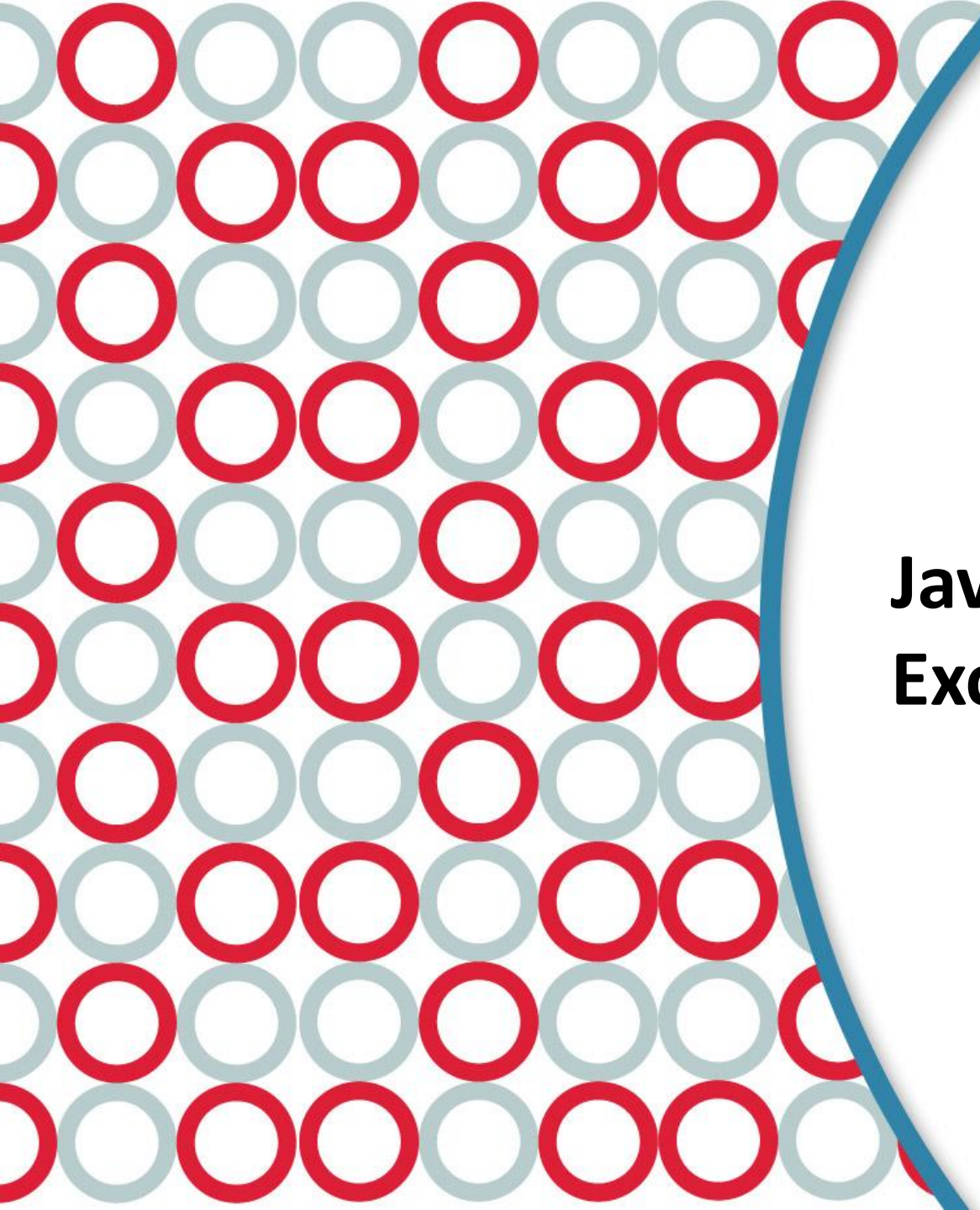

September 2022,
Programming in Java

Java IO. NIO. NIO2 Exception Handling

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Where to Find the Code?

Java Academy Development projects and examples are available @ GitHub:

https://github.com/iproduct/java-academy-2022

Exception handling

Exception Handling in Java

- Obligatory exception handling in Java → secure and reliable code
- Separation of concerns: business logic from exception handling code
- Class **Throwable** → classes Error и Exception
- Generating Exceptions – keyword **throw**
- Exception handling:
  - **try – catch – finally** block
  - Delegating the handling to the caller method - **throws**

Try-Catch-Finally Block

- Operator **try** for demarcation of un-reliable code, multiple **catch** blocks for catching exceptions, and **finally** clause for garateed clean-up in the end:

```
try {
    // code that can throw Exceptions: Ex1, Ex2,  ...
} catch(Ex1 ex) {  // excuted only when Ex1 is thrown
    // handling problem 1 (Ex1)
} catch(Ex2 ex) {  // excuted only when Ex2 is thrown
    // handling problem 2 (Ex2)
} finally {
    // executed always independently of whether an exception
    was thrown or not
}
```

Exception Handling in Java - II

- Implementing custom exceptions
- Using stack trace
- Unchecked exceptions extending **RuntimeException**
- Guaranteed completion using **finally**

Novelties in Exception Handling since Java 7

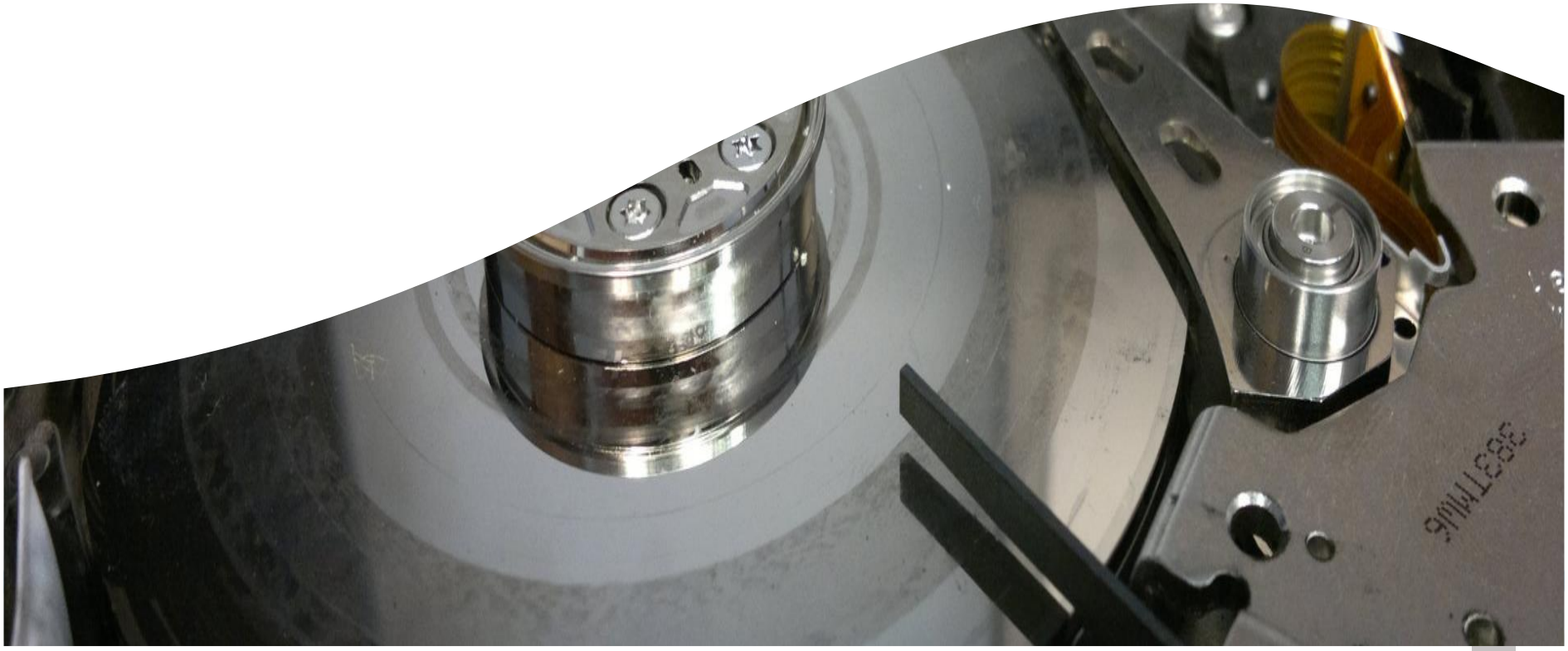
- **Multi-catch** clause:

```
catch (Exception1|Exception2 ex) {
    ex.printStackTrace();
}
```

