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Java Web Debelopment

The Reflection API

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Where to Find the Code?

Intarmediate Java Programming projects and examples are available @ GitHub:

https://github.com/iproduct/course-java-web-development

RTTI & Reflection

- **Runtime Type Information (RTTI)** allows you to discover and employ type information in runtime.
- The difference between **RTTI** and **reflection** is that with **RTTI**, the compiler **opens and examines the .class file at compile time**, while with **reflection**, the .class file is unavailable at compile time; it is **opened and examined by the runtime** environment. Examples:
  - **JavaBeans** - Rapid Application Development (RAD) in an Application Builder Integrated Development Environment (IDE)
  - Object serialization – Serializable interface
  - **Remote Method Invocation (RMI)** - discovering class information at run time provides ability to create and execute objects on remote platforms, across the network.
  - **Dynamic Proxies** – DI, Spring, AOP

Runtime Type Information (RTTI)

- The **Class** object, **Class.forName()**, **Type.class**, and **object.getClass( )**
- **Class** models all types in java – class, interface, array, primitive type, void (e.g. int.class, long.class, double.class, void.class, etc.)
- It allows writing flexible and generic utility methods and tools capable of processing (field, method, type variable, annotation, superclass and interface metadata reflection, instantiation (constructor invocation), method invocation, field data access, etc.) of different types of objects given as parameters to those methods and tools, and generally not known at the time of their writing.
- **T newInstance()** - creates a new instance of the class
- **T cast(Object obj)** - casts an object to the class or interface

Class: Names, Loader, Annotations

- **String getName()** - name of the type (class, interface, array, primitive type, void)
- **String getSimpleName()** - the simple name of the underlying class
- **String getCanonicalName()** - canonical name of class
- **ClassLoader getClassLoader()** - returns the class loader for the class.
- **<A extends Annotation>A getAnnotation(Class<A> annotationClass)** - annotation if present
- **Annotation[] getAnnotations()** - all annotations present on this type
- **<A extends Annotation> A[] getAnnotationsByType(Class<A> annotationClass)** – if its argument is a repeatable annotation type (JLS 9.6), it attempts to find one or more annotations of that type by "looking through" a container annotation.
- **Annotation[] getDeclaredAnnotations()** - directly present annotations
- **<A extends Annotation> A getDeclaredAnnotation(Class<A> annotationClass)**
- **<A extends Annotation> A[] getDeclaredAnnotationsByType(Class<A>)**
- **boolean isAnnotation()** - true if an annotation type.
- **Boolean isAnnotationPresent(Class<? extends Annotation> annotatClass)**

Class: Constructors, Fields, Methods

- **Constructor<?>[] getConstructors()** - array of all public Constructors
- **Constructor<T> getConstructor(Class<?>... parameterTypes)** – public
- **Constructor<?>[] getDeclaredConstructors()** - all class constructors
- **Constructor<T> getDeclaredConstructor(Class<?>... parameterTypes)**
- **Field getField(String name)** - public member field
- **Field[] getFields()** - public member fields
- **Field getDeclaredField(String name)** - a field:public, private, package, protected
- **Field[] getDeclaredFields()** - all class fields: public, private, package, protected
- **Method getMethod(String name, Class<?>... parameterTypes)** - reflects the specified public member method
- **Method[] getMethods()** - reflects all public member method
- **Method getDeclaredMethod(String name, Class<?>... parameterTypes)**
- **Method[] getDeclaredMethods()** - all methods

Class: Members, Inner Classes,Types

- **Class<?>[] getClasses()** - public class and interface members of this Class
- **Class<?>[] getDeclaredClasses()** - all the class and interface members
- **Class<?> getDeclaringClass()** - if a member of another class
- **Class<?> getEnclosingClass()** - enclosing class of the underlying class
- **Constructor<?> getEnclosingConstructor()** - for local/anonymous class
- **Method getEnclosingMethod()** - for local/anonymous class
- **T[] getEnumConstants()** - elements of this enum class
- **Type[] getGenericInterfaces()** - Types representing the interfaces impl.
- **Type getGenericSuperclass()** - Type representing the superclass impl.
- **AnnotatedType[] getAnnotatedInterfaces()** - annotated superinterfaces
- **AnnotatedType getAnnotatedSuperclass()** - annotated superclass
- **Class<?> getComponentType()** - the component type of an array

