Session 3: Commenting, data types, casting

Softwaretechnologie: Java I

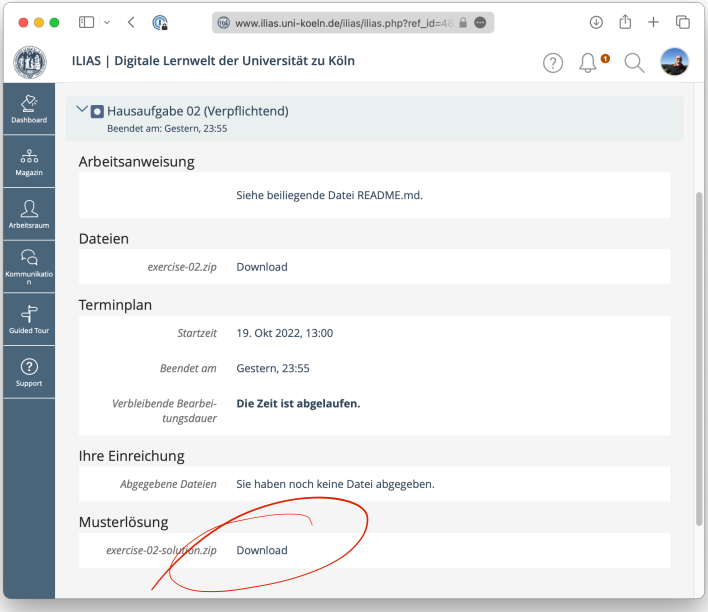
Nils Reiter
nils.reiter@uni-koeln.de

October 26, 2022

INSTITUT FÜR
DIGITAL HUMANITIES
UNIVERSITÄT ZU KÖLN

Section 1

Exercise 2


www.ilias.uni-koeln.de/ilias/ilias.php?ref_id=4
ILIAS | Digitale Lernwelt der Universität zu Köln
Dashboard
Magazin
Arbeitsraum
Kommunikation
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 01: Operators

```
1  public class Operators {
2    public static void main(String[] args) {
3      int i;
4      int j;
5      boolean b;
6      i = 5;
7
8      j = 5 + 5; // 10
9      System.out.println(j);
10
11     j = 5 - 5 + 5 * 2; // 10
12     System.out.println(j);
13
14     j = i - (10 * i) + 10; // -35
15     System.out.println(j);
16
17     b = (i + 1) > (i * 1); // true
18     System.out.println(b);
19   }
20 }
```

Exercise 02: Functions

```java
public class Functions {
  public static void main(String[] args) {
    System.out.println(cube(5));
    System.out.println(compare("7",5));
  }

  static int cube(int x) {
    // calculate x to the power of 3 the old fashioned way
    return x*x*x;
  }

  static boolean compare(String s, int i) {
    // get int value from within the string
    int j = Integer.valueOf(s);

    // compare the two int values and return the result
    return j == i;
  }
}
```

Section 2

Commenting

Comments

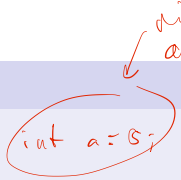
- Ignored by the compiler
- Information for us humans

Comments

- Ignored by the compiler
- Information for us humans

Two types

```
1 // This comment ends when the line ends
2
3 /* This comments ends with */
4
5 /*
6 We can include text that spans
7 multiple lines
8 */
```



Comments

Example

```
1  public class Example {
2
3    public static void main(String[] args) {
4      // stores how much users want to withdraw
5      int amount = 1500;
6
7      /* the next lines are supposed to calculate
8         the third root of amount, I took the idea from
9         http://www...
10     */
11     int temp = 3;
12     amount = amount / temp;
13     // TODO: Implement me!
14   }
15 }
```

Commenting

- No fixed rules what to comment

Commenting

- No fixed rules what to comment
- Helpful: Your intentions, complex expressions, non-trivial functions
- Avoid commenting trivial things
- Keep comments up to date
- Don't make ASCII art in comments

Section 3

Data Types

Data Types

- Java: Strong typing
  - All variables and literals in Java have types
  - Types are known at compile-time
  - Benefit: Compiler can prevent type-related errors
    - E.g., it's a compile error to subtract a String

Primitive Data Types and Objects

- Two kinds of types
  - Primitive data types: Built into the language
    - Type names are reserved keywords in Java
    - Convention: Lower cased

Primitive Data Types and Objects

- Two kinds of types
  - Primitive data types: Built into the language
    - Type names are reserved keywords in Java
    - Convention: Lower cased
  - Non-primitive data types ("reference types"): Established in the library
    - Type names are defined by library authors
    - Convention: Upper cased
    - Reference types can also be defined by us
      (in the form of classes, to be discussed later)

Primitive Data Types

Keyword	Full name	Values
`boolean`	Binary value	`true`, `false`

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 $9\,223\,372\,036\,854\,775\,807$

