Software Reuse Techniques

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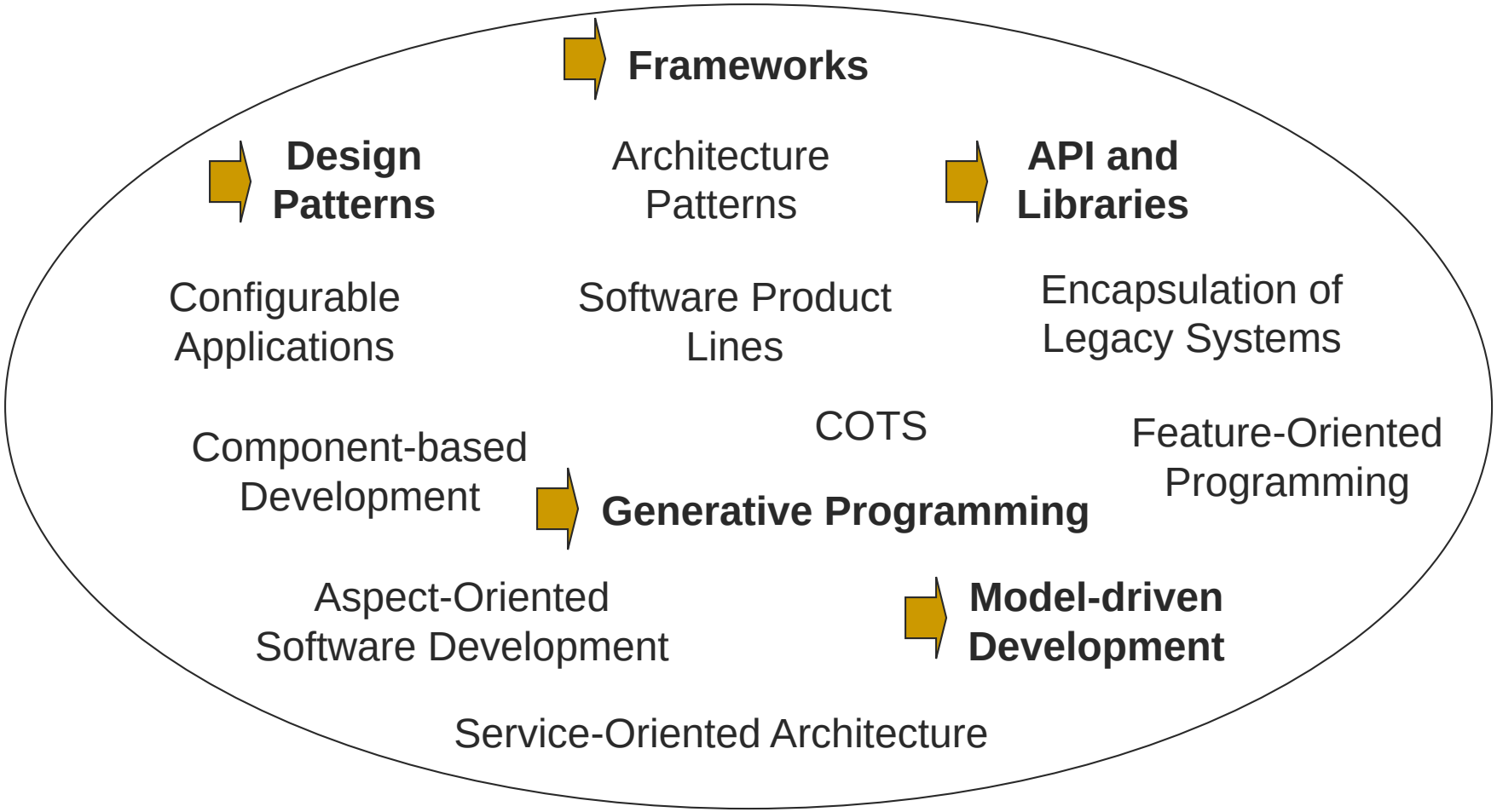
Overview of Reuse Techniques