- Program block **try-with-resources**

```
String readInvoiceNumber(String myfile) throws
  IOException {
      try (BufferedReader input = new
                  BufferedReader(new
                      FileReader(myfile))) {
          return input.readLine();
  }
}
```

Java IO. New IO (NIO) 2



Agenda for This Session

- I/O basics,
- AutoCloseable,
- Closeable and Flushable interfaces,
- I/O exceptions,
- Serialization,
- java.io. and nio

Java I/O

- Input/Output from/to:

✓ Memory
✓ String
✓ Between different threads
✓ Files
✓ Console
✓ Network sockets

- Different data types – bytes / characters. Encoding.

- Common and extensible architecture of Java I/O system using Decorator design pattern.

Class **File** – Working with Files and Dirs

- Class ***File***
- Represents a file or a directory.
- Methods ***getName()*** and ***list()***
- Getting file information
- Creating, renaming and deleting directories.

Input and Output Streams

- Input streams – class ***InputStream*** and its inheritors
- Output streams – class ***OutputStream*** and its inheritors
- Decorator design pattern
- Decorators - class ***FilterInputStream*** and its inheritors, class ***FilterOutputStream*** and its inheritors

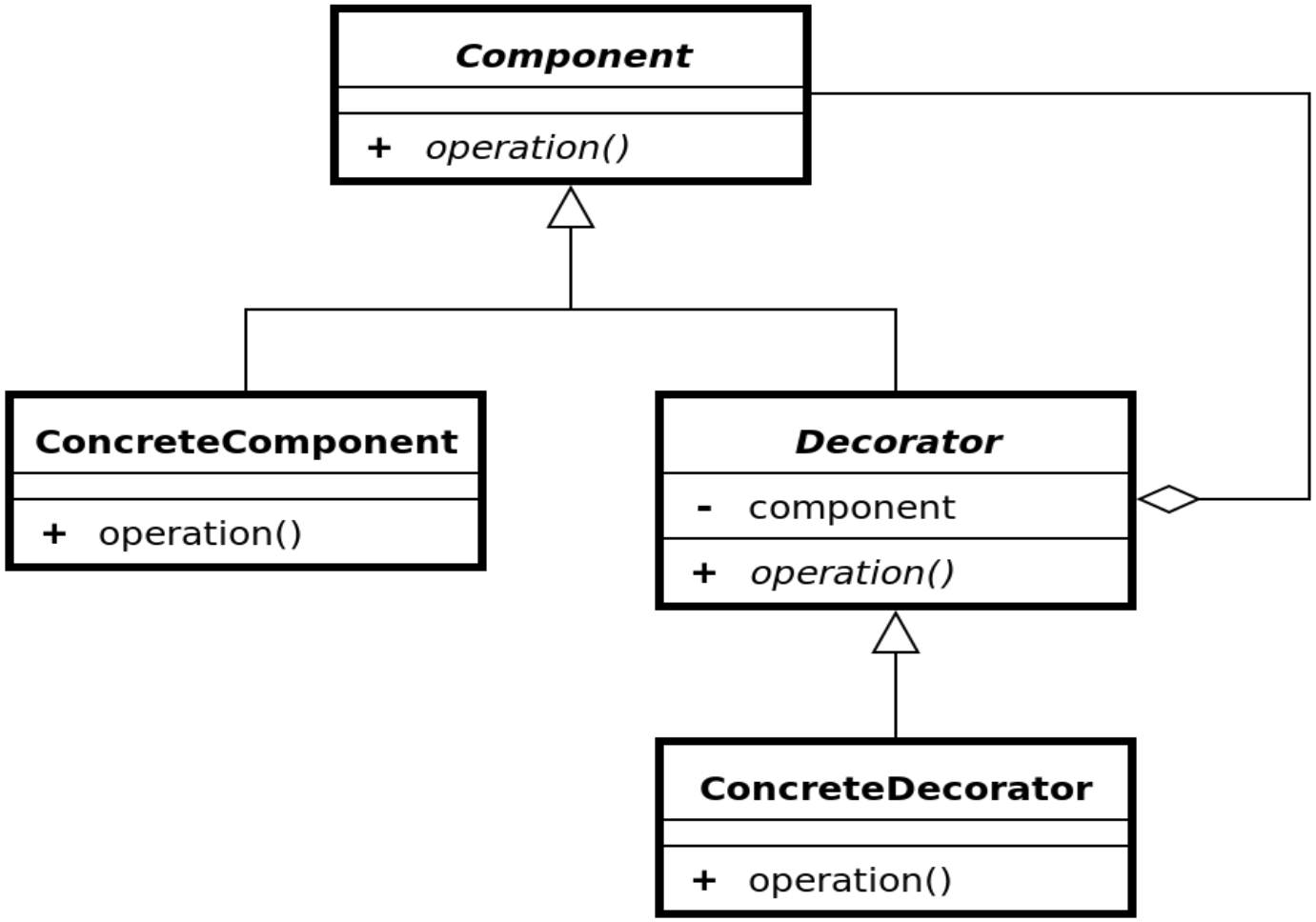
Input Streams: ***InputStream***

- **FileInputStream** – reads data from file
- **ByteArrayInputStream** – reads data from memory
- **StringBufferInputStream** – reads data from StringBuffer
- **ObjectInputStream** – de-serializes Objects and primitives
- **PipedInputStream** – receives data from another thread
- **SequenceInputStream** – combines several InputStreams
- **FilterInputStream** – decorates wrapped input streams with additional functionality

Output Streams: ***OutputStream***

- **FileOutputStream** – writes data to file
- **ByteArrayOutputStream** – writes data to memory buffer
- **ObjectOutputStream** – serializes objects and primitives
- **PipedOutputStream** – sends data to another thread
- **FilterOutputStream** – decorates wrapped InputStreams with additional functionality

Decorator Design Pattern



Input Stream Decorators

- **DataInputStream** – reads primitive types
- **BufferedInputStream** – buffers the input, allows reading lines instead of characters
- **DigestInputStream** – calculates content hash using algorithms such as: SHA-1, SHA-256, MD5
- **DeflaterInputStream** – data compression
- **InflaterInputStream** – data decompression
- **CheckedInputStream** – calculates checksum (Adler32, CRC32)
- **CipherInputStream** – decrips data (using Cipher)

Output Stream Decorators

- **PrintStream** – provides convenient methods for printing different data types, processes exceptions
- **DataOutputStream** – writes primitive data types
- **BufferedOutputStream** – output buffering
- **DigestOutputStream** – calculates content hash using algorithms such as: SHA-1, SHA-256, MD5
- **DeflaterOutputStream** – data compression
- **InflaterOutputStream** – data decompression
- **CheckedOutputStream** – checksum computation
- **CipherInputStream** – encrips data (using Cipher)

Reading Character Data: ***Reader***
Adaptor Class: ***InputStreamReader***

- **FileReader** – reads character data from file
- **CharArrayReader** - reads character data from memory
- **StringReader** – reads character data from String
- **PipedReader** – receives character data from a thread
- **FilterReader** – Reader decorator base class

Writing Character Data : ***Writer***
Adaptor Class: ***OutputStreamWriter***

- **FileWriter** – writes character data to file
- **CharArrayWriter** - writes character data to array
- **StringWriter** – writes character data to StringBuffer
- **PipedWriter** – sends character data to another thread
- **FilterWriter** – base class for Writer decorators
- **PrintWriter** – formatted output in string format, handles all exceptions

Reader / Writer Decorators

- **BufferedReader** – character input buffering
- **PushbackReader** – allows characters to be read without consuming
- **BufferedWriter** – character output buffering
- **StreamTokenizer** – allows parsing of character input (from Reader) token by token

Direct Access Files

- Class ***RandomAccessFile***.
- Access modes
- Method ***seek()***
- Usage examples.

