

Unit 2: Using Objects Strings

Adapted from:

- 1) Building Java Programs: A Back to Basics Approach
by Stuart Reges and Marty Stepp
- 2) Runestone CSAwesome Curriculum

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Textbook Reference

[Online Textbook Think Java - 2nd Edition](#) by Allen Downey and Chris Mayfield

For this lecture use [Chapter 9.3](#)

Strings

- **string**: An object storing a sequence of text characters.
 - String is not a primitive type. String is an object type.
 - Three ways to initialize a string:
 1. `String a = new String("text");`
 2. `String b = "text";`
 3. `String c = expression;`
 - Examples:

```
String a = new String("John Smith");  
String b = "John Smith";  
String c = "John" + "Smith";
```

The String class is part of the java.lang package. Classes in the java.lang package are available by default.

Indexes

- Characters of a string are numbered with 0-based indexes:

```
String a = "J. Smith";
```

index	0	1	2	3	4	5	6	7
character	J	.		S	m	i	t	h

- First character's index : 0
- Last character's index : 1 less than the string's length

String concatenation

string concatenation: primitive values can be concatenated with a String object using `+`. This causes implicit conversion of the values to String objects.

<code>"hello" + 42</code>	is	<code>"hello42"</code>
<code>1 + "abc" + 2</code>	is	<code>"1abc2"</code>
<code>"abc" + 1 + 2</code>	is	<code>"abc12"</code>
<code>"1" + 1</code>	is	<code>"11"</code>
<code>1 + 2 + "abc"</code>	is	<code>"3abc"</code>
<code>"abc" + 9 * 3</code>	is	<code>"abc27"</code>
<code>4 - 1 + "abc"</code>	is	<code>"3abc"</code>

Use `+` to print a string and an expression's value together.

- `System.out.println("Grade: " + (95.1 + 71.9) / 2);`
- **Output:** Grade: 83.5

Escape sequences

escape sequence: A special sequence of characters used to represent certain special characters in a string.

<code>\n</code>	new line character
<code>\"</code>	quotation mark character
<code>\\</code>	backslash character

– **Example:**

```
System.out.println("\\hello\\nhow are \"you\"?\\\\\\");
```

– **Output:**

```
\\hello  
how are "you"?\\
```

Questions

- What is the output of the following `println` statements?

```
System.out.println("\\\\\\" );  
System.out.println("'" );  
System.out.println("\\" "\"");
```

- Write a `println` statement to produce this output:

```
/ \ // \\ /// \\\
```

Answers

- Output of each `println` statement:

```
\\  
'  
"""
```

- `println` statement to produce the line of output:

```
System.out.println("/  \\  //  \\\\  ///  \\\\\\\");
```


String methods

Method name	Description
<code>String(String str)</code>	Constructs a new String object that represents the same sequence of characters as str
<code>int length()</code>	Returns number of characters in this string
<code>substring(index1, index2)</code> or <code>substring(index1)</code>	Returns the characters in this string from index1 (inclusive) to index2 (<u>exclusive</u>); if index2 is omitted, grabs till end of string
<code>boolean equals(String other)</code>	Returns true if this is equal to other; returns false otherwise
<code>int compareTo(String other)</code>	Returns a value < 0 if this is less than other; returns zero if this is equal to other; returns a value > 0 if this is greater than other
<code>indexOf(str)</code>	Returns index where the start of the given string appears in this string (-1 if not found)

String method examples

```
// index      0123456789012345678
String s1 = "programming in java";
System.out.println(s1.length());           // 19
System.out.println(s1.indexOf("i"));        // 8
System.out.println(s1.indexOf("gram"));     // 3
System.out.println(s1.indexOf("hi"));       // -1
System.out.println(s1.substring(7, 10));    // "min"
System.out.println(s1.substring(12));       // "in java"
System.out.println(s1.substring(2, 3));     // "o"
System.out.println(s1.substring(2, 2));     // "", empty str
String s2 = s1.substring(10, 17);          // "g in ja"
```

String method examples

Given the following string:

```
// index      0123456789012345678901
String book = "Building Java Programs";
```

How would you extract the word "Java" ?

```
String word = book.substring(9,13);
```

String's equals:

```
String a = "hello", b = "Hello";
System.out.println(a.equals(b)); // false
System.out.println(a.equals("hello")); // true
```

Comparing strings

When the operator `==` is used with object variables it returns true when the two variables refer to the same object. These variables are called **aliases** for the same object and **object references**.