Library, API, and Framework

Library (API)

- Application Programming Interface (API)
- Libraries (or API) implement services used by several kinds of programs
  - It is a common way of software reuse
- API makes available common functions
  - To convert data from common formats (e.g., string to integer)
  - To access resources, files, DB, etc.
  - Abstract data types, such as queue, stack

Example of Java API Use

```
import java.util.Vector;

public class Customer {

  String name;
  Vector phoneNumbers = new Vector();

  void removePhoneNumber(String c){
    phoneNumbers.removeElement(c);
  }

  void addPhoneNumber(String c){
    phoneNumbers.addElement(c);
  }

  ...
}
```

Framework

- Framework is a general structure
- Framework is an incomplete system
  - It is composed of classes and interfaces that implement the system standard structure
- A system is implemented by adding classes to fill in the gaps (i.e., hot spots)
  - For instance, abstract class in a framework should be extended in a system

Main Properties of Framework

- Inversion of control
  - Unlike in libraries or applications, the program flow of control is dictated by the framework
- Extensibility
  - A framework can be extended by the user
- Non-modifiable framework code
  - The framework code should not be modified
- A framework has a default behavior

Classification of Frameworks

- Infrastructure Frameworks
  - Support the creation of infrastructure for systems, such as compiling environment
- Integration Frameworks
  - Support exchanges of messages among components (communication)
- Application Frameworks
  - Support development of new applications with common characteristics, such as Web applications

Framework Extension

- Frameworks are large entities which are supposed to be extended
- Examples of framework extension
  - Include new concrete classes that extend abstract ones
  - Override methods that implement standard behavior
  - Include configuration files, such as XML

Main Drawback

- *Framework* is usually large and complex
  - It is hard to understand
  - It may take long time to be effectively used
  - Developers may need only a simple functionality