- Standard I/O to/from console. Redirecting.

New More Effective I/O Implementation: New I/O

- Java New I/O – package ***java.nio.**** introduced in JDK 1.4
- Uses low level OS mechanisms and structures to allow more effective, faster and non-blocking IO.
- Underlying all types of Streams (FileInputStream, FileOutputStream, RandomAccessFile) as well as network socket streams.

New More Effective I/O Implementation: New I/O

- Buffers for primitive data types: **java.nio.Buffer, ByteBuffer, CharBuffer, DoubleBuffer, FloatBuffer, IntBuffer, LongBuffer, ShortBuffer**
- Channels – new low level IO abstraction: **java.nio.channels.Channel, FileChannel, SocketChannel**
- Supports different encodings: **java.nio.charset.Charset**

New More Effective I/O Implementation: New I/O

- Supports read/write locking of arbitrary sections of a file up to Integer.MAX_VALUE байта (2 GiB). Depending on OS can allow shared locking: **tryLock( )** or **lock( )** of the class **java.nio.channels.FileChannel**

- Allows multiplexing of I/O operations for implementing scalable servers processing multiple sessions using a single thread asyncronously: **java.nio.channels.Selector** и **SelectableChannel**

Compression: GZIP, ZIP. JAR Files

- File compression – gzip, zip. Check Sum.
- Application deployment using .jar archives. JAR file manifest.
- **jar** [options] archive [manifest] files

c – creates new archive
x / x файл – extracts specific/all files from an archive
t – prints archive content table
f – necessary to specify the file we read/write from/to
m – if we provide a manifest file
M – do not create manifest file automatically
0 – without compression
v – verbose output

Object Serialization

- Interface ***Serializable*** **–** all fields are serialized except those marked as ***transient***
- Interface ***Externalizable*** **–** we serialize all fields explicitely
- Methods ***readObject()*** and ***writeObject()*** **–** ***Serializable*** + customization where necessary
- Examples

Novelties in Java 7 - JSR 203: NIO.2 (1)

- New NIO packages: java.nio.file, java.nio.file.attribute
- FileSystem – allows a unified aceess to different file systems using URI or the method FileSystems.getDefault(). A factory for file system object creation. Methods: getPath(), getPathMatcher(), getFileStores(), newWatchService(), getUserPrincipalLookupService().
- FileStore – models a drive, partition or a root directory. Can be accessed using FileSystem.getFileStores()

Novelties in Java 7 - JSR 203: NIO.2 (1)

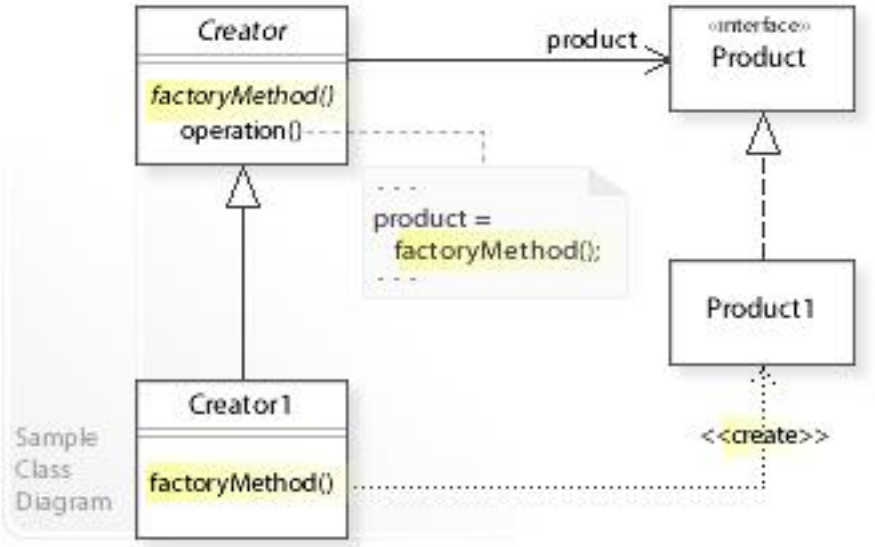
- Path – represents a file or directory path in the file system. Has a hierarchical structure – a sequence of directories separated using an OS specific separator ('/' или '\'). Provides methods for composing, decomposing, comparing, normalizing, transforming relative and absolute paths, watching for file and directory changes, conversion to/from File objects (java.io.File.toPath() и Path.toFile()).
- Files – utility class providing static methods for manipulation (creation, deletion, renaming, attributes change, content access, automatic MIME type inference, etc.) of files, directories, symbolic links, etc.

Resources

- Sun Microsystems Java™ Technologies webpage – http://java.sun.com/
- New I/O във Wikipedia: http://en.wikipedia.org/wiki/New_I/O
- Уроци за новостите в JSR 203: NIO.2 http://download.oracle.com/javase/tutorial/essential/io/fileio.html

Design patterns

Builder, Factory, Dependency Injection, MVC pattern, Adapter



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Software Design Patterns

- Design patterns – software design pattern is a general, reusable solution to a commonly occurring problem within a given context in software design. It is not a finished design that can be transformed directly into source or machine code. Rather, it is a description or template for how to solve a problem that can be used in many different situations. Design patterns are formalized best practices that the programmer can use to solve common problems when designing an application or system.
- Object-oriented design patterns – present relationships and interactions between classes or objects, without specifying the final application classes or objects that are involved.
- Design patterns may be viewed as a structured approach to computer programming intermediate between the levels of a programming paradigm and a concrete algorithm.

