Building Java Programs

Chapter 4
Lecture 4-3: Strings; `char`

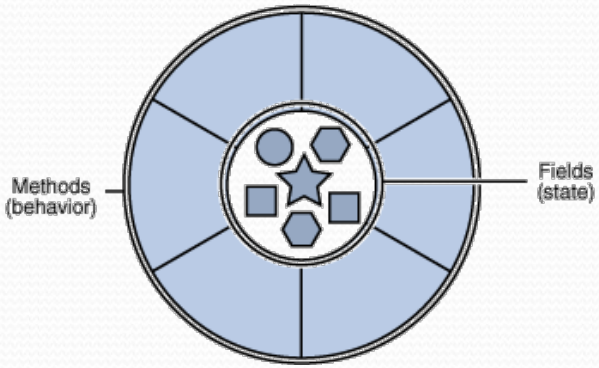
reading: 3.3, 4.3

Strings

reading: 3.3

Objects

- **object:** An entity that contains data and behavior.
  - *data*: variables inside the object
  - *behavior*: methods inside the object
    - You interact with the methods; the data is hidden in the object.
    - A **class** is a *type* of objects.



- Constructing (creating) an object:

```
Type objectName = new Type(parameters);
```

- Calling an object's method:

```
objectName.methodName(parameters);
```

Strings

- **string**: An object storing a sequence of text characters.
  - Unlike most other objects, a `String` is not created with `new`.

```
String name = "text";
String name = expression (with String value);
```

  - Examples:

```
String names = "Alice and Bob";
int x = 3;
int y = 5;
String point = "(" + x + ", " + y + ")";
```

Indexes

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

```
String name = "M. Mouse";
```

index	0	1	2	3	4	5	6	7
character	M	.		M	o	u	s	e

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

  - The individual characters are values of type `char` (seen later)

`String` methods

Method name	Description
`indexOf(`**str**`)`	index where the start of the given string appears in this string (-1 if not found)
`length()`	number of characters in this string
`substring(`**index1**`, `**index2**`)` or `substring(`**index1**`)`	the characters in this string from *index1* (inclusive) to *index2* (exclusive); if *index2* is omitted, grabs till end of string
`toLowerCase()`	a new string with all lowercase letters
`toUpperCase()`	a new string with all uppercase letters

- These methods are called using the dot notation:

```
String starz = "Prince vs. Michael";
System.out.println(starz.length());   // 18
```

String method examples

```
// index      012345678901
String s1 = "Stuart Reges";
String s2 = "Marty Stepp";

System.out.println(s1.length());          // 12
System.out.println(s1.indexOf("e"));      // 8
System.out.println(s1.substring(7, 10)); // "Reg"

String s3 = s2.substring(1, 7);
System.out.println(s3.toLowerCase());     // "arty s"
```

- Given the following string:

```
// index        01234567890123456789 01
String book = "Building Java Programs";
```

  - How would you extract the word "Java" ?

Modifying strings

- Methods like `substring` and `toLowerCase` build and return a new string, rather than modifying the current string.

```
String s = "Mumford & Sons";
s.toUpperCase();
System.out.println(s);    // Mumford & Sons
```

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

```
String s = "Mumford & Sons";
s = s.toUpperCase();
System.out.println(s);    // MUMFORD & SONS
```

Strings as user input

- `Scanner`'s `next` method reads a word of input as a `String`.

```
Scanner console = new Scanner(System.in);
System.out.print("What is your name? ");
String name = console.next();
name = name.toUpperCase();
System.out.println(name + " has " + name.length() +
    " letters and starts with " + name.substring(0, 1));
```

Output:

```
What is your name? Bono
BONO has 4 letters and starts with B
```

- The `nextLine` method reads a line of input as a `String`.

```
System.out.print("What is your address? ");
String address = console.nextLine();
```

Name border

```
HELENE
HELEN
HELE
HEL
HE
H
HE
HEL
HELE
HELEN
HELENE
MARTIN
MARTI
MART
MAR
MA
M
MA
MAR
MART
MARTI
MARTIN
```

- Prompt the user for full name
- Draw out the pattern to the left
- This should be resizable. Size 1 is shown and size 2 would have the first name twice followed by last name twice

Strings question

- Write a program that outputs "The Name Game" with a person's first and last name.

