This document presents a checklist for larger (object-oriented) programs, especially in the course *Programming Methods* (2IP15).

Requirements

1. Understand and analyze the requirements. Preferably, precise requirements are available in a written document.

! Coding Standard

2. Adhere to a good coding standard for a readable layout, through systematic indentation, spacing, and empty lines. There is a (mild) coding standard for this course [1].

Naming

3. Use appropriate identifiers to name entities. Local entities can be designated by shorter names. Java naming conventions:
   - Class names are (singular) nouns, starting with a capital letter: `Card`
   - Method names are verbs (or begin with a verb), starting with a lower case letter: `turnCard()`
   - Variable names (including instance variables, local variables, and parameters) are nouns, starting with a lower case letter: `card`
   - Constants are written in all upper case: `QUEEN`
   - Use *camelCasing* to distinguish words in a name; except in constants, use underscores: `CardDeck, getCard(), MAXIMUM_RANK`

Constants

4. Avoid *magic literals*; use named constants:

```
public static final int MAXIMUM_RANK = 13;
```

Auxiliary variables

5. Use auxiliary variables to reduce the complexity of expressions, to avoid code duplication, to improve efficiency, and to facilitate focused comments.

Coding idiom

6. Use appropriate coding idiom to reveal the code's intention, in particular for selection (`?:`, **`if`**–**`else`**, **`switch`**–**`case`**–**`break`**) and repetition (**`for`**, **`while`**, **`do`**–**`while`**).

! Procedural abstraction SRP

7. Avoid large method bodies and (deeply) nested control structures; decompose functionality into multiple methods, through procedural abstraction. Each method must serve a well-defined purpose (Single Responsibility Principle) specified in a contract. Be aware of the pros and cons of recursive methods.

Prefer local declarations

8. Declare variables as locally as possible; from most preferred to least preferred: within a statement block (e.g., inside a loop body), local to a method body, as a method parameter, non-public instance variable of a class, public instance variable of a class. Use **`final`** if the value should not change.

Method coupling

9. Communicate data between methods via parameters and return values; minimize communication where methods refer directly to variables that are *global* to these methods.

! Unit tests

10. Provide unit tests for key functionality. Aim for 100% branch coverage. Apply Test Driven Development (TDD): (1) specify functionality in contracts, (2) develop tests, (3) implement functionality, (4) execute tests, (5) use functionality.

! Robustness

11. Use `assert` statements and exceptions to signal abnormal conditions, and thus make facilities robust. Avoid the use of exceptions for normal operation (less clear control flow; run-time penalty). Check the proper throwing of exceptions in unit tests.

! Data abstraction

12. Bundle related variables in a class (data decomposition).

• Enum

(a) Consider an **`enum`** to define related constants.

• Record

(b) Consider a record, i.e., a class that only has public instance variables, when there is no concern about data representation. Optionally provide a constructor that sets the instance variables, and a conversion to a string.

• ! ADT

(c) Consider an Abstract Data Type (ADT) with private instance variables to provide data abstraction (hide the data representation from clients); provide public methods to access the data. See to it that methods either

- inspect the state (also known as queries), or
- modify the state (also known as commands),

but not do both. Provide a class contract via public invariants between queries, and contracts for each method. For the implementation, provide a (private) representation invariant and an abstraction function.

Iterators

13. Use iterators, preferably standard iterators in a for-each statement, instead of ad-hoc loops. Consider providing (standard) iterators.

Coherence

14. Define functionality as close as possible to the data that it operates on (coherence).

Packages

15. Put related classes together in their own package. Explain the relationship and development status in `package-info.java`.

Decoupling DIP

16. Avoid mutual dependencies; decouple functionality through callbacks, also knowns as listeners or observers (cf. Dependency Inversion Principle).

Composition/ Inheritance

17. Prefer association and interfaces over inheritance.

JCF

18. Reuse standardized facilities, such as the Java Collections Framework.

Design Patterns

19. Apply common Design Patterns. See [2].

DRY

Keep in mind: avoid code duplication (Don't Repeat Yourself); aliasing, sharing; mutable versus immutable classes; static members; inheritance, abstract classes, interfaces; mutually related classes (package level invariants); nested classes; generics; annotations; choice of algorithm and data representation; Graphical User Interface (GUI) mechanisms (event driven); the SOLID OO design principles

SOLID

References

[1] *Coding Standard* for the Course 'Programming Methods', (2IP15).

[2] Eddie Burris. *Programming in the Large with Design Patterns*. Pretty Print Press, 2012.