Class: SuperClasses, Interfaces, Resources

- **Class<? super T> getSuperclass()** - the superclass of the entity
- **Class<?>[] getInterfaces()** - the interfaces implemented
- **int getModifiers()** - Java language modifiers for entity (public, package) - as int
- **Package getPackage()** - gets the package for this class.
- **URL getResource(String name)** - finds a resource with a given name
- **InputStream getResourceAsStream(String name)** - finds a resource with a given name.
- **ProtectionDomain getProtectionDomain()** - returns the ProtectionDomain of this class.
- **Object[] getSigners()** - gets the signers of this class
- **String toGenericString()** - Returns a string describing this Class, including information about modifiers and type parameters

Class: Superclass, Type Vars, Is*

- **String getTypeName()** - an informative string for the name of this type.
- **TypeVariable<Class<T>>[] getTypeParameters()** - generic declaration GenericDeclaration TypeVariable objects
- **boolean isAnonymousClass()** - true if anonymous class.
- **boolean isArray()** - if an array class.
- **boolean isAssignableFrom(Class<?> cls)** -same/ superclass/ superinterface
- **boolean isEnum()** - if enum
- **boolean isInstance(Object obj)** – dynamic instanceof
- **boolean isInterface()** - if interface
- **boolean isLocalClass()** - if local class
- **boolean isMemberClass()** - if the underlying class is a member of this class
- **boolean isPrimitive()** - if the specified Class object represents a primitive type
- **boolean isSynthetic()** - if this class is a synthetic class