Source: Wikipedia - https://en.wikipedia.org/wiki/Software_design_pattern

Design Patterns Structure

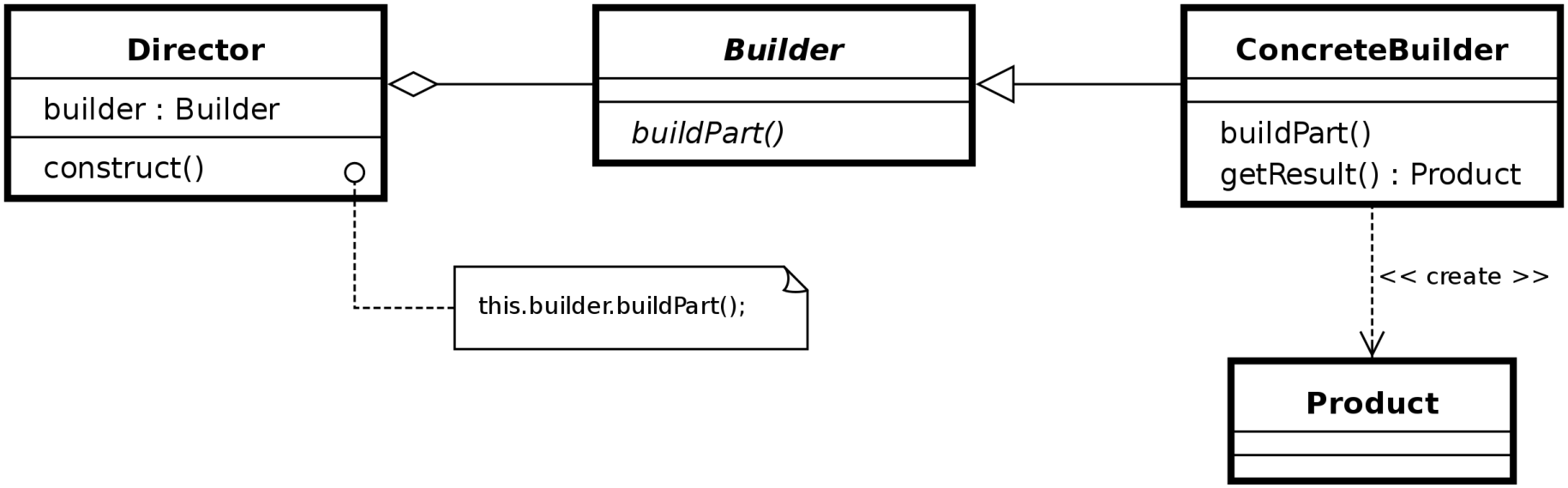
- Design patterns gained popularity in computer science after the book Design Patterns: Elements of Reusable Object-Oriented Software was published in 1994 by the so-called "Gang of Four" (Gamma et al.), which is frequently abbreviated as "GoF".
- Design patterns common description structure – Pattern Name and Classification, Intent, Also Known As, Motivation (Forces – problem and context), Applicability, Structure, Participants, Collaboration, Consequences, Implementation, Sample Code, Known Uses, Related Patterns (differences with similar patterns).

Categories of Design Patterns

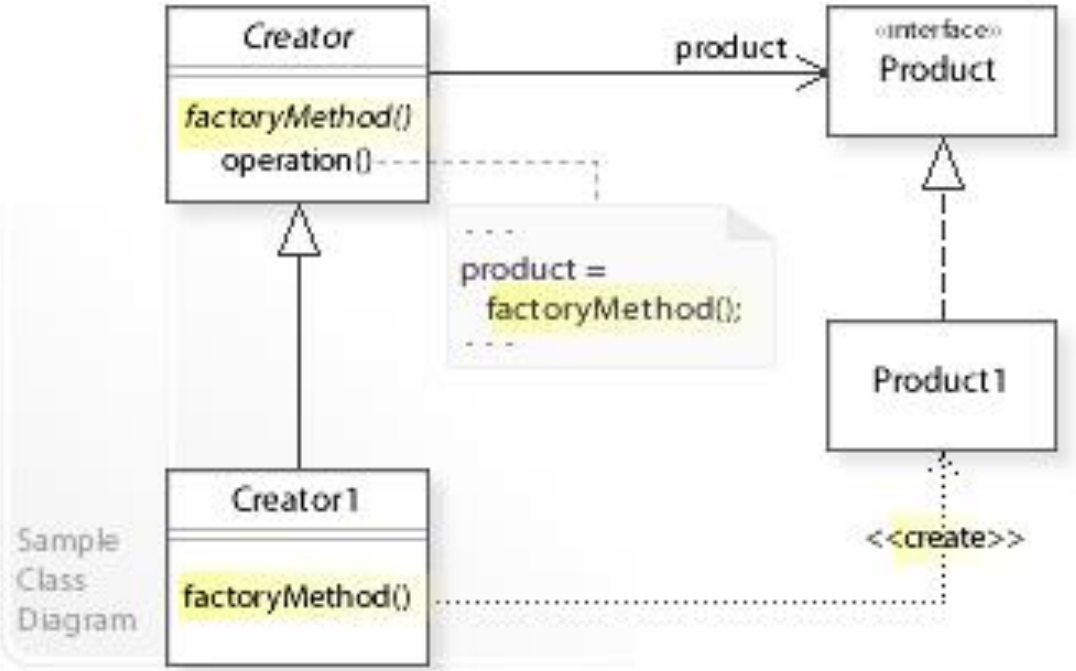
- Creational patterns provide the capability to create objects based on a required criterion and in a controlled way.
- Structural patterns are about organizing different classes and objects to form larger structures and provide new functionality.
- Behavioral patterns are about identifying common communication patterns between objects and realize these patterns.

