Building Java Programs

Chapter 4
Strings, `char`

reading: 3.3, 4.3

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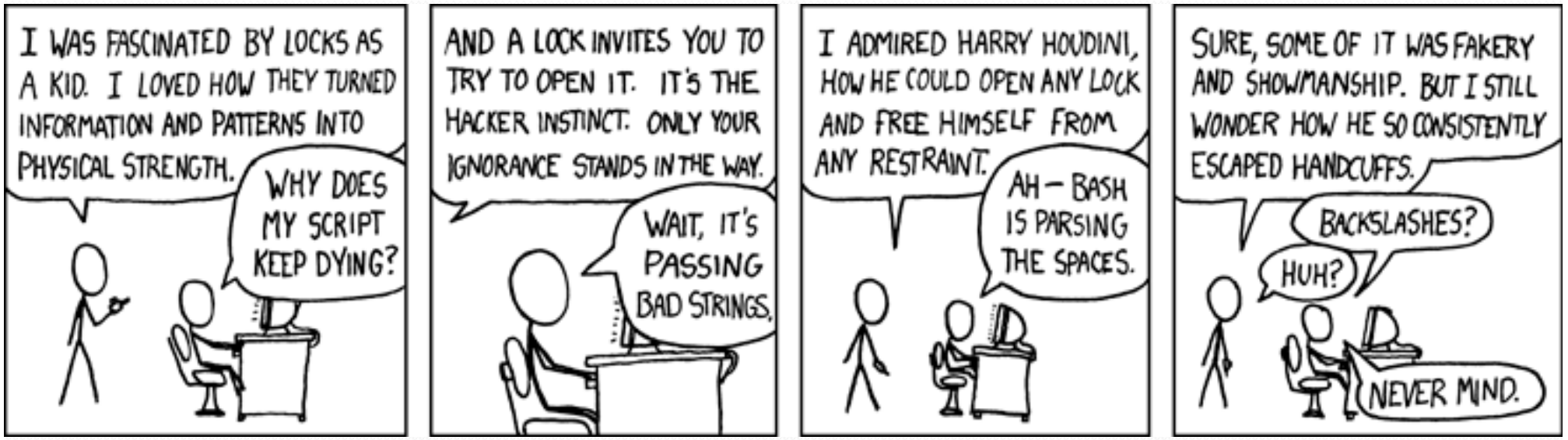

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Strings

- **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;
```

  - Examples:

```
String name = "Kanye West";

int x = 3;
int y = 5;
String point = "(" + x + ", " + y + ")";
```

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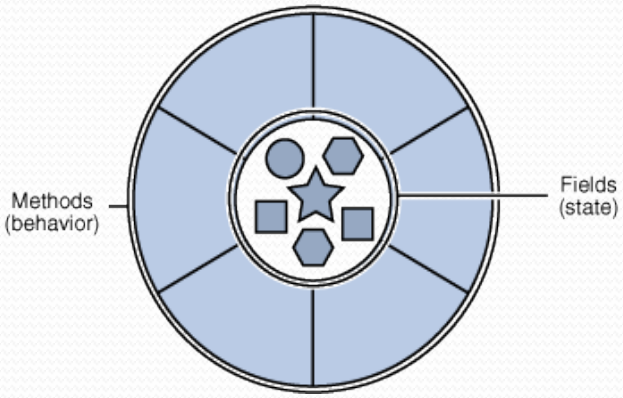
Objects (usage)

- **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);
```

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Indexes

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

```
String name = "Ultimate";
```

index	0	1	2	3	4	5	6	7
character	U	l	t	i	m	a	t	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)

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`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 sesameStreet = "Bert & Ernie";
System.out.println(sesameStreet.length());   // 12
```

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`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       01234567890123456789012
String book = "Building Java Programs";
```

  - How would you extract the word `"Java"` ?

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Modifying strings

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

```
String s = "Aceyalone";
s.toUpperCase();
System.out.println(s);   // Aceyalone
```

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

```
String s = "Aceyalone";
s = s.toUpperCase();
System.out.println(s);   // ACEYALONE
```

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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

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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? Nas
NAS has 3 letters and starts with N
```

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

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

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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("Lance")) {
    System.out.println("Pain is temporary.");
    System.out.println("Quitting lasts forever.");
}
```

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

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`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.next();
if(name.endsWith("Kweli")) {
   System.out.println("Pay attention, you gotta listen to hear.");
} else if(name.equalsIgnoreCase("NaS")) {
   System.out.println("I never sleep 'cause sleep is the cousin of
                       death.");
}
```

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Strings question

- Write a program that reads two people's names and generates a new hybrid name.

Example Output:

```
Person 1 name? John
Person 2 name? Danielle
Name Gender? f
Suggested name: JODANIA
```

```
Person 1 name? John
Person 2 name? Danielle
Name Gender? nope
Suggested name: JODANI
```

```
Person 1 name? John
Person 2 name? Danielle
Name Gender? Masculine
Suggested name: JODANIO
```

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The `charAt` method

- The `char`s in a `String` can be accessed using the `charAt` method.

