Session 4: Data types, casting, javadoc, conditionals

Softwaretechnologie: Java I

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November 2, 2022

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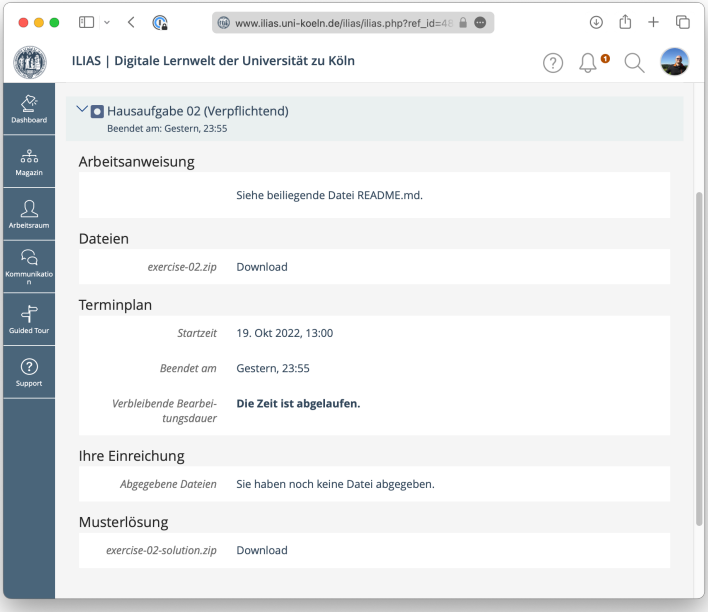
Section 1

Exercise 3


www.ilias.uni-koeln.de/ilias/ilias.php?ref_id=4
ILIAS | Digitale Lernwelt der Universität zu Köln
Dashboard
Magazin
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Guided Tour
Support
Hausaufgabe 02 (Verpflichtend)
Beendet am: Gestern, 23:55
Arbeitsanweisung
Siehe beiliegende Datei README.md.
Dateien
exercise-02.zip
Download
Terminplan
Startzeit
19. Okt 2022, 13:00
Beendet am
Gestern, 23:55
Verbleibende Bearbeitungsdauer
Die Zeit ist abgelaufen.
Ihre Einreichung
Abgegebene Dateien
Sie haben noch keine Datei abgegeben.
Musterlösung
exercise-02-solution.zip
Download

Exercise 03: isOdd(int)

```java
public class Exercise03 {

  public static void main(String[] args) {
    System.out.println(isOdd(3)); // true
    System.out.println(isOdd(1)); // true
    System.out.println(isOdd(457483841)); // true
    System.out.println(isOdd(12)); // false
  }

  static boolean isOdd(int number) {
    return number % 2 == 1; // shortest version, operator precedence relevant!
  }

}
```

Operator precedence

Section 2

Data Types, Part 2

Primitive Data Types

Keyword	Full name	Values
`boolean`	Binary value	`true`, `false`
`byte`	1 Byte (= 8 bit)	-128 to 127
`short`	short integer (16 bit)	$-32\,768$ to $32\,767$
`int`	Integer (32 bit)	$-2\,147\,483\,648$ to $2\,147\,483\,647$
`long`	long integer (64 bit)	$-9\,223\,372\,036\,854\,775\,808$ to $9\,223\,372\,036\,854\,775\,807$
`char`	Character in UTF-16	`'\u0000'` to `'\uffff'` ($65536 = 2^{16}$ symbols)
`float`	Decimal numbers (32 bit)	$\pm 1.4 \times 10^{-45}$ to $\pm 3.4 \times 10^{38}$
`double`	Decimal numbers (64 bit)	$\pm 4.9 \times 10^{-324}$ to $\pm 1.8 \times 10^{308}$

Table: All primitive data types in Java

Integral Data Types

Literals

- By default: full numbers within expressions are of type `int`

```
1 int myIntValue = 27; // literal int value assigned to an int variable
2 byte myByteValue = 27; // literal int value assigned to a byte variable
3 long myLongValue = 27; // literal int assigned to a long variable
4
5 long myLargeLongValue = 2700000000000000000L;
6                         // append L to enforce a long literal
7 long mySmallLongValue = 27L; // also works for small numbers
```

- Why can we assign an int literal to a byte/long/short variable?
  ➔Implicit casting (see below)!

Character Data

Keyword	Full name	Values
`char`	Character in UTF-16	`'\u0000'` to `'\uffff'` ($65536 = 2^{16}$ symbols)

- Characters are represented in computers by enumerating them
- American Standard Code for Information Interchange (ASCII) Wikipedia: ASCII
  - 128 characters, including control symbols for telegraphy
  - No German Umlauts etc.

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  - 128 characters, including control symbols for telegraphy
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- Unicode: A single standard to represent *all* characters from all languages — unicode.org
  - 149 186 characters, including CJK ideographs — Unicode 15.0 charts
  - Complex enumeration scheme

Character Data

char data type

- `char` represents a single character in two bytes (16 bit)
- Literal char values are written with single quotes: `char ch = 'a';`
- Unicode code points can also be used: `char ch = '\u1A0A'; //"BUGINESE LETTER NA"`
  - $1A0A_{b=16} = 6666_{b=10}$
- Integer values also possible: `char ch = 121;` (implicit cast)
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⚠ Not all Unicode characters can be represented as a single `char` value
- Because Unicode now defines more than 2^{16} characters
- Be aware that this might be a problem

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- Naive idea: Two integer values, before and after decimal point
  - Wasteful and complex to implement mathematical operations
- Better idea: Represent number in scientific notation, store digits and exponent separately
  - E.g.: $123.345 = 123345 * 10^{-3}$ (there are many details left out here)