Source: Wikipedia - https://en.wikipedia.org/wiki/Software_design_pattern

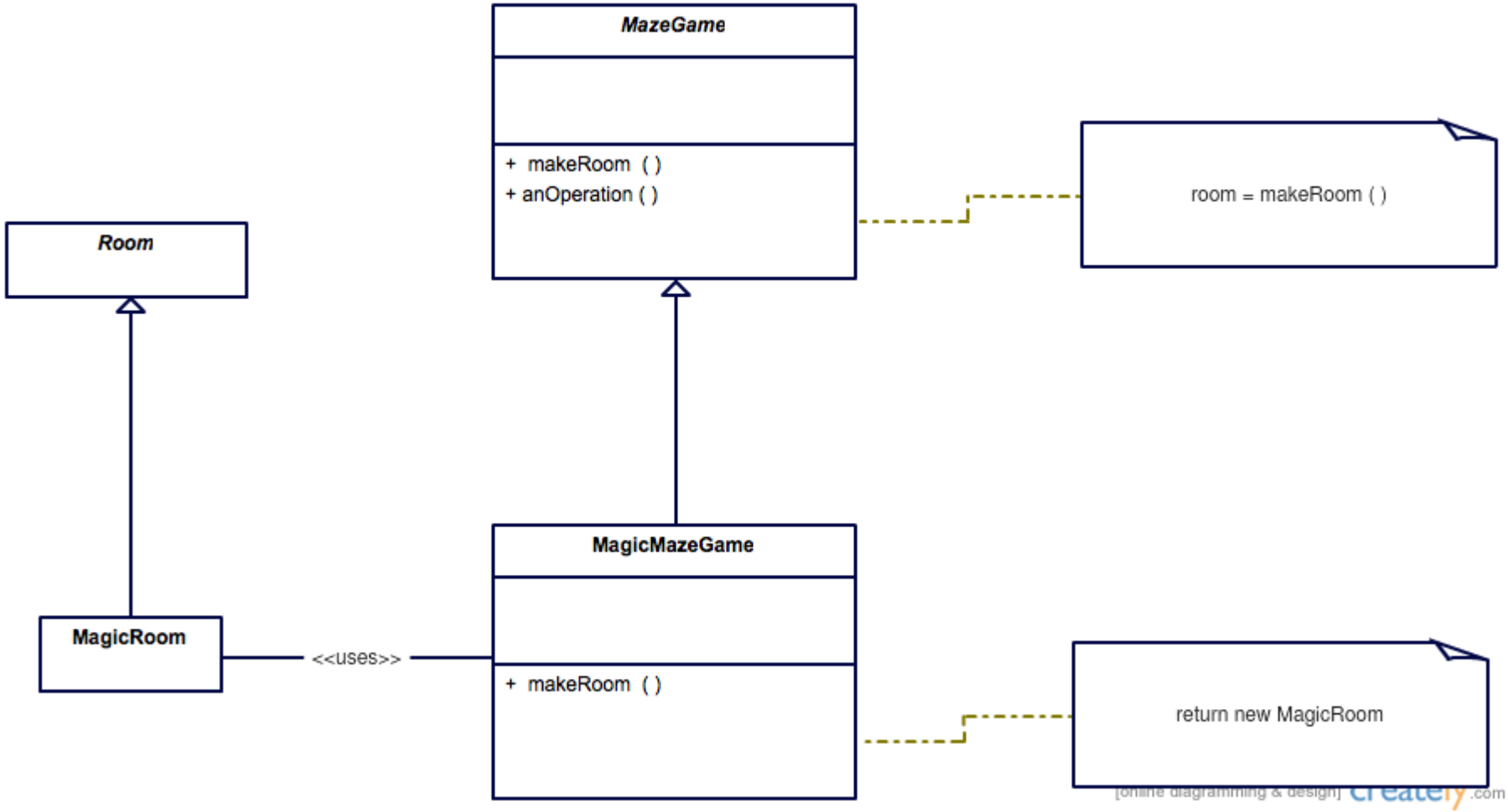
Design Pattern Builder



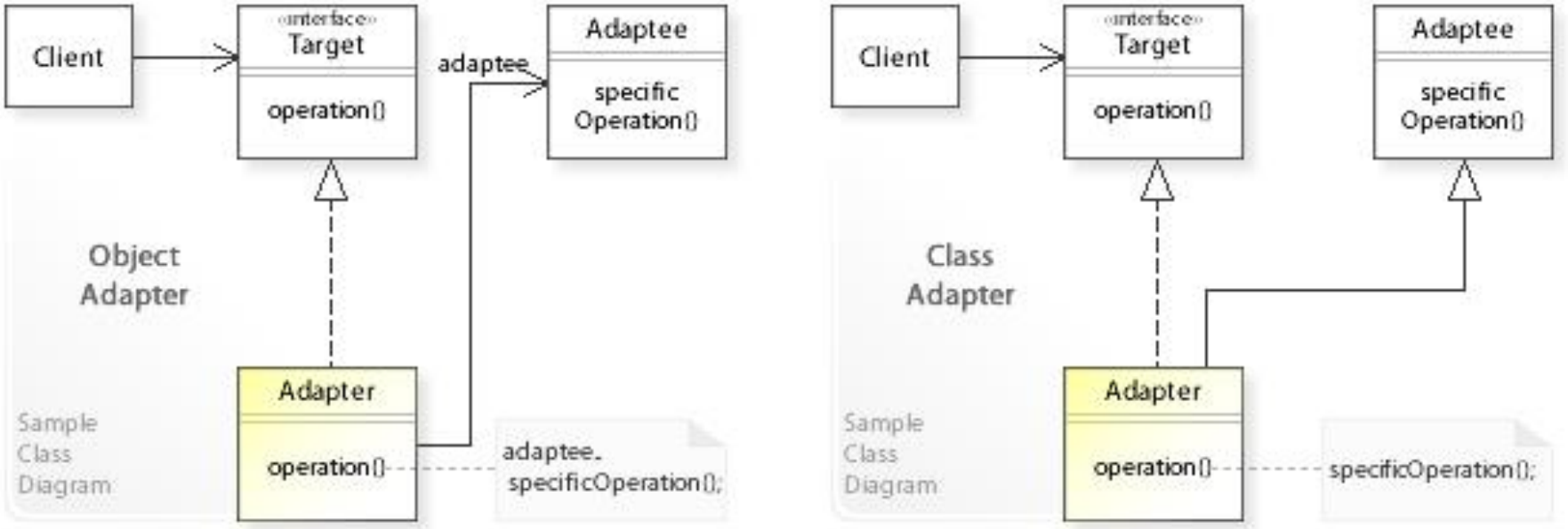
Design Pattern Factory Method



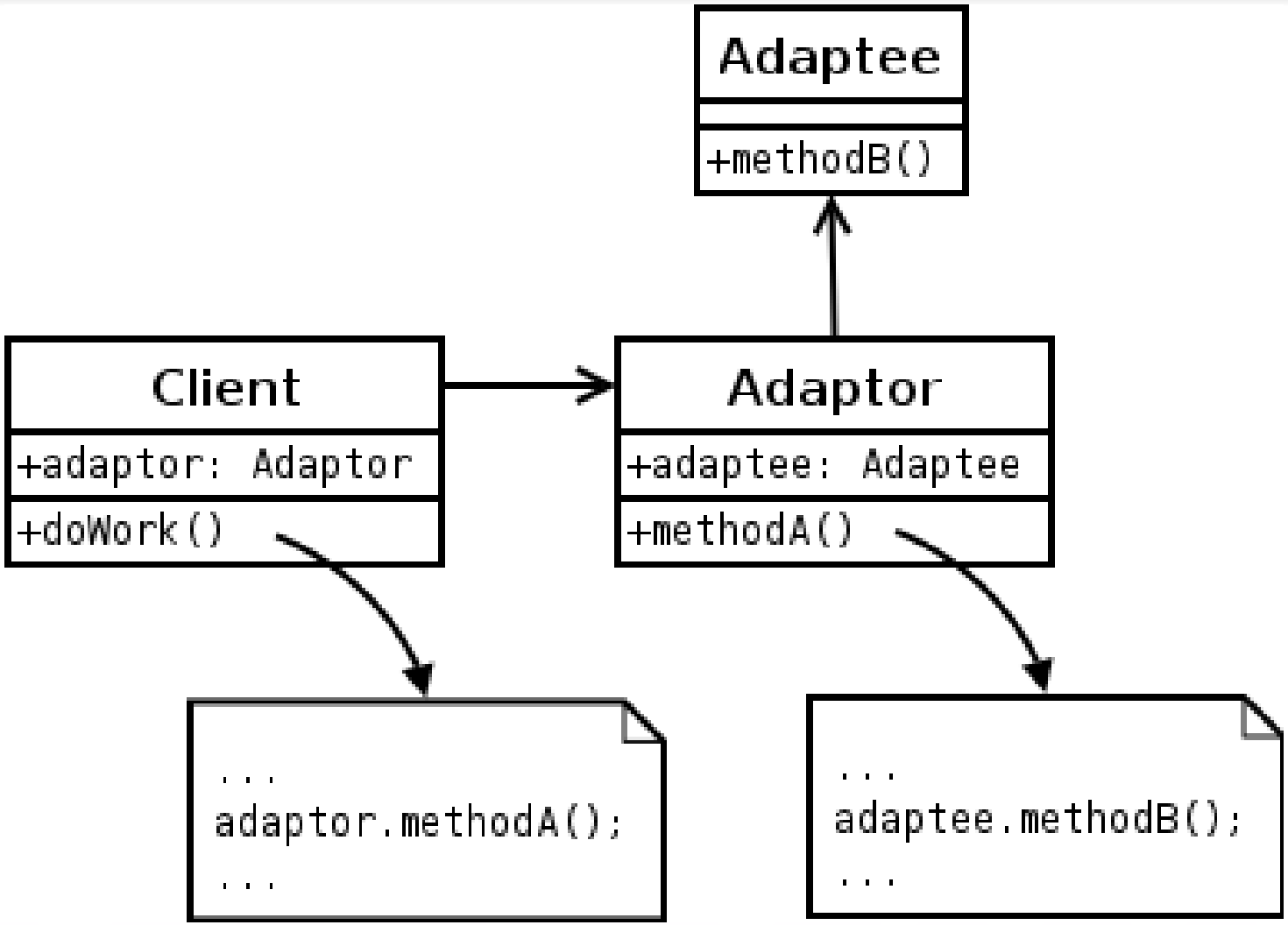
Factory Method Example



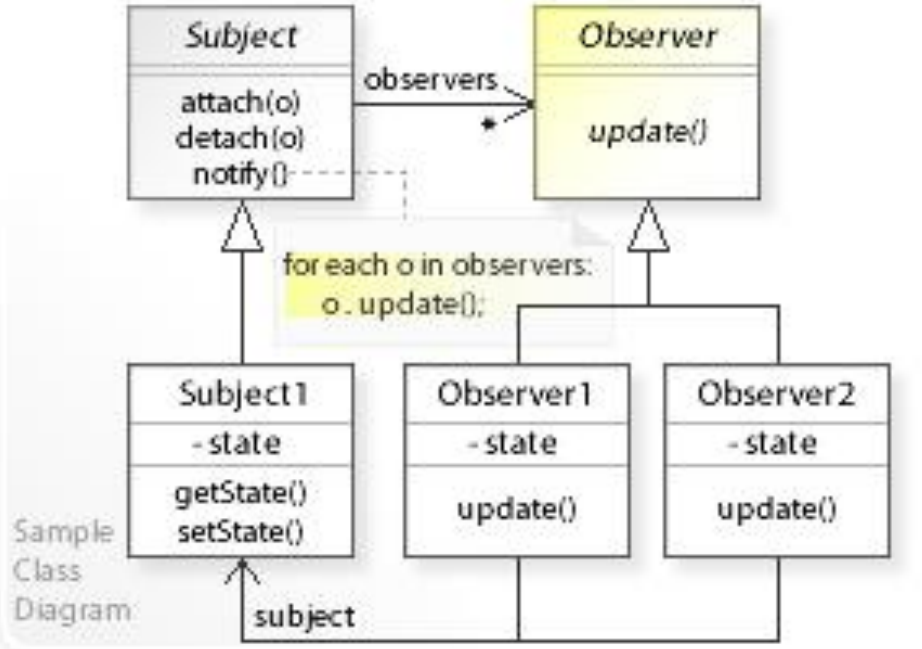
Design Pattern Adapter

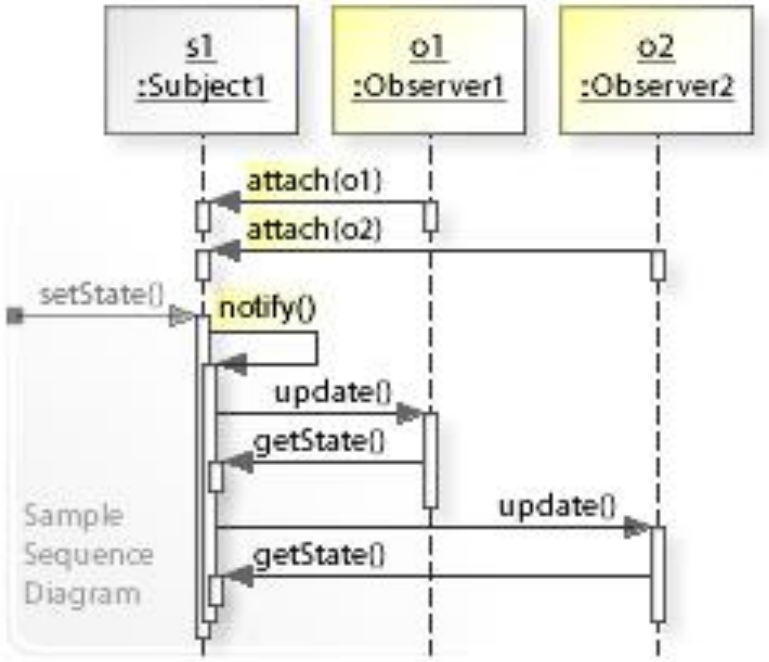


