Summary

- In this lesson, you should have learned how to:
  - Locate the String class in the Java API documentation
  - Understand the methods of the String class
  - Compare two String objects lexicographically
  - Find the location of a substring in a String object
  - Extract a substring from a String object

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