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)

Primitive Data Types

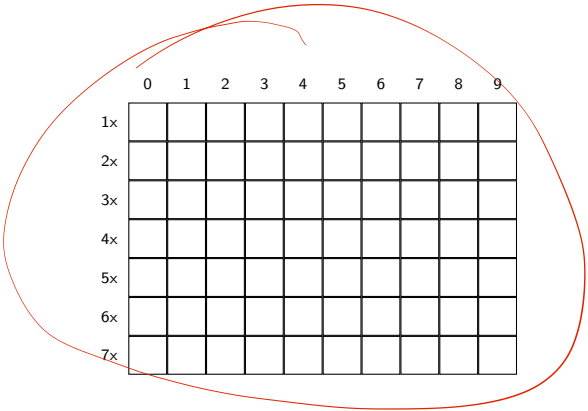
Keyword	Full name	Values
`boolean`	Binary value	`true`, `false`
`byte`	1 Byte (= 8 bit)	-128 to 127
`short`	short integer (16 bit)	$-32\,768$ to $32\,767$
`int`	Integer (32 bit)	$-2\,147\,483\,648$ to $2\,147\,483\,647$
`long`	long integer (64 bit)	$-9\,223\,372\,036\,854\,775\,808$ to $9\,223\,372\,036\,854\,775\,807$
`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

Bits and Bytes

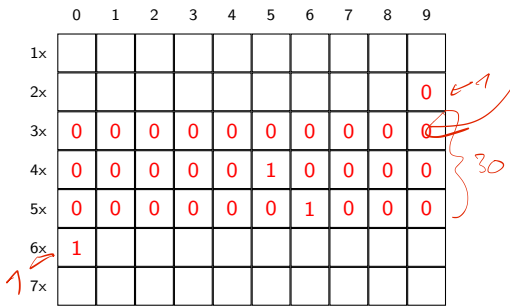
- 1 Bit: 0 or 1
- 1 Byte = 8 Bit: 0 0 0 0 0 0 0 0 – 1 1 1 1 1 1 1 1

Primitive Types in Memory



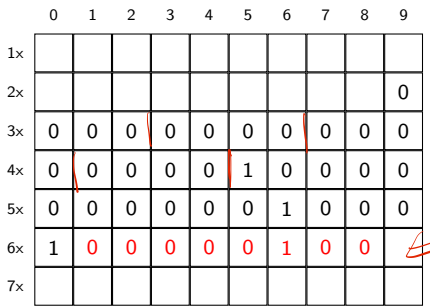

```
1 int myIntVariable = 32785;
2 // compiler knows that myIntVariable
3 // goes from bits 29 to 60
4 byte myByteVariable = 4;
5 // myByteVariable: bits 61 to 68
```

Primitive Types in Memory




```
1 int myIntVariable = 32785;
2 // compiler knows that myIntVariable
3 // goes from bits 29 to 60
4 byte myByteVariable = 4;
5 // myByteVariable: bits 61 to 68
```

Primitive Types in Memory




```
1 int myIntVariable = 32785;
2 // compiler knows that myIntVariable
3 // goes from bits 29 to 60
4 byte myByteVariable = 4;
5 // myByteVariable: bits 61 to 68
```

Place Value Systems

"Stellenwertsysteme"

$7 \cdot 100 + 1 \cdot 10 + 2 \cdot 1$

- What's the value of 712 (in the decimal system)?

Place Value Systems

"Stellenwertsysteme"

- What's the value of 712 (in the decimal system)?
  $7 * 100 + 1 * 10 + 2 * 1$

Place Value Systems

"Stellenwertsysteme"

- What's the value of 712 (in the decimal system)?
  $7 * 100 + 1 * 10 + 2 * 1$
- What's the value of x, if x has four places?

Place Value Systems

"Stellenwertsysteme"

- What's the value of 712 (in the decimal system)?
  $7 * 100 + 1 * 10 + 2 * 1$
- What's the value of x, if x has four places?
  $x_3 * 1000 + x_2 * 100 + x_1 * 10 + x_0 * 1$

Place Value Systems

"Stellenwertsysteme"

- What's the value of 712 (in the decimal system)?
  $7 * 100 + 1 * 10 + 2 * 1$
- What's the value of x, if x has four places?
  $x_3 * 1000 + x_2 * 100 + x_1 * 10 + x_0 * 1$
- Even more generic (with n being the number of digits):

$$
\begin{aligned}
x &= x_n * 10^n + x_{n-1} * 10^{n-1} + \cdots + x_0 * 10^0 \\
&= \sum_{i=0}^{n} x_i 10^i
\end{aligned}
$$