Design Patterns

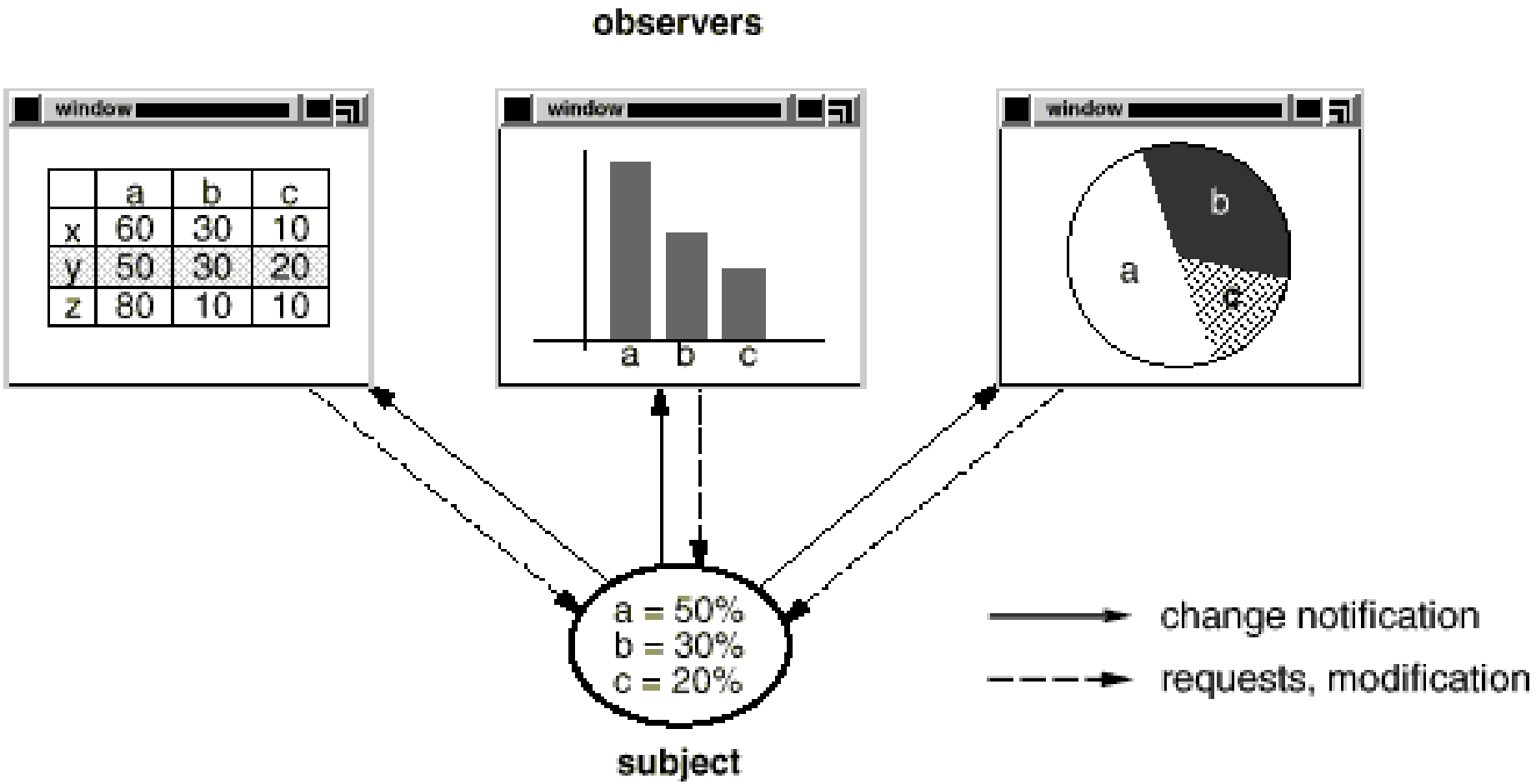
Design Patterns

- A design pattern is a general reusable solution to a common problem
- Patterns are known best practices
  - They allow reuse of knowledge from experts
- They do not describe a complete solution, since it is supposed to be reused in different applications

Elements of a Design Pattern

- Name
  - It is an identifies
- Problem Description
- Solution
  - It is a *template* of the solution and can be used in different applications
- Consequences
  - Results you get when you apply the pattern