Adapter Example

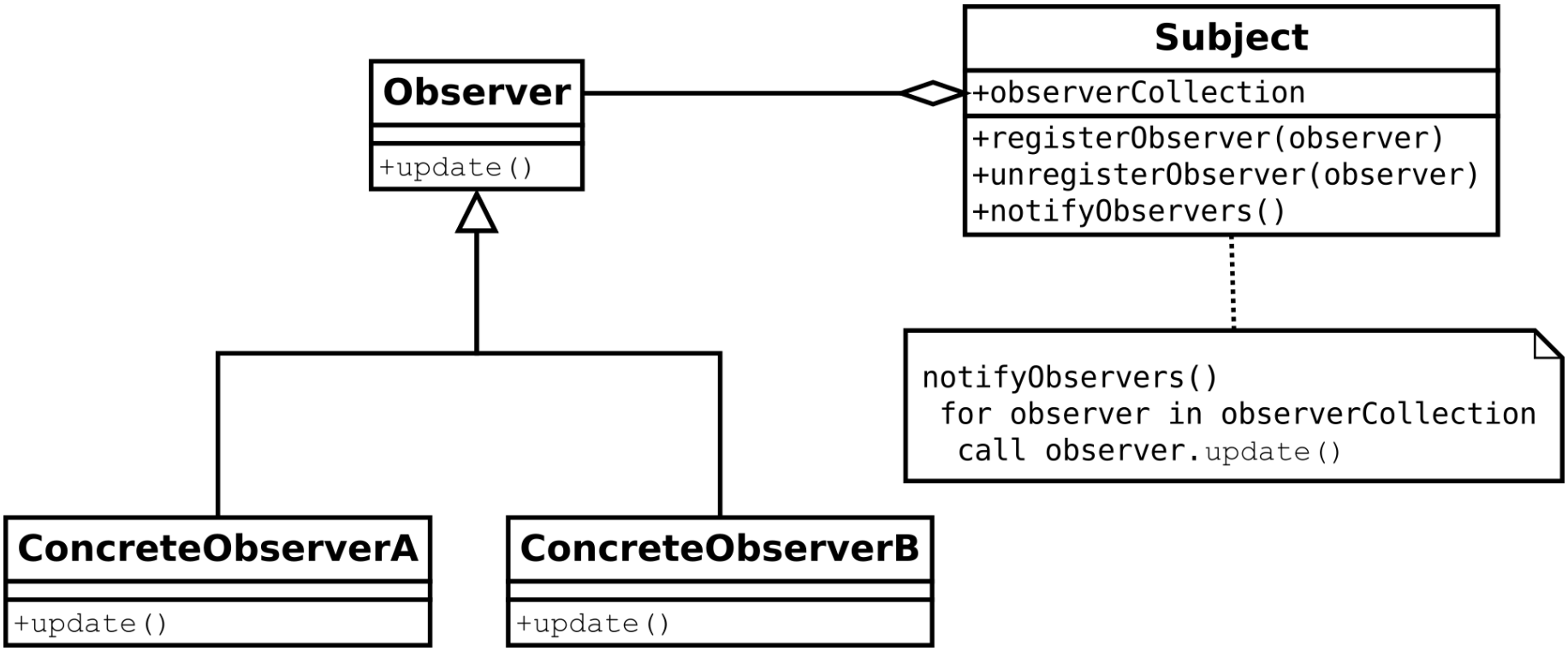


Design Pattern Observer

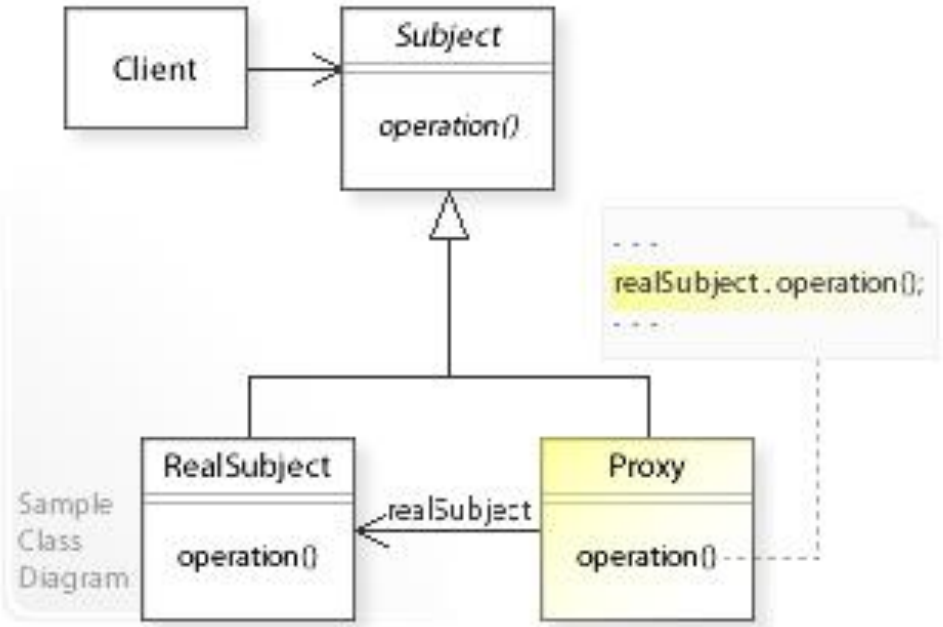


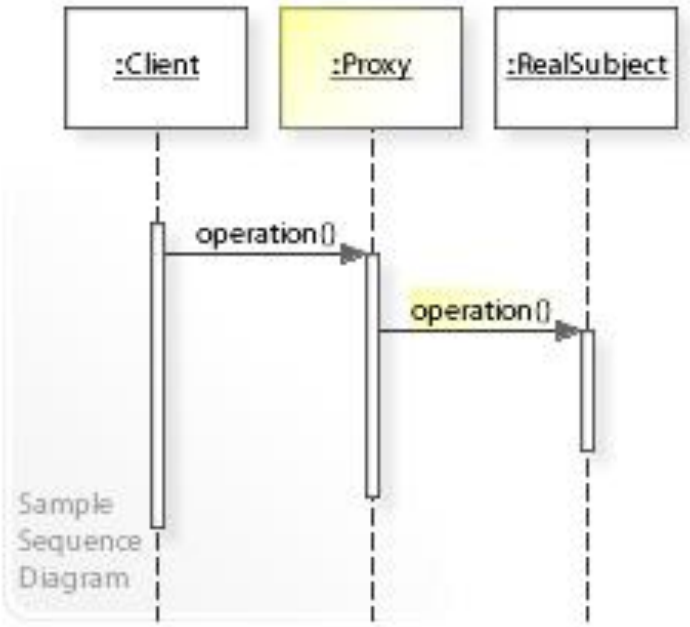


Observer Example

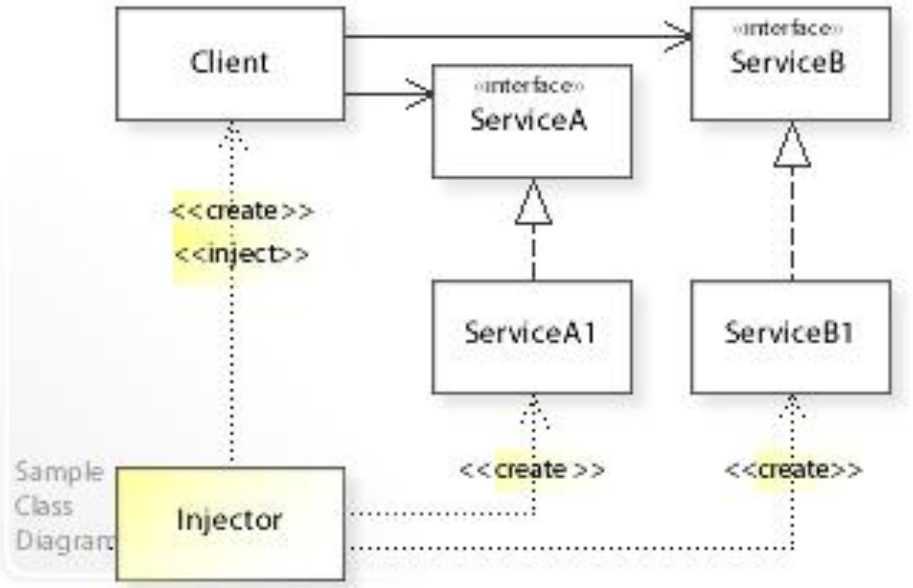


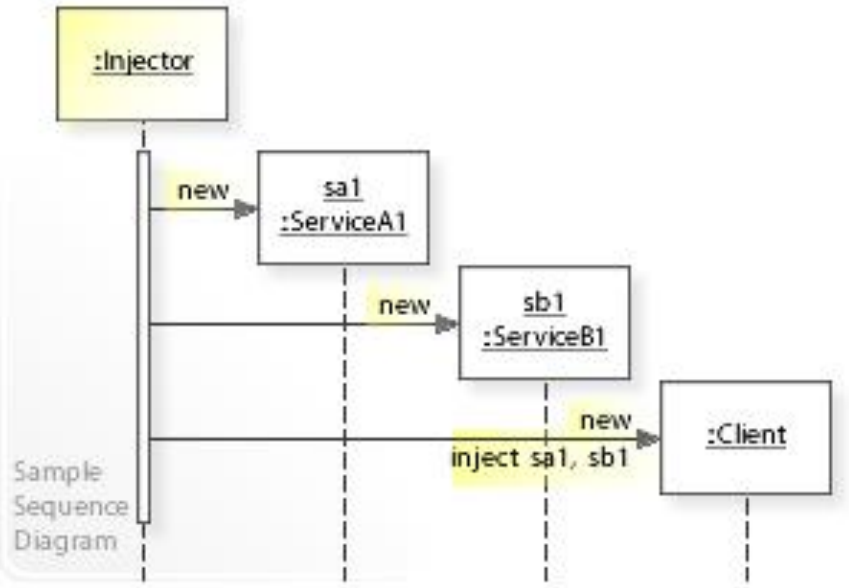
Proxy Design Pattern





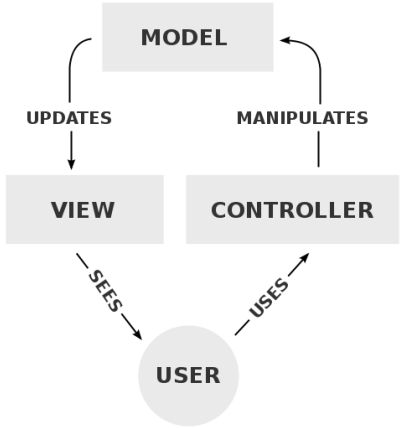
Dependency Injection Pattern