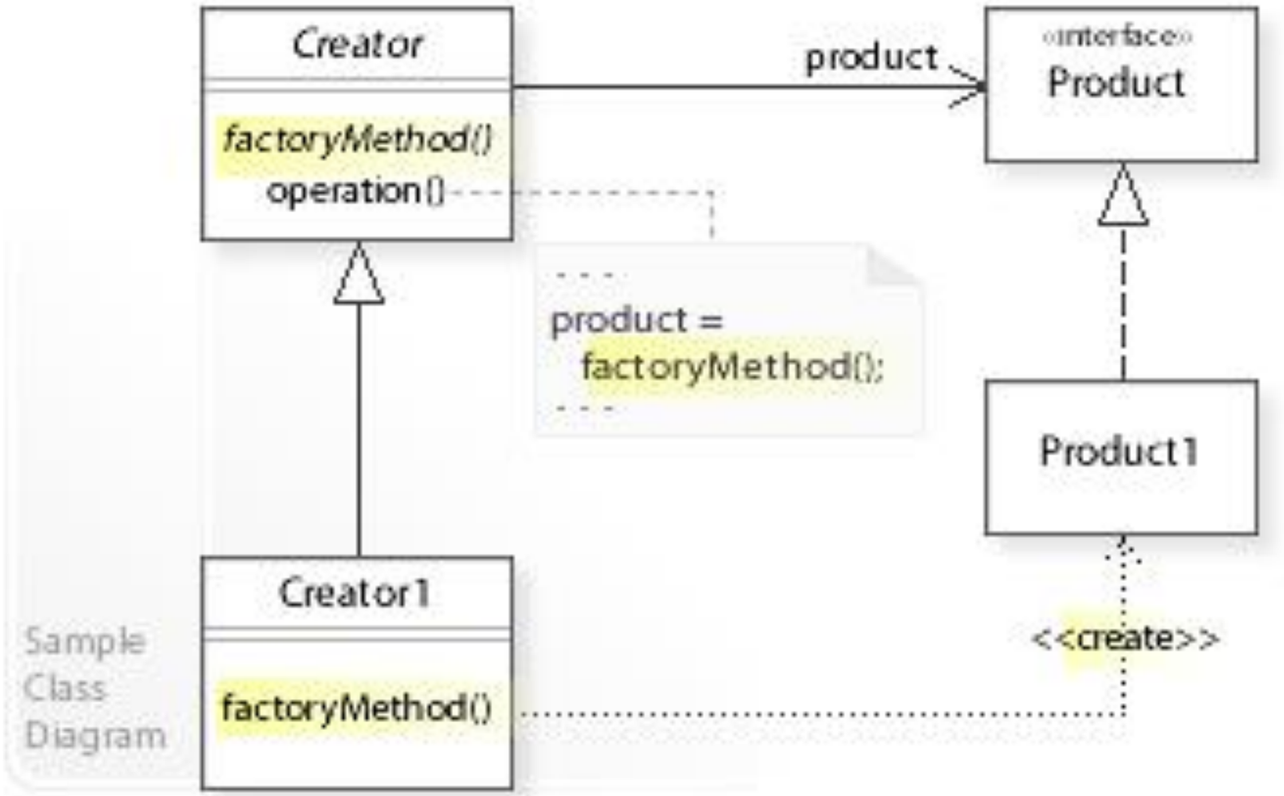
SOLID Design Principles of OOP

- Single responsibility principle - a class should only have a single responsibility, that is, only changes to one part of the software's specification should be able to affect the specification of the class.
- Open–closed principle - software entities should be open for extension, but closed for modification.
- Liskov substitution principle - Objects in a program should be replaceable with instances of their subtypes without altering the correctness of that program.
- Interface segregation principle - Many client-specific interfaces are better than one general-purpose interface.
- Dependency inversion principle - depend upon abstractions, not concretions.

Factory Method Design Pattern

- **Factory method** pattern is a creational pattern that uses factory methods to deal with the problem of creating objects without having to specify the exact class of the object that will be created.
- This is done by creating objects by calling a factory method – either specified in an interface and implemented by child classes, or implemented in a base class and optionally overridden by derived classes – rather than by calling a constructor.

