BIRZEIT UNIVERSITY

# Elementary Programming



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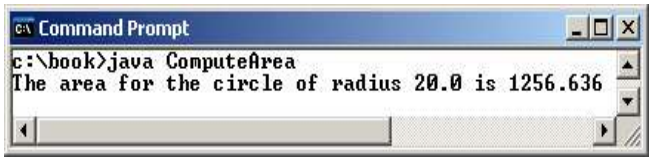
## Trace a Program Execution

```
public class ComputeArea {
  /** Main method */
  public static void main(String[] args) {
    double radius;
    double area;

    // Assign a radius
    radius = 20;

    // Compute area
    area = radius * radius * 3.14159;

    // Display results
    System.out.println("The area for the circle of radius " + radius + " is " + area);
  }
}
```

memory

| | |
|---|---|
| radius | 20 |
| area | 1256.636 |

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# Identifiers

- Identifiers are for **naming** variables, methods, classes
- An **identifier** is a sequence of characters that consist of letters, digits, underscores (_), and dollar signs ($).
- An identifier must start with a letter, an underscore (_), or a dollar sign ($). It cannot start with a digit.
- An identifier cannot be a reserved word.
- An identifier cannot be **true**, **false**, or **null**.
- An identifier can be of any length.

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# Java Keywords and Reserved Words

| | | | |
|---|---|---|---|
| abstract | double | int | super |
| assert | else | interface | switch |
| boolean | enum | long | synchronized |
| break | extends | native | this |
| byte | final | new | throw |
| case | finally | package | throws |
| catch | float | private | transient |
| char | for | protected | try |
| class | goto | public | void |
| const | if | return | volatile |
| continue | implements | short | while |
| default | import | static | |
| do | instanceof | strictfp* | |

# Variables

- Variables are used to represent values that may be changed in the program.
- A variable must be declared before it can be assigned a value.
- A variable declared in a method must be assigned a value before it can be used.

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# Declaring Variables

```
int x;            // Declare x to be an integer variable
double radius;    // Declare radius to be a double variable
char a;           // Declare a to be a character variable
```

# Assignment Statements

```
x = 1;            // Assign 1 to x
radius = 1.0;     // Assign 1.0 to radius
a = 'A';          // Assign 'A' to a
```

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## Declaring and Initializing in 1 Step

```
int x = 1;
double d = 1.4;
```

## Named Constants

```
final datatype CONSTANTNAME = VALUE;
final double PI = 3.14159;
final int SIZE = 3;
```

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## Naming Conventions

- Choose **meaningful** and descriptive names
- Variables and method names:
  - Use lowercase.
  - If the name consists of several words, concatenate all in one, use lowercase for the first word, and capitalize the first letter of each subsequent word in the name.
  - For example, the variables **radius** and **area**, and the method **computeArea**.

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# Naming Conventions, cont.

- **Class names:**
  - Capitalize the 1st letter of each word in the name
  - For example, the class name **ComputeArea**
- **Constants**:
  - Capitalize all letters in constants, and use underscores to connect words.
  - For example, the constant **PI** and **MAX_VALUE**

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# Numerical Data Types

| Name | Range | Storage Size |
|---|---|---|
| `byte` | $-2^7$ to $2^7 - 1$ (-128 to 127) | 8-bit signed |
| `short` | $-2^{15}$ to $2^{15} - 1$ (-32768 to 32767) | 16-bit signed |
| `int` | $-2^{31}$ to $2^{31} - 1$ (-2147483648 to 2147483647) | 32-bit signed |
| `long` | $-2^{63}$ to $2^{63} - 1$ (i.e., -9223372036854775808 to 9223372036854775807) | 64-bit signed |
| `float` | Negative range: -3.4028235E+38 to -1.4E-45 Positive range: 1.4E-45 to 3.4028235E+38 | 32-bit IEEE 754 |
| `double` | Negative range: -1.7976931348623157E+308 to -4.9E-324 Positive range: 4.9E-324 to 1.7976931348623157E+308 | 64-bit IEEE 754 |

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# Numeric Operators

| *Name* | *Meaning* | *Example* | *Result* |
|---|---|---|---|
| + | Addition | 34 + 1 | 35 |
| – | Subtraction | 34.0 – 0.1 | 33.9 |
| * | Multiplication | 300*30 | 9000 |
| / | Division | 1.0 / 2.0 | 0.5 |
| % | Remainder | 20 % 3 | 2 |