With strings this happens when one string variable is set to another or when strings are set to the same string literal.

```
String a = "hi"; //String literal
String b = "hi";
System.out.println(a == b); /* true
the Java run-time will check if that string
literal already exists as an object in memory, and
if so reuse it. So a and b will refer to the same
string object. */
String c = b;
System.out.println(b == c); //true
```

Comparing strings

With String objects, you must use the equals method to test if two strings have the same characters in the same order instead of == which is used for primitive types.

If you use the **new** keyword to create a string it will create a new string object. So, even if we create two string objects with the same characters using the new operator they will not refer to the same object.

```
String a = new String("hi");  
String b = new String("hi");  
System.out.println(a == b); //false, not same objects  
System.out.println(a.equals(b)); //true, same characters & order
```

compareTo

The compareTo method compares strings in dictionary (lexicographical) order:

- If `string1.compareTo(string2) < 0`, then string1 precedes string2 in the dictionary.
- If `string1.compareTo(string2) > 0`, then string1 follows string2 in the dictionary.
- If `string1.compareTo(string2) == 0`, then string1 and string2 are identical. (This test is an alternative to `string1.equals(string2)`.)

All you need to know is that all digits precede all capital letters, which precede all lowercase letters. Thus "5" comes before "R", which comes before "a".

compareTo

```
String s1 = "HOT", s2 = "HOTEL", s3 = "dog";  
String s4 = "hot";  
String s5 = new String("hot");
```

`s1.compareTo(s2)` returns a negative number(<0) since `s1 < s2`.

`s4.compareTo(s3)` returns a positive number(>0) since `s4 > s3`.

`s4.compareTo(s5)` returns 0 since `s4` is equal to `s5`.

Modifying strings

- Methods like `substring` build and return a new string, rather than modifying the current string.
 - String is **immutable**; once created, its value cannot be changed.

```
String s = "kendrick";  
s = "snoop dog";  
// "kendrick" is discarded and a new String  
// object "snoop dog" is created.
```

```
s.substring(0, 5); // returns snoop, not stored  
System.out.println(s);  
// snoop dog, s is not changed
```


Modifying strings

- To modify a variable's value, you must reassign it:

```
String s = "lil bow wow";  
s = s.substring(0,3);  
System.out.println(s);    // lil
```

Value semantics

Value semantics: String is the only object class that follows value semantics. Modifying the parameter will not affect the variable passed in.

```
public class MyClass{
    public static void main(String[] args){
        String x = "hi";
        changeMe(x);
        System.out.println(x); // hi
    }
    public static void changeMe(String x){
        x = "hello";
    }
}
```

Note: The value of x in main did not change.

Silly Strings

```
String beans;  
String cheese;  
String quartet;  
String bikini;  
String theory;
```

```
String school = "Hogwarts: School for Pigs";  
String headmaster = "Kevin Bacon";  
String teacher = "Brad Pig";  
String gf = "Piggy Azalea";
```

```
String fav_book = "Hamlet";  
String fav_char_star_wars = "Ham Solo";  
String fav_char_star_wars_2 = "ChewBacon";
```

Lab 1

Login to repl.it classroom, do the 5 "String Methods" problems.

Lab 2

Create a new repl on repl.it.

Implement the driver class(Main.java) to include two methods: printName and pigLatin.

`printName`: static, void method which takes a String input which represents a full name in the format: first name, a space, middle name, space and last name. The method extracts first, middle and last name and prints them. Use Scanner class to take input.(String full_name = console.nextLine();).

input: "Michael Benjamin Smith"

print output:

First: Michael

Middle: Benjamin

Last: Smith

Lab 2: Extracting Substring

`pigLatin`: static, method which takes a `String` input and returns the string in Pig Latin: take the first letter and put it at the end of the word and add the letters "ay" to the end. For example:

input: "pig"

returns: "igpay"

References

- 1) [CPJava Website](#)
- 2) [CPJava Google Classroom](#)
- 3) [CPJava repl.it Classroom](#)
- 4) [Runestone CSAwesome BUSHSCHOOL_CPJAVA Course](#)
- 5) [Online Textbook Think Java - 2nd Edition](#) by Allen Downey and Chris Mayfield
- 6) Building Java Programs: A Back to Basics Approach by Stuart Reges and Marty Stepp