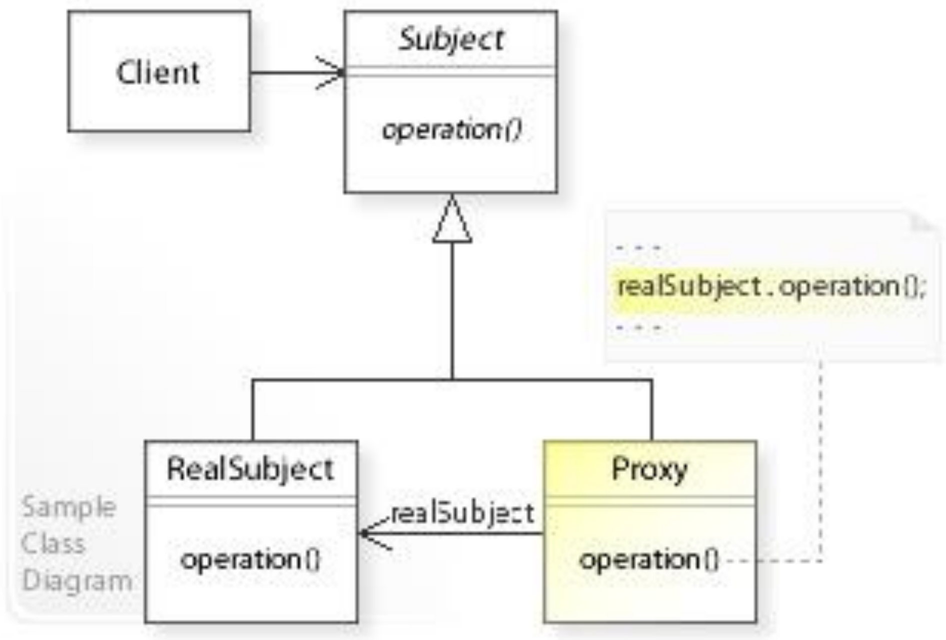
Factory Method Design Pattern

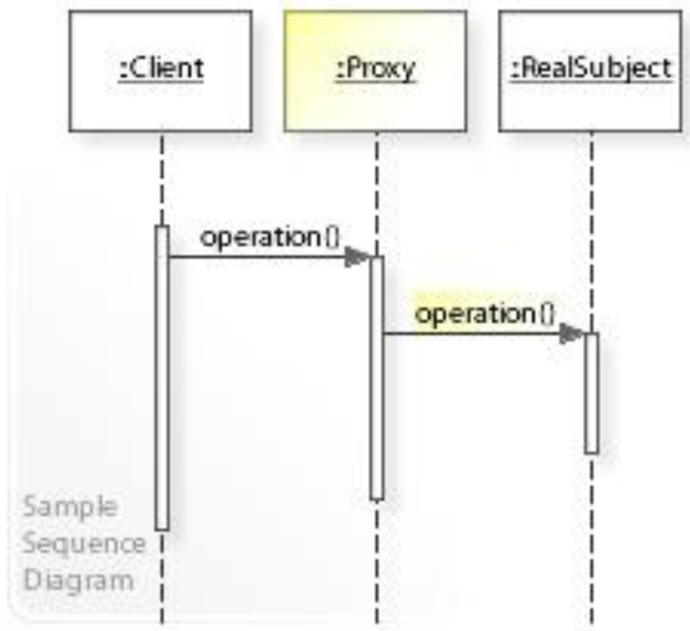


Dynamic Proxy Design Pattern

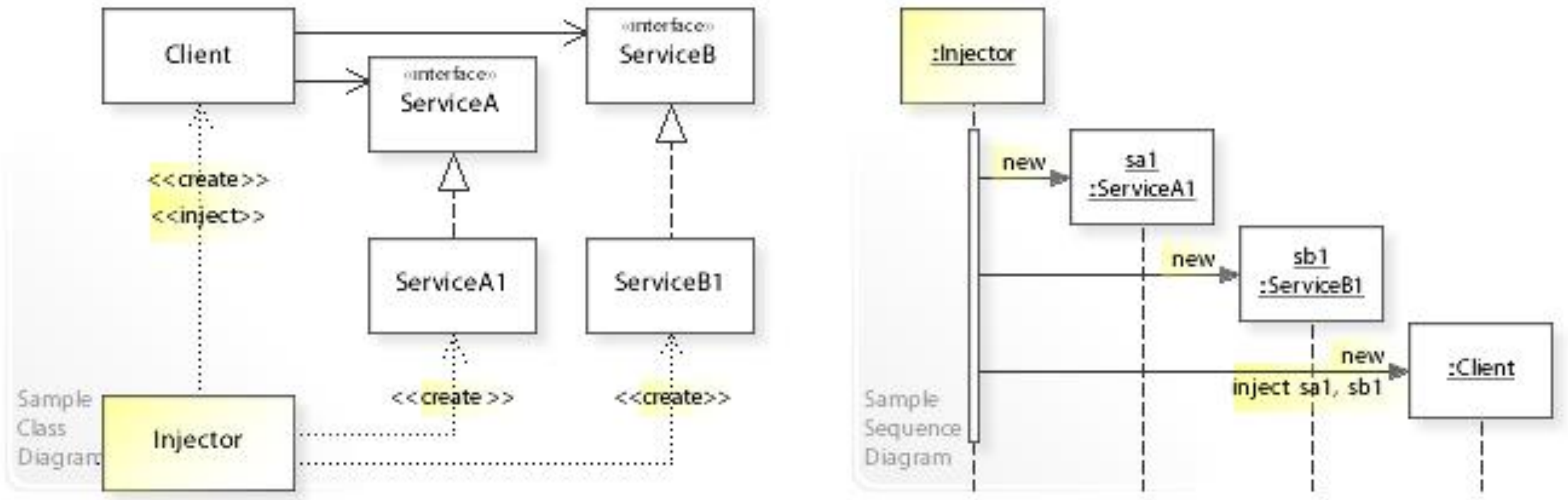
- A proxy, in its most general form, is a class functioning as an **interface to something else**. A proxy is a wrapper or agent object that is being called by the client to access the real serving object behind the scenes. Use of the proxy can simply be forwarding to the real object, or can provide **additional logic**.
- In the proxy, **extra functionality can be provided**, for example caching when operations on the real object are resource intensive, or checking preconditions before operations on the real object are invoked.
- For the client, usage of a proxy object is similar to using the real object, because **both implement the same interface**.
- **Dynamic proxies** can be generated through reflection of bean methods, providing additional functionality