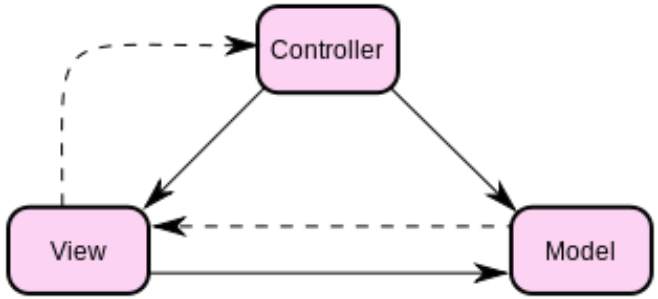




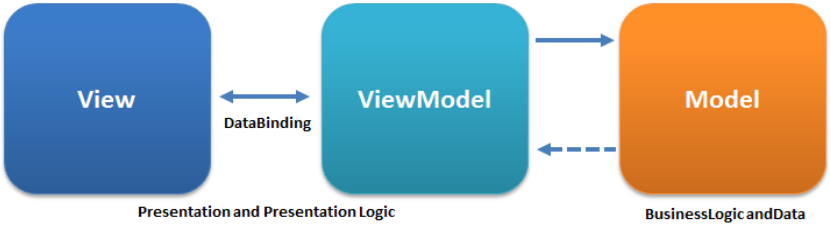
Model-View-Controller Pattern

MVC

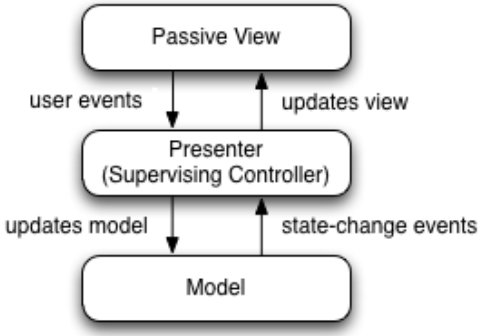




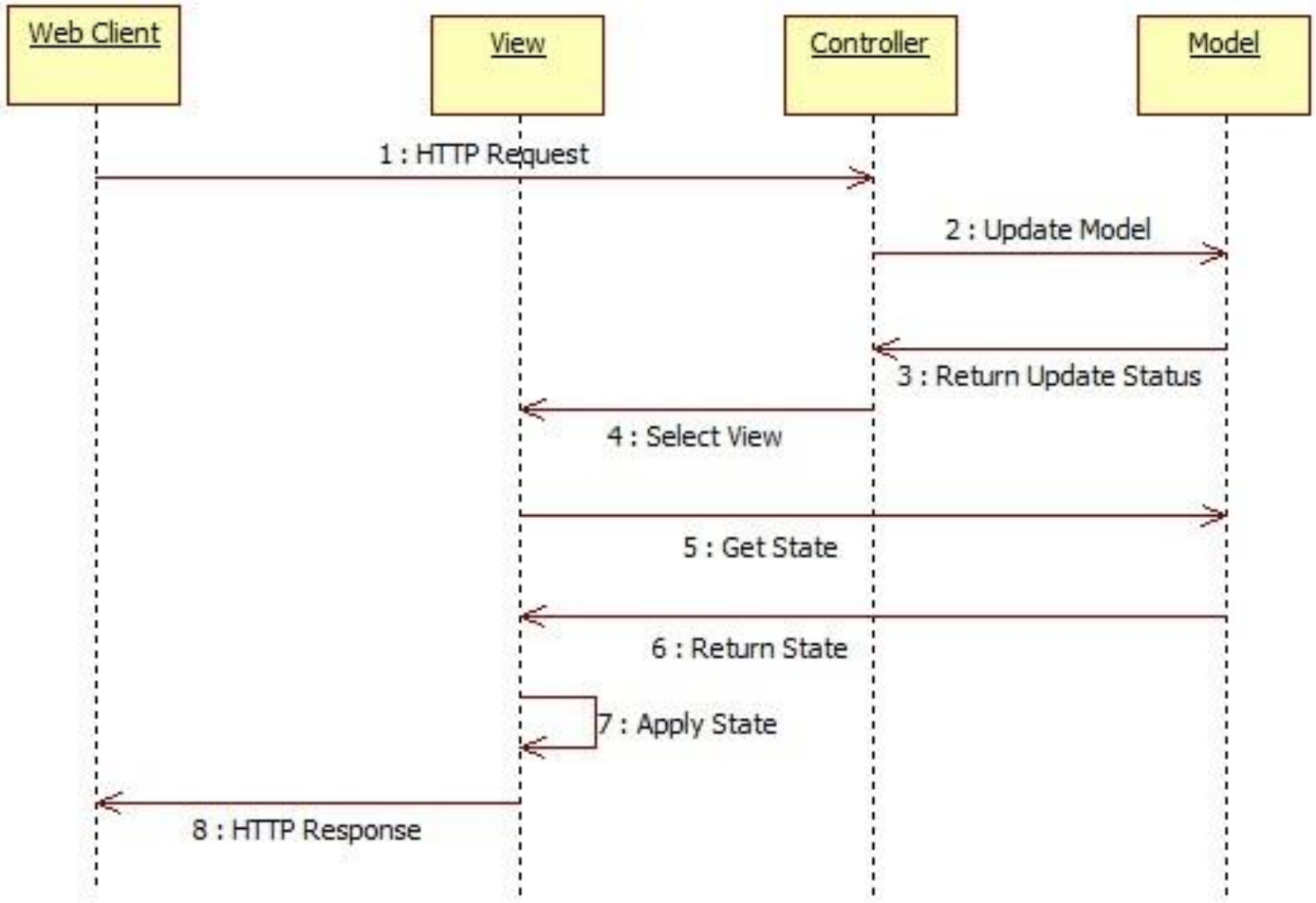
MVVM



MVP



Web MVC Interactions Sequence Diagram



Трислойна архитектура: презентация, бизнес логика и данни: Model -View-Controller-MVC design pattern, Model 2

- Servlet (Controller) + JSPs (Views) + POJOs (Model)