# Integer Division

- 5 **/** 2 yields an integer 2.
- 5.0 **/** 2 yields a double value 2.5
- 5 **%** 2 yields 1 (the remainder of the division)
- The **%** operator is often used for positive integers, but it can also be used with negative integers and floating-point values.
- The remainder is negative only if the dividend is negative. For example,
  - -7 % 3 yields -1 -12 % 4 yields 0
  - -26 % -8 yields -2 20 % -13 yields 7

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# double vs. float

The double type values are more accurate than the float type values. For example,

```
System.out.println("1.0 / 3.0 is " + 1.0 / 3.0);
```

displays `1.0 / 3.0 is 0.3333333333333333`

16 digits

```
System.out.println("1.0F / 3.0F is " + 1.0F / 3.0F);
```

displays `1.0F / 3.0F is 0.33333334`

7 digits

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# Scientific Notation

- Floating-point literals can be written in scientific notation in the form of ***a* * 10^*b***. For example:
  - The scientific notation for 123.45 is 1.2345 * 10^2
  - For 0.012345 is 1.2345 * 10^-2
- A special syntax is used to write scientific notation numbers. For example:
  - 1.2345 * 10^2 is written as **1.2345E2** or **1.2345E+2**
  - 1.2345 * 10^-2 as **1.2345E-2**
- **E** (or **e**) represents an exponent, and can be in either lowercase or uppercase.

# Evaluating Expressions

❖ Java expressions are evaluated in the same way as arithmetic expressions.

$$\frac{3 + 4x}{5} - \frac{10(y - 5)(a + b + c)}{x} + 9\left(\frac{4}{x} + \frac{9 + x}{y}\right)$$

```
(3 + 4 * x) / 5 – 10 * (y – 5) * (a + b + c) /
        x + 9 * (4 / x + (9 + x) / y)
```

# Operator Precedence

❖ Operators contained within pairs of parentheses **()** are evaluated first.

❖ When more than one operator is used in an expression, the following operator precedence rule is used to determine the order of evaluation:

- *****, **/**, and **%** operators are applied first.
- If an expression contains several *****, **/**, and **%** operators, they are applied from **left** to **right**.
- **+** and **-** operators are applied last.
- If an expression contains several **+** and **-** operators, they are applied from left to right.

# Augmented Assignment Operators

| *Operator* | *Name* | *Example* | *Equivalent* |
|---|---|---|---|
| `+=` | Addition assignment | `i += 8` | `i = i + 8` |
| `-=` | Subtraction assignment | `i -= 8` | `i = i - 8` |
| `*=` | Multiplication assignment | `i *= 8` | `i = i * 8` |
| `/=` | Division assignment | `i /= 8` | `i = i / 8` |
| `%=` | Remainder assignment | `i %= 8` | `i = i % 8` |

**Note: There are no spaces in the augmented assignment operators.**

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# Increment and Decrement Operators

| *Operator* | *Name* | *Description* | *Example (assume i = 1)* |
|---|---|---|---|
| `++var` | preincrement | Increment `var` by `1`, and use the new `var` value in the statement | `int j = ++i;`<br>`// j is 2, i is 2` |
| `var++` | postincrement | Increment `var` by `1`, but use the original `var` value in the statement | `int j = i++;`<br>`// j is 1, i is 2` |
| `--var` | predecrement | Decrement `var` by `1`, and use the new `var` value in the statement | `int j = --i;`<br>`// j is 0, i is 0` |
| `var--` | postdecrement | Decrement `var` by `1`, and use the original `var` value in the statement | `int j = i--;`<br>`// j is 1, i is 0` |

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# Numeric Type Conversion

Consider the following statements:

```
byte i = 100;

long k = i * 3 + 4;

double d = i * 3.1 + k / 2;
```

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# Conversion Rules

- When performing a binary operation involving 2 operands of different types, Java automatically converts the operand using the following rules:

1. If one of the operands is **double**, the other is converted into double.
2. Otherwise, if one of the operands is **float**, the other is converted into float.
3. Otherwise, if one of the operands is **long**, the other is converted into long.
4. Otherwise, both operands are converted into **int**.