Dynamic Proxy Design Pattern





Dependency Injection Design Pattern



MVC Comes in Different Flavors

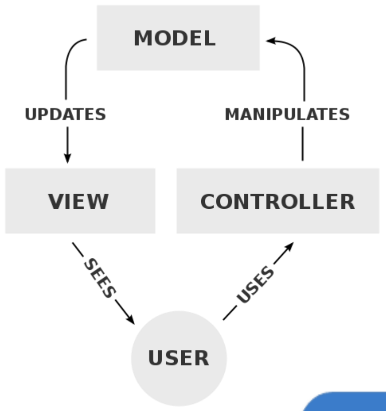
What is the difference between following patterns:

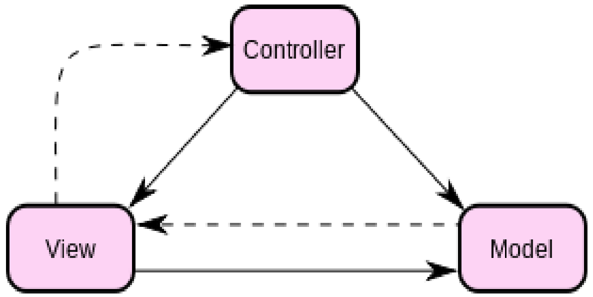
- Model-View-Controller (MVC)
- Model-View-ViewModel (MVVM)
- Model-View-Presenter (MVP)

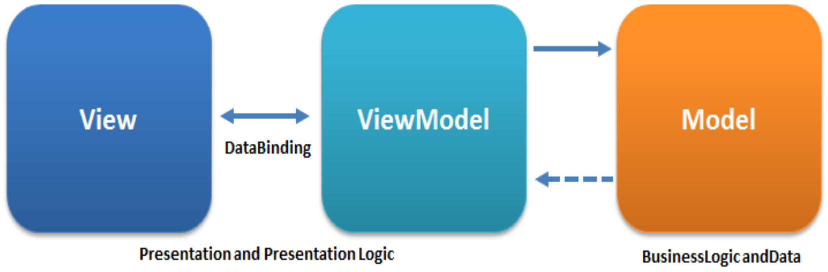
http://csl.ensm-douai.fr/noury/uploads/20/ModelViewController.mp3