Example Output:

```
What is your name? James Joyce

James, James, bo-bames
Banana-fana fo-fames
Fee-fi-mo-mames
JAMES!

Joyce, Joyce, bo-boyce
Banana-fana fo-foyce
Fee-fi-mo-moyce
JOYCE!
```

Strings answer

```
// This program prints "The Name Game".
import java.util.*;

public class TheNameGame {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);
        System.out.print("What is your name? ");
        String name = console.nextLine();

        int spaceIndex = name.indexOf(" ");
        String firstName = name.substring(0, spaceIndex);
        String lastName = name.substring(spaceIndex + 1);

        singSong(firstName);
        singSong(lastName);
    }
```

Strings answer (cont.)

```
 public static void singSong(String name) {
        System.out.println();
        String allButLast = name.substring(1);
        System.out.println(name + ", " + name + ", bo-b" + allButLast);
        System.out.println("Banana-fana fo-f" + allButLast);
        System.out.println("Fee-fi-mo-m" + allButLast);
        System.out.println(name.toUpperCase() + "!");
    }
}
```

Comparing strings

- Relational operators such as < and == fail on objects.

```
Scanner console = new Scanner(System.in);
System.out.print("What is your name? ");
String name = console.next();
if (name == "Barney") {
    System.out.println("I love you, you love me,");
    System.out.println("We're a happy family!");
}
```

  - This code will compile, but it will not print the song.

  - == compares objects by *references* (seen later), so it often gives `false` even when two `String`s have the same letters.

The `equals` method

- Objects are compared using a method named `equals`.

```
Scanner console = new Scanner(System.in);
System.out.print("What is your name? ");
String name = console.next();
if (name.equals("Barney")) {
    System.out.println("I love you, you love me,");
    System.out.println("We're a happy family!");
}
```

- Technically this is a method that returns a value of type `boolean`, the type used in logical tests.

`String` test methods

Method	Description
`equals(`**str**`)`	whether two strings contain the same characters
`equalsIgnoreCase(`**str**`)`	whether two strings contain the same characters, ignoring upper vs. lower case
`startsWith(`**str**`)`	whether one contains other's characters at start
`endsWith(`**str**`)`	whether one contains other's characters at end
`contains(`**str**`)`	whether the given string is found within this one

```
String name = console.nextLine();
if (name.startsWith("Dr.")) {
    System.out.println("Will you marry me?");
} else if (name.equalsIgnoreCase("buTteRs")) {
    System.out.println("You're grounded, young man!");
}
```

String documentation: http://docs.oracle.com/javase/7/docs/api/java/lang/String.html

Strings question

- Write a program that reads two people's first names and suggests a name for their child.
  - The suggestion is the concatentation of the first halves of both names.

Example Output:

```
Parent 1 first name? Danielle
Parent 2 first name? John
Child gender? f
Suggested baby name: JODANI

Parent 1 first name? Danielle
Parent 2 first name? John
Child gender? Male
Suggested baby name: DANIJO
```

Strings answer

```
// Suggests a baby name based on parents' names.
import java.util.*;

public class BabyNamer {
   public static void main(String[] args) {
      Scanner s = new Scanner(System.in);
      System.out.print("Parent 1 first name? ");
      String name1 = s.next();
      System.out.print("Parent 2 first name? ");
      String name2 = s.next();
      System.out.print("Child gender? ");
      String gender = s.next();

      System.out.println("Suggested name: " +
                         suggestChildName(gender, name1, name2).toUpperCase());
   }

   ...
```

Strings answer (cont.)

```
    ...

    // Return the first half of the given name.
    public static String getHalfName(String name) {
        int halfIndex = name.length() / 2;
        return name.substring(0, halfIndex);
    }

    // Suggests a child's name (for a given gender) for parents with the given names.
    public static String suggestChildName(String gender, String name1, String name2) {
        String halfName1 = getHalfName(name1);
        String halfName2 = getHalfName(name2);
        String name;
        if (gender.toLowerCase().startsWith("f")) {
            name = halfName1 + halfName2;
        } else {
            name = halfName2 + halfName1;
        }
        return name;
    }
}
```

Another Strings question

- Prompt the user for two words and report whether they:
  - *"rhyme"* (end with the same last two letters)
  - *alliterate* (begin with the same letter)
  - Example output: (run #1)

```
Type two words: car STAR
They rhyme!
```

(run #2)

```
Type two words: bare bear
They alliterate!
```

(run #3)

```
Type two words: sell shell
They alliterate!
They rhyme!
```

(run #4)

```
Type two words: extra strawberry
```

Another Strings answer

```
// Determines whether two words rhyme and/or alliterate.
import java.util.*;

public class Rhyme {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);
        System.out.print("Type two words: ");
        String word1 = console.next().toLowerCase();
        String word2 = console.next().toLowerCase();
        printIfRhyme(word1, word2);
        printIfAlliterate(word1, word2);
    }

    // print if two words "rhyme" (i.e., end with the same two letters)
    public static void printIfRhyme(String word1, String word2) {
        if (word2.length() >= 2 &&
            word1.endsWith(word2.substring(word2.length() - 2))) {
            System.out.println("They rhyme!");
        }
    }

    // print if two alliterate
    public static void printIfAlliterate(String word1, String word2) {
        if (word1.startsWith(word2.substring(0, 1))) {
            System.out.println("They alliterate!");
        }
    }
}
```