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# Type Casting

**Implicit casting**

double d = 3; (type widening)

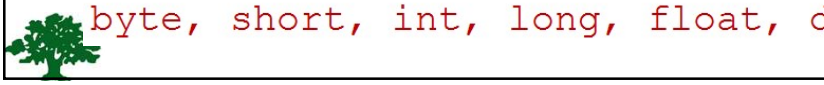
**Explicit casting**

int i = (int) 3.0; (type narrowing)

int i = (int) 3.9; (Fraction part is truncated)

What is wrong? int x = 6 / 2.0;

range increases



byte, short, int, long, float, double

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# Character Data Type

char letter = 'A'; (ASCII)

char numChar = '4'; (ASCII)

char letter = '**¥u**0041'; (Unicode)

char numChar = '**¥u**0034'; (Unicode)

NOTE: The increment and decrement operators can also be used on **char** variables to get the next or preceding Unicode character.

For example, the following statements display character **b**.

```
char ch = 'a';
System.out.println( ++ch );
```

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## ASCII Code for Commonly Used Characters

| Characters | Code Value in Decimal | Unicode Value |
|---|---|---|
| '0' to '9' | 48 to 57 | \u0030 to \u0039 |
| 'A' to 'Z' | 65 to 90 | \u0041 to \u005A |
| 'a' to 'z' | 97 to 122 | \u0061 to \u007A |

## Escape Sequences for Special Characters

| *Escape Sequence* | *Name* | *Unicode Code* | *Decimal Value* |
|---|---|---|---|
| \b | Backspace | \u0008 | 8 |
| \t | Tab | \u0009 | 9 |
| \n | Linefeed | \u000A | 10 |
| \f | Formfeed | \u000C | 12 |
| \r | Carriage Return | \u000D | 13 |
| \\ | Backslash | \u005C | 92 |
| \" | Double Quote | \u0022 | 34 |

## Casting between char and Numeric Types

```
int i = 'a';          // Same as int i = (int)'a';

char c = 97;          // Same as char c = (char)97;
```

## Comparing and Testing Characters

```
if (ch >= 'A' && ch <= 'Z')
  System.out.println(ch + " is an uppercase letter");
else if (ch >= 'a' && ch <= 'z')
  System.out.println(ch + " is a lowercase letter");
else if (ch >= '0' && ch <= '9')
  System.out.println(ch + " is a numeric character");
```

# The String Type

- The char type only represents **1** character.
- To represent a string of characters, use the data type called **String**. For example:

```
String message = "Welcome to Java!";
```

- String is actually a predefined class in the Java library.
- The String type is not a primitive type. It is known as a ***reference** type*.

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# String Concatenation

```
// Three strings are concatenated
String message = "Welcome " + "to " + "Java";

// String Chapter is concatenated with number 2
String s = "Chapter" + 2; // s becomes Chapter2

// String Supplement is concatenated with character B
String s1 = "Supplement" + 'B'; // s1 becomes SupplementB
```

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# Simple Methods for Strings

| Method | Description |
|---|---|
| `length()` | Returns the number of characters in this string. |
| `charAt(index)` | Returns the character at the specified index from this string. |
| `concat(s1)` | Returns a new string that concatenates this string with string s1. |
| `toUpperCase()` | Returns a new string with all letters in uppercase. |
| `toLowerCase()` | Returns a new string with all letters in lowercase. |
| `trim()` | Returns a new string with whitespace characters trimmed on both sides. |

# Console Input

- You can use the **Scanner** class for console input
- Java uses **System.in** to refer to the standard input device (i.e. Keyboard)

```
import  java.util.Scanner;
public class Test{
   public static void main(String[] s){
      Scanner input = new Scanner(System.in);
      System.out.println("Enter  X : ");
       int x = input.nextInt();
       System.out.println("You entered: "+ x);
   }
}
```

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## Reading Numbers from the Keyboard

| Method | Description |
|---|---|
| `nextByte()` | reads an integer of the `byte` type. |
| `nextShort()` | reads an integer of the `short` type. |
| `nextInt()` | reads an integer of the `int` type. |
| `nextLong()` | reads an integer of the `long` type. |
| `nextFloat()` | reads a number of the `float` type. |
| `nextDouble()` | reads a number of the `double` type. |

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## Reading a String from the Console

```
Scanner input = new Scanner(System.in);
System.out.print("Enter three words separated by spaces: ");
String s1 = input.next();
String s2 = input.next();
String s3 = input.next();
System.out.println("s1 is " + s1);
System.out.println("s2 is " + s2);
System.out.println("s3 is " + s3);
```