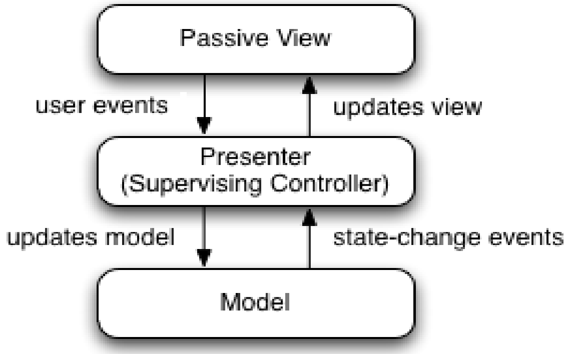
MVC Comes in Different Flavors - II

- MVC
- MVVM
- MVP









Sources:https://en.wikipedia.org/wiki/Model_View_ViewModel#/media/File:MVVMPattern.png,
https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93presenter#/media/File:Model_View_Presenter_GUI_Design_Pattern.png
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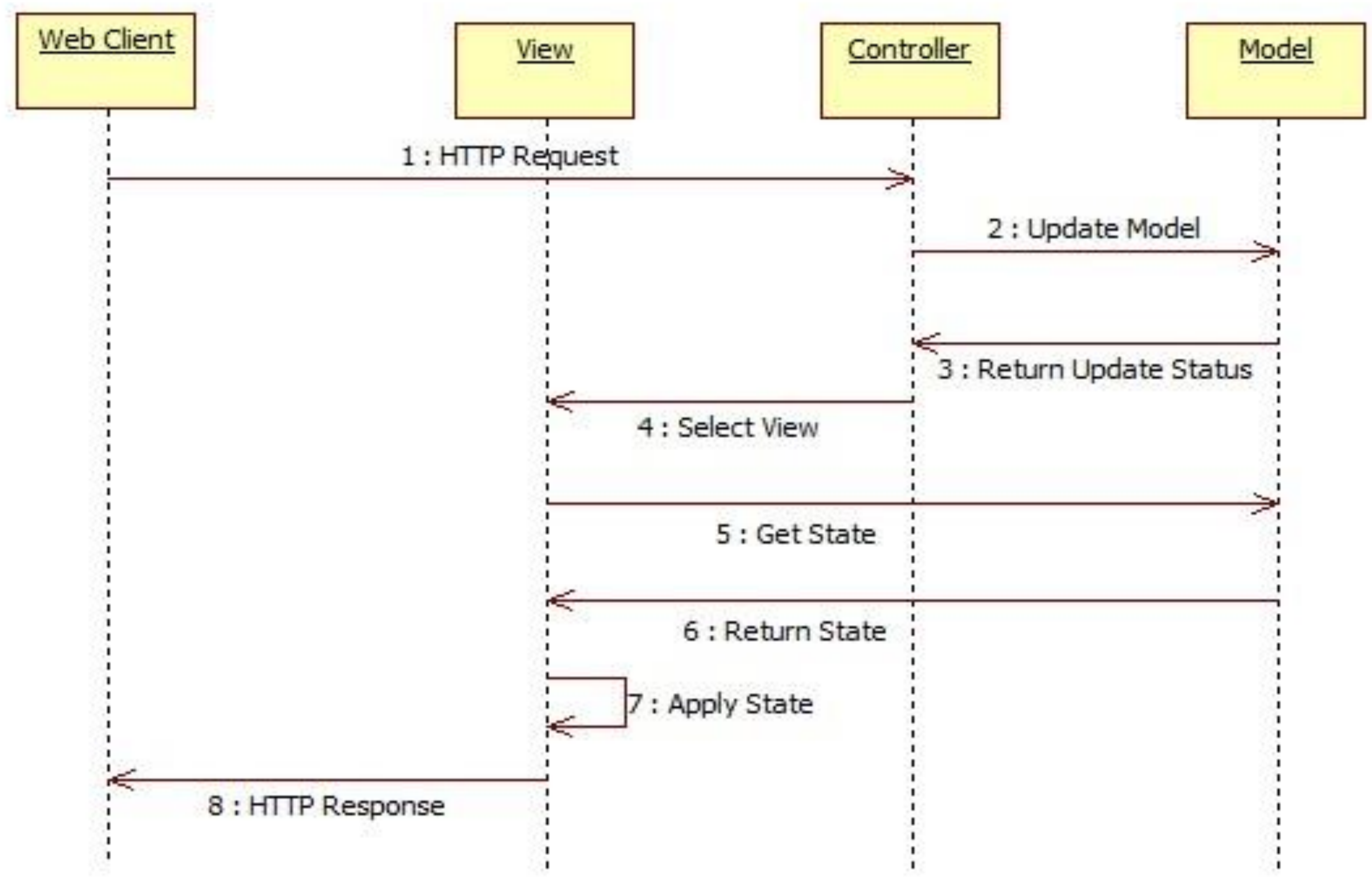
Web MVC Interactions Sequence Diagram



Domain Driven Design (DDD)

We need tools to cope with all that complexity inherent in robotics and IoT domains.

