

# **F1 – A Java program**

Ch 1 in PPIJ

Introduction to the course

The computer and its workings

    The algorithm concept

The structure of a Java program

    Classes and methods

    Variables

    Program statements

    Comments

    Naming conventions

Compiling and execution

    Manual compilation

    Using an IDE

Basic I/O

    System.out

Demo: Hello World

The Java Standard Library

    java.lang

    java.io

    java.util

## **F2 – Data storage**

Ch 2 in PPIJ

Variables

- The type concept
- The declaration concept
- Simple assignment
- Constants

Primitive data types in Java

- byte
- char
- boolean
- short
- int and long
- float and double

Type conversions

- Automatic type conversions
- Explicit type conversions

Object data types

- Reference variables
- Class String

## F3 – Standard input + operations on primitive values

CH 3 and 4 in PPIJ

Basic I/O

- The streams concept
- System.in
- Java.util.Scanner
  - Characters
  - Strings
  - Numbers

The expression concept

Operations on integers

- Standard arithmetic
- Integer expressions
- Automatic type conversions in computation
- Over- and underflow in results

Operations on floating point numbers

- Floating point expressions
- Automatic type conversions in computation
- Rounding
- +/- infinity

The precedence order of operators, and parentheses

Ex:  $2 + 3 * 4$  vs  $(2 + 3) * 4$

Operations on a variable

- Assignment operators
- Increment- and decrement operators

Comparing primitive values

- Numeric comparison operators
- Boolean comparison operators

Logical operations

- Conjunction and disjunction
- Negation

Logical expressions

## **F04 – Logic**

Ch 5 in PPIJ

The concepts *sequence*, *selection*, and *iteration*

A statement and a block of statements

Conditional statements

- If
- If-else
- The '?' operator
- Switch

Iteration

- While
- Do – while
- For-loop
- For-each loop (Iterable)
- Nested loops
- Break
- Continue

## **F05 – Vectors (Arrays)**

Ch 6 in PPLJ

### **One-dimensional vectors**

- Index

- Creating and using a vector

- Length

- Vectors are objects

  - The vector variable is a reference type

- Static initialization of a vector

- For- and for-each loops

### **Multi-dimensional vectors**

- A vector of references to references ... to data

- Matrices

- Cubes

The concepts *element data type*, and *vector data type*

## **F06 – Methods**

Ch 7 in PPIJ

Creating and using methods

- The concept of a subprogram

- Example (the underlining method)

- Parameters

- The concept of a function

- The return value

- Expressions in actual parameters (arguments)

Managing methods

- Sequences of method calls

- Method call chains

- Selecting the method by parameter type – overloading

Local variables

Global variables

Recursive iteration

Vectors as parameters and return values

A variable number of arguments

## **F07 – A class library**

### **Distributed code**

- Class libraries

- Packages

### **The Java Standard Library**

- Java.lang.Math

- Java.lang.String

- Wrapper classes

  - Integer

  - Character

- Java.lang.System

- Java.util.Arrays

### **Exceptions**

- The exception hierarchy

- Checked vs unchecked

- Create, throw, declare

## **F08 – Algorithms (1/2)**

Ch 9 in PPIJ

A problem and an algorithm

- A problem and its instances
- Algorithm description

Selection algorithms

- A prioritized element
- The update algorithm

Sorting algorithms

- Selection sort
- Insertion sort

Search algorithms

- Sequential search
- Binary search



## **F09 – Objects (1/1)**

Ch 10 in PPIJ

Defining, creating, and using objects

- A composite data type
- Initialization
- Methods and behavior
- The Object.toString method
- Encapsulation and interfaces
- References to objects

Objects that manage strings

- String
- StringBuffer/StringBuilder
- java.util.Scanner
- Immutable objects
- References to strings
- Using Scanner

Typical services by an object

- Inspectors
- Mutators
- Combiners
- Comparators
- Predicates
- Transformers

## **F10 – Algorithms (2/2)**

Ch 9 in PPIJ

The complexity of an algorithm

- The complexity function

- Estimating the order of a complexity function

The correctness of an algorithm

- Specification and meaning

- Review

- Tracing

- Proof

## F11 – Objects (2/2)

Ch 10 in PPIJ

Object resources

- String.length()
- String.isEmpty()
- Integer.<type>Value()
- Integer.equals()
- Integer.toString()