Place Value Systems

Decimal and others

- Decimal system uses base 10, but other bases could be used as well

Place Value Systems

Decimal and others

- Decimal system uses base 10, but other bases could be used as well

$$\text{value of } x \text{ with } n \text{ places, interpreted to the base } b \quad = \sum_{i=0}^{n} x_i b^i$$

Examples

$$15_{b=10} = 1 * 10^1 + 5 * 10^0 = 15_{b=10}$$

$$15_{b=8} = 1 * 8^1 + 5 * 8^0 = 13_{b=10}$$

Place Value Systems

Decimal and others

- Decimal system uses base 10, but other bases could be used as well

$$\text{value of } x \text{ with } n \text{ places, interpreted to the base } b \quad = \quad \sum_{i=0}^{n} x_i b^i$$

Dez: 0–7

3-er: 0–2

Examples

$$15_{b=10} = 1 * 10^1 + 5 * 10^0 = 15_{b=10}$$
$$15_{b=8} = 1 * 8^1 + 5 * 8^0 = 13_{b=10}$$
$$15_{b=3} = 1 \cdot 3^1 + 5 \cdot 3^0$$

Place Value Systems

Decimal and others

- Decimal system uses base 10, but other bases could be used as well

$$\text{value of } x \text{ with } n \text{ places, interpreted to the base } b \quad = \quad \sum_{i=0}^{n} x_i b^i$$

Examples

$$\begin{aligned} 15_{b=10} &= 1 * 10^1 + 5 * 10^0 = 15_{b=10} \\ 15_{b=8} &= 1 * 8^1 + 5 * 8^0 = 13_{b=10} \\ 15_{b=3} &= \text{undefined symbol 5} \end{aligned}$$

Place Value Systems

Decimal and others

- Decimal system uses base 10, but other bases could be used as well

$$\text{value of } x \text{ with } n \text{ places, interpreted to the base } b \quad = \quad \sum_{i=0}^{n} x_i b^i$$

Examples

$$\begin{aligned} 15_{b=10} &= 1 * 10^1 + 5 * 10^0 = 15_{b=10} \\ 15_{b=8} &= 1 * 8^1 + 5 * 8^0 = 13_{b=10} \\ 15_{b=3} &= \text{undefined symbol 5} \\ 11_{b=2} &= 1 * 2^1 + 1 * 2^0 = 3_{b=10} \end{aligned}$$

Place Value Systems

Decimal and others

- Decimal system uses base 10, but other bases could be used as well

$$\text{value of } x \text{ with } n \text{ places, interpreted to the base } b \quad = \quad \sum_{i=0}^{n} x_i b^i$$

Examples

$$\begin{aligned}
15_{b=10} &= 1 * 10^1 + 5 * 10^0 = 15_{b=10} \\
15_{b=8} &= 1 * 8^1 + 5 * 8^0 = 13_{b=10} \\
15_{b=3} &= \text{undefined symbol 5} \\
11_{b=2} &= 1 * 2^1 + 1 * 2^0 = 3_{b=10} \\
1010_{b=2} &= 1 * 2^3 + 0 * 2^2 + 1 * 2^1 + 0 * 2^0 = 10_{b=10}
\end{aligned}$$

Place Value Systems

Maximal Numbers

- Highest number depends on the number of places
- For 3 places
  - Decimal ($b = 10$): $999_{b=10} = 1000_{b=10} - 1$
  - Octal ($b = 8$): $777 = 511_{b=10} = 1000_{b=8} - 1$
  - Binary ($b = 2$): $111 = 7_{b=10} = 1000_{b=2} - 1$

Place Value Systems

Maximal Numbers

- Highest number depends on the number of places
- For 3 places
  - Decimal ($b = 10$): $999_{b=10} = 1000_{b=10} - 1$
  - Octal ($b = 8$): $777 = 511_{b=10} = 1000_{b=8} - 1$
  - Binary ($b = 2$): $111 = 7_{b=10} = 1000_{b=2} - 1$
- More general
  - Maximal value with n places to base b: $b^n - 1$
  - I.e.: 4 bits can distinguish 16 different states

Place Value Systems

Maximal Numbers

- Highest number depends on the number of places
- For 3 places
  - Decimal ($b = 10$): $999_{b=10} = 1000_{b=10} - 1$
  - Octal ($b = 8$): $777 = 511_{b=10} = 1000_{b=8} - 1$
  - Binary ($b = 2$): $111 = 7_{b=10} = 1000_{b=2} - 1$
- More general
  - Maximal value with n places to base b: $b^n - 1$
  - I.e.: 4 bits can distinguish 16 different states

0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111

Integral Data Types

Keyword	Full name	Values
`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 $9\,223\,372\,036\,854\,775\,807$

- Integral data types defined over the number of places they occupy
- Shorter types consume less memory
- I.e.: If you know a value will never be higher than 127, use a byte
  - E.g., For calendar weeks

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)!

Section 5

Exercise