Simple solutions are needed – cope with problems through divide and concur on different levels of abstraction:

Domain Driven Design (DDD) – back to basics: domain objects, data and logic.

Described by Eric Evans in his book:
Domain Driven Design: Tackling Complexity in the Heart of Software, 2004

Domain Driven Design (DDD)

Main concepts:

❖ Entities, value objects and modules

❖ Aggregates and Aggregate Roots [Haywood]:

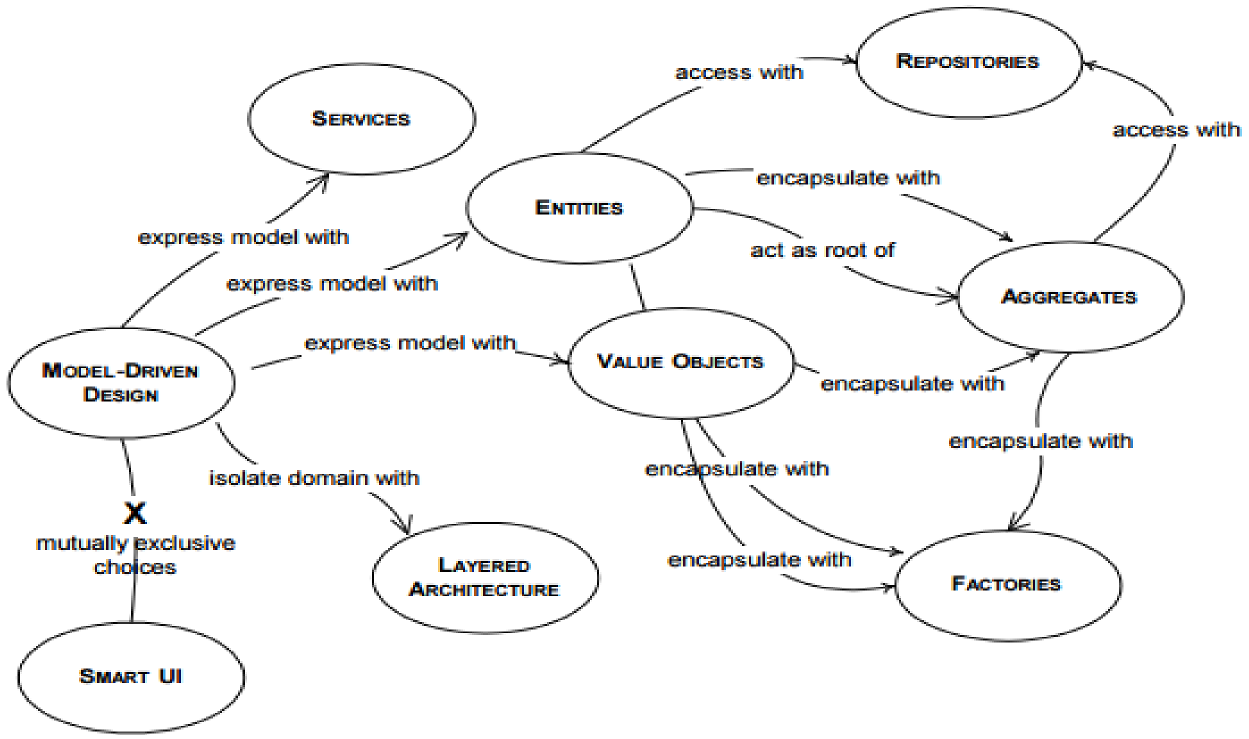
value < entity < aggregate < module < BC