Decimal Numbers in Java

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```
1 float myFloatVariable = 3.0; // literal double, no implicit cast: compile error!
2 double myDoubleVariable = 3.0; // literal double
3 float myExplicitFloatVariable = 5.0f; // literal float value
4 double myDoubleVariable = 5.0f; // literal float casted into a double
```

Division, again

- Dividing two `int` numbers yields unexpected results (last week)
- If one number is a floating-point-number, we get decimal division

```
1 int a = 7;
2 int bInt = 14;
3 System.out.println(a / bInt); // prints 0
4
5 double bFloat = 14.0;
6 System.out.println(7 / bFloat); // prints 0.5
```

Floating Point Complexities

- Floating point numbers are *approximations*
  - Not all values can be represented

  - Some calculations lead to erroneous results
    E.g., `1.25f - 1.05f //yields -0.20000005`

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- Java floating values have a negative zero
  E.g., `-0f` and `0f` are differently represented in memory, but defined as equal
- In general: Do not use `==` with floating point numbers
  - Check if some result is 'close enough' at the expected result

Section 3

Casting

Casting

- Converting from one type into another
- Explicit casting: Target type in parentheses

```
1 char myChar = 'a';
2 int myInteger = (int) myChar;
3 double d = (double) myInteger;
```

- Not all types can be cast into all other types
  - E.g., no casting from int to boolean
- Cast operator is an operator, i.e.: Can be used in expressions
  - `boolean b = (double) ( (int)'a'+ 5 ) / 17 >= 5.0`

Implicit Casting

- If needed *and* if possible without information loss
- `double` can represent more numbers than `float`
  - `float` to `double`: No information loss
  - `double` to `float`: Potential loss
    - Explicit casting possible, use at your own risk
- `long` can represent more numbers than `short`
  - `short` to `long`: No information loss
  - `long` to `short`: Potential loss
    - Explicit casting possible, use at your own risk

Section 4

Javadoc

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  - API comment for other programmers about a function/class/method
  - Not about specific lines, but the entire function
- API comments can be extracted to an HTML page
  - All Java classes/functions/methods have such a documentation
  - Javadoc: Integer.valueOf()

Javadoc

Javadoc

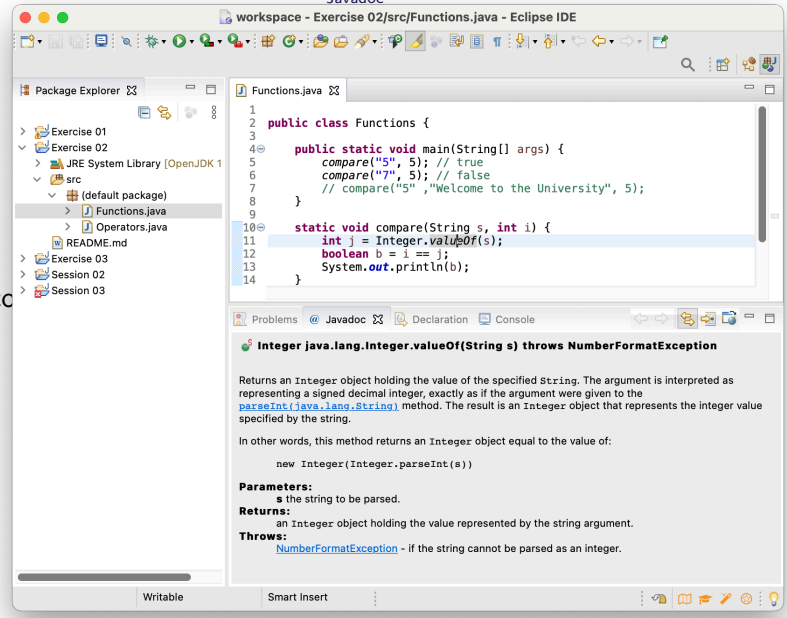
Eclipse

- Javadoc comments directly displayed by Eclipse

Javadoc

Eclipse

- Javadoc co



Javadoc

Eclipse

- Javadoc comments directly displayed by Eclipse
- Eclipse can generate Javadoc HTML files
  - Menu > Project > Generate Javadoc ...

Section 5

Conditionals

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- So far: All statements are executed in sequence
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- Multiple forms:

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if (EXPRESSION) STATEMENT
```

```
if (EXPRESSION) STATEMENT else STATEMENT
```

  - EXPRESSION must evaluate to a `boolean` value
- The `if`-statement is a statement, therefore:

```
if (EXP1) STATEMENT else if (EXP2) STATEMENT else STATEMENT
```

is also possible
- Remember: code blocks `{ ... }` are also statements

demo

Conditional Expression

- The if-statement is a statement
- Sometimes, it's useful to make such a distinction in the form of an expression
- All other operators are unitary or binary (i.e.: take one or two values)
- Ternary operator has three parts: `EXP1 ? EXP2 : EXP3`
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- `short daysInYear = isLeapYear() ? 366 : 365;`

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```
1 switch (EXPRESSION) {
2 case CONSTANT: STATEMENT; break;
3 case CONSTANT2, CONSTANT3: STATEMENT; break;
4 default: STATEMENT
5 }
```

demo

Switch-Statement

Example

```
1 static short daysInMonth(byte month) {
2     switch(month) {
3     case 2: return 28; // no break needed, because of return
4     case 4: // fall through to case 11
5     case 6:
6     case 9:
7     case 11: return 30;
8     default: return 31;
9   }
10 }
```

Section 6

Exercise