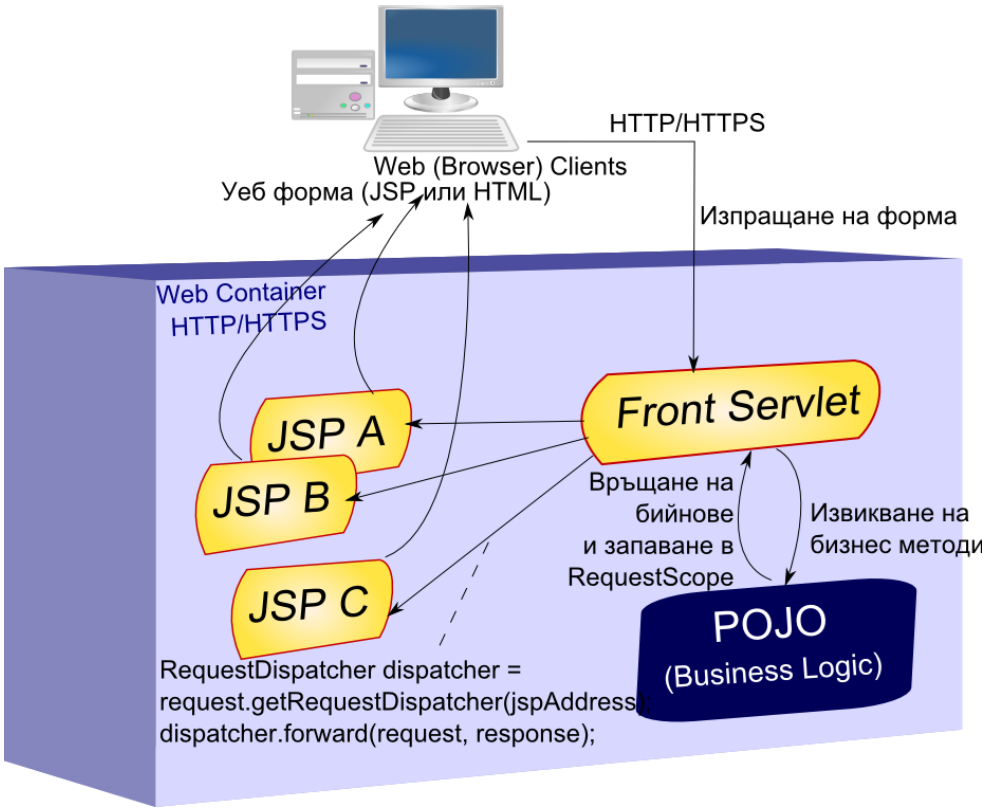
Предимства на MVC:

Разделяне на труда между уеб дизайнери и програмисти на Java™

Възможност за независима промяна на презентационната логика и визуалното представяне на данните

По-лесна поддръжка, модификация и разширяване

Улеснена навигация



Thank's for Your Attention!

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