❖ Repositories, Factories and Services:

application services <-> **domain services**

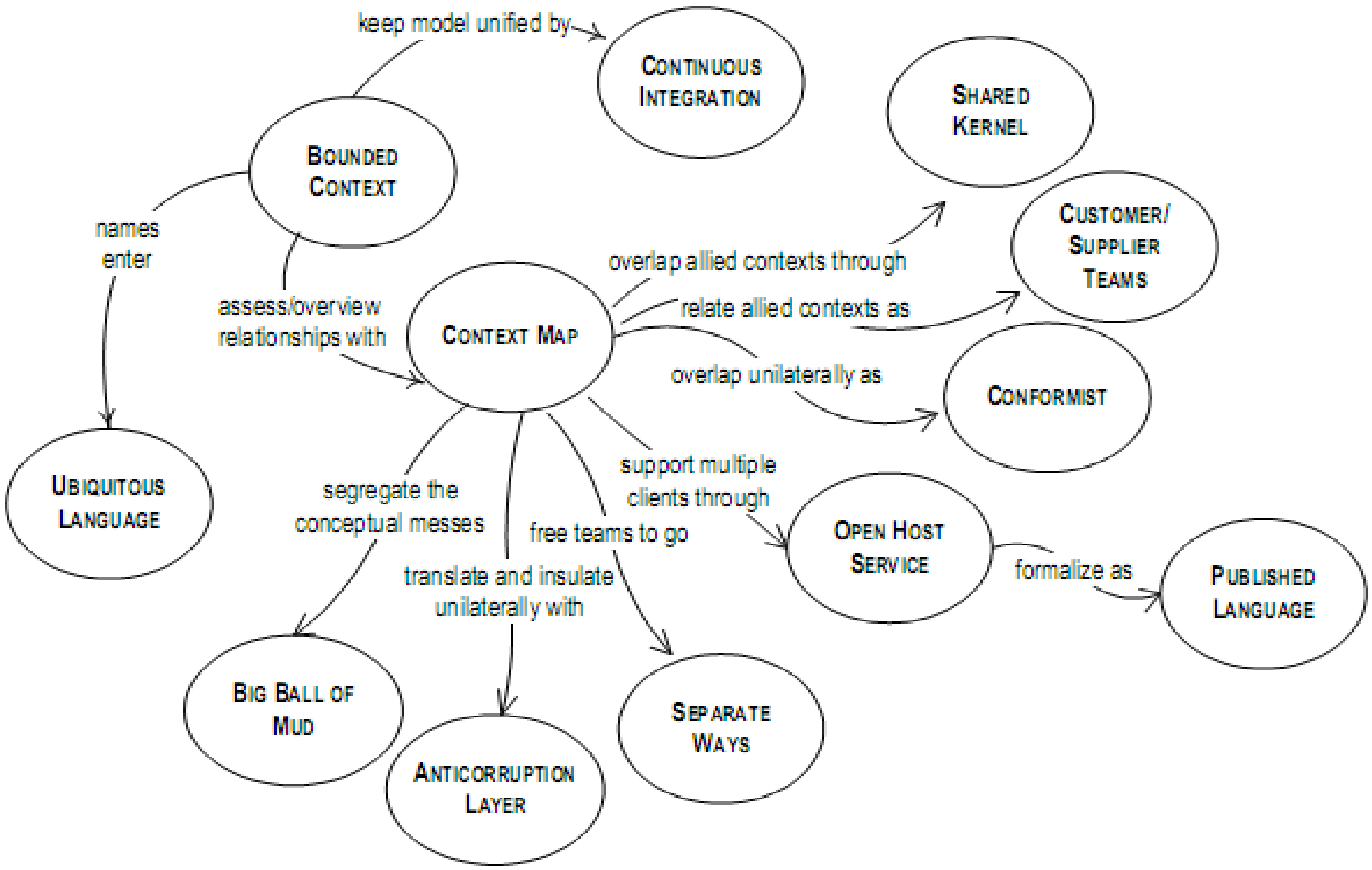
❖ Separating interface from implementation

Domain Driven Design (DDD)



Domain Driven Design (DDD)

Maintaining Model Integrity



Domain Driven Design (DDD)

❖Ubiquitous language and Bounded Contexts

❖DDD Application Layers:

❖Infrastructure, Domain, Application, Presentation