Class resources

- String.valueOf(<type>)
- Integer.parseInt
- Integer.MIN\_VALUE, Integer.MAX\_VALUE

Classes in Java

- Inheritance
- The class hierarchy

Autoboxing/Unboxing

Vectors of references to objects

- Matrices

Passing a vector as a parameter

- java.util.Arrays.sort
- Parameters to main

Algorithms in conjunction with objects

## F12 – Exceptions

Ch 11 in PPIJ

Managing exceptions

- Creating, throwing, declaring

- Catch and manage

- Catch at the right level

The exception hierarchy

- Sequence ordering in catch

- RuntimeException – unchecked

Nested try-catch clauses

try-catch-finally

try-with-resources

Rethrown exception

Defensive coding – exceptions should be exceptional

# F13 – In- and output

Ch 12 in PPIJ

Stream

- Byte-streams
- Buffered streams
- Character streams
- Data streams
- Object streams

Stdin and stdout

- java.io.InputStreamReader
- java.util.Scanner
- java.io.PrintWriter
- System.out
- Formatted output – printf

Managing files

- java.io.File
- Directories and files

Textfiles

- Unicode vs local encoding
- Writer with subclasses
- BufferedWriter
- InputStreamReader
- Close

Binary files

- Outputstream with subclasses
- InputStream with subclasses
- Buffered streams
- Primitive data types and strings

Objects in files

- java.io.Serializable
- ObjectOuputStream
- ObjectInputStream

Random access files

## **F14 – Creating new object types (1/2)**

Ch 13 in PPIJ

Composite data types

- Vectors

- Definition class

- The standard library

Objects with data

- Variables

- Initialize

- Constructor

Operations

- Methods

Encapsulation and interfaces

- Private and public members

- Accessor methods

- Access levels

## **F15 – Creating new object types (2/2)**

Ch 13 in PPIJ

Instance resources and class resources

- Class variables
- Class methods

An object's references to other objects

- Dependencies
- Independent references
- Retain control (return copies)
- Strings are immutable
- Instantiation in the declaration

Inner classes

- Managing complex inner instance properties
  - Person
- Internal dynamic data structures
  - Linked list

# F16 – Developing new object types

Ch 14 in PPIJ

## Defining a new type of object

- Modelling, design, revision
- Choosing instance variables
- Accessor and mutator methods
- Help classes
- Defining constructors
- Defining methods
- Designing services
- Combiner methods
- Comparators
- Predicates
- Converters
- Static variables
- Static methods

## Implementing the definition class

- Constructors
- Instance methods

## Testing

- Creating and displaying objects
- Testing services
  - Assert
  - Test program
  - JUnit

## Comments

- Code comments
- Javadoc
- Documentation



# Lecture 17 – Inheritance

Ch 15 in PPIJ

## Subclasses

- Extending an existing type
- Constructors in subclasses
- Methods in subclasses
- Overriding methods in the superclass
- Access protection in the superclass

## Super- and subclass references

- Vertical type derivation

## Polymorphism and dynamic binding

- Access via the superclass type
- Denying class extension

## Lecture 18 – Class hierarchies

Ch 16 in PPIJ

Class hierarchy

- Simple inheritance
- Common superclass
- Inheritance chain
- Java and class Object
- Inheriting from the standard library

Managing a class hierarchy

- Abstract superclasses
- Inheriting from an abstract class
- Managing objects with the same superclass
  - Vector
  - The instanceof operator

More of class Object

- The class Class
- getClass vs instanceof
- Object.equals
- References to Object

Type independent programming

- Managing a local class hierarchy
  - Number

## **F19 – Class hierarchies and interfaces**

Ch 16-17 in PPLJ

Type independent data structures  
Generic types

Interface classes  
Comparable  
Implementing an interface  
Empty interfaces  
References to interface types  
Constants in interfaces

## **F20 – Interfaces**

Ch 17 in PPIJ

Type independent programming with interfaces

- Hierarchies of interfaces

- Methods with interfaces as parameters and return type

- Type expressions

Interface vs multiple inheritance

Interfaces and inner classes

- Standard

- Anonymous inner classes