```
String food = "cookie";
char firstLetter = food.charAt(0);    // 'c'

System.out.println(firstLetter + " is for " + food);
System.out.println("That's good enough for me!");
```

- You can use a `for` loop to print or examine each character.

```
String major = "CSE";
for (int i = 0; i < major.length(); i++) {
    char c = major.charAt(i);
    System.out.println(c);
}
```

Output:

```
C
S
E
```

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Type `char`

- `char` : A primitive type representing single characters.
  - Each character inside a `String` is stored as a `char` value.
  - Literal `char` values are surrounded with apostrophe (single-quote) marks, such as `'a'` or `'4'` or `'\n'` or `'\''`
  - It is legal to have variables, parameters, returns of type `char`

```
char letter = 'S';
System.out.println(letter);                 // S
```

- `char` values can be concatenated with strings.

```
char initial = 'P';
System.out.println(initial + " Diddy");  // P Diddy
```

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char vs. String

- "h" is a String
  'h' is a char (the two behave differently)
- String is an object; it contains methods

```
String s = "h";
s = s.toUpperCase();          // 'H'
int len = s.length();         //  1
char first = s.charAt(0);     // 'H'
```

- char is primitive; you can't call methods on it

```
char c = 'h';
c = c.toUpperCase();    // ERROR: "cannot be dereferenced"
```

- What is s + 1 ? What is c + 1 ?
- What is s + s ? What is c + c ?

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`char` vs. `int`

- All `char` values are assigned numbers internally by the computer, called *ASCII* values.
  - Examples:
    `'A'` is 65, `'B'` is 66, `' '` is 32
    `'a'` is 97, `'b'` is 98, `'*'` is 42
  - Mixing `char` and `int` causes automatic conversion to `int`.
    `'a' + 10` is 107, `'A' + 'A'` is 130
  - To convert an `int` into the equivalent `char`, type-cast it.
    `(char) ('a' + 2)` is `'c'`

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Comparing `char` values

- You can compare `char` values with relational operators:

  `'a' < 'b'` and `'X' == 'X'` and `'Q' != 'q'`

  - An example that prints the alphabet:

```
for (char c = 'a'; c <= 'z'; c++) {
    System.out.print(c);
}
```

- You can test the value of a string's character:

```
String word = console.next();
if (word.charAt(word.length() - 1) == 's') {
    System.out.println(word + " is plural.");
}
```

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`String/char` question

- A *Caesar cipher* is a simple encryption where a message is encoded by shifting each letter by a given amount.
  - e.g. with a shift of 3, A → D, H → K, X → A, and Z → C

- Write a program that reads a message from the user and performs a Caesar cipher on its letters:

```
Your secret message: I love Computer Science
Your secret key: 3
The encoded message: l oryh frpsxwhu vflhqfh
```

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Strings answer 1

```
// This program reads a message and a secret key from the user and
// encrypts the message using a Caesar cipher, shifting each letter.

import java.util.*;

public class SecretMessage {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);

        System.out.print("Your secret message: ");
        String message = console.nextLine();
        message = message.toLowerCase();

        System.out.print("Your secret key: ");
        int key = console.nextInt();

        encode(message, key);
    }

    ...
```

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Strings answer 2

```
// This method encodes the given text string using a Caesar
// cipher, shifting each letter by the given number of places.
public static void encode(String text, int shift) {
    System.out.print("The encoded message: ");
    for (int i = 0; i < text.length(); i++) {
        char letter = text.charAt(i);

        // shift only letters (leave other characters alone)
        if (letter >= 'a' && letter <= 'z') {
            letter = (char) (letter + shift);

            // may need to wrap around
            if (letter > 'z') {
                letter = (char) (letter - 26);
            } else if (letter < 'a') {
                letter = (char) (letter + 26);
            }
        }
        System.out.print(letter);
    }
    System.out.println();
}
}
```

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