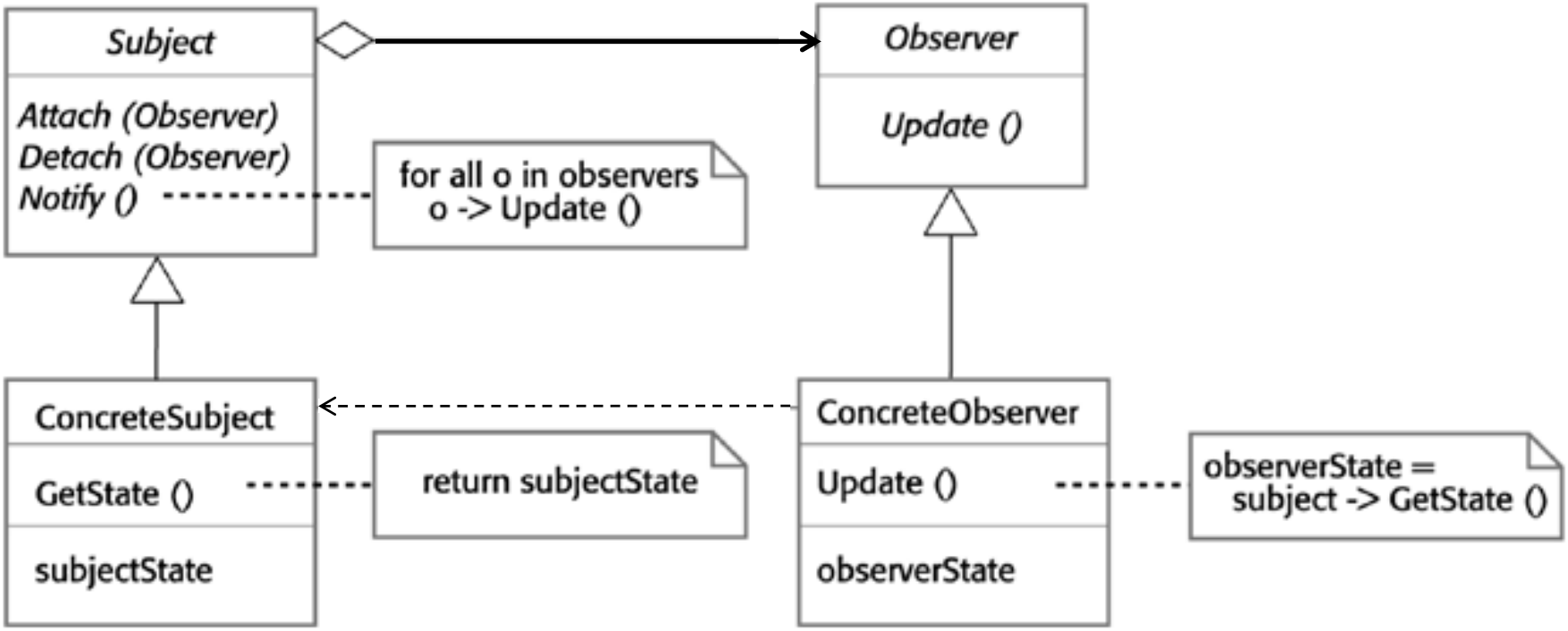
Example of Problem



The Observer Design Pattern

- Name
  - Observer
- Problem Description
  - It separates the subject of its representations
- Solution (next slide)
- Consequences
  - It optimizes updates from and notification to the viewers

Observer Solution



MDD and Code Generation

Motivation

- Reuse of code is usually hard to achieve
  - It involves loads of details which are language and platform dependents

MDD Solution

- Model-driven Development (MDD)
- It aims to raise the abstraction level
  - Reuse of models instead o code
- By means of code generators, the system code is automatically created

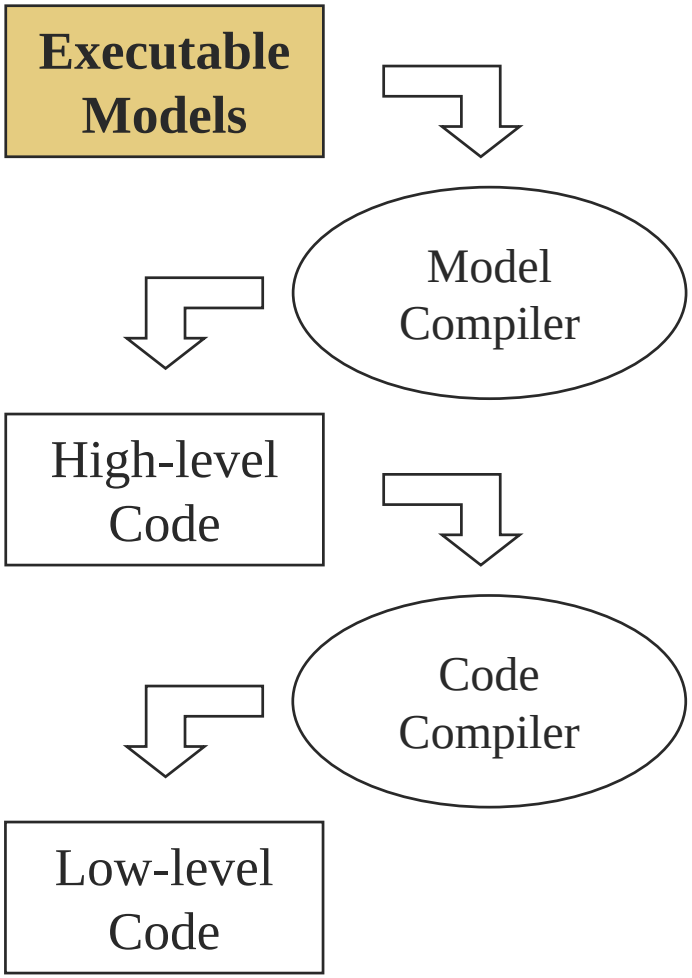
Why Reuse of Models?

- Models are expected to last longer
- Models facilitate communication among developers
  - They are sometimes used to communicate with costumers
- Models are usually developed in mature software process
  - With or without code generation

The MDD Approach

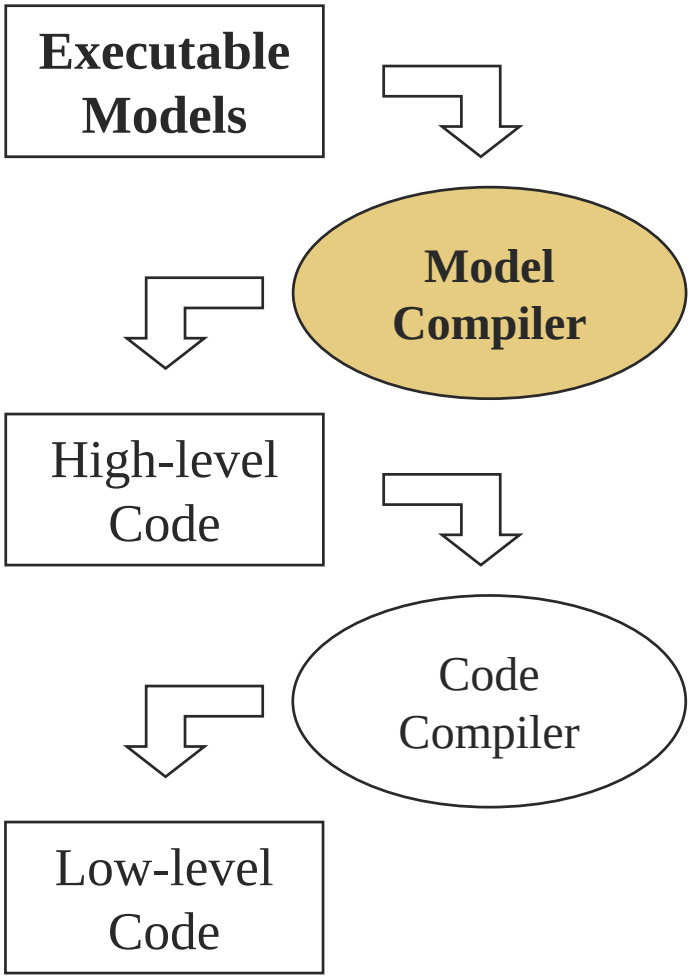
- It proposes the development, reuse, maintenance and evolution at design phase
- Reuse of models is still in maturing stage (not very frequent in industry)
  - It is more common in specific domains or in research center or academia

MDD Process



- Models are software independent
  - As, high-level code is hardware independent

MDD Process



- Models can be compiled to a high-level programming language
  - Models can be (partially) reused in different contexts

MDD Steps

1. Select some of existing models
2. Choose parts of the models you want
   - It might be necessary to adapt a model
   - It might be necessary to create new models
3. Integrate all partial models of a system
4. Choose a implementation technology
   - It might be necessary to describe the mapping from models to implementation
5. Generate the system code

Current Drawbacks

- MDD is still immature
  - For instance, it lacks support from tools and development environments
- Models are usually seen as superfluous
  - Code is the main asset
- Developers resist to MDD
  - They prefer programming than modelling
  - They are afraid of losing their jobs as programmers

Bibliography

- Ian Sommerville. **Software Engineering**, 9th Edition. Pearson Education, 2011.
  - Chap. 16 Software Reuse
  - Section 5.5 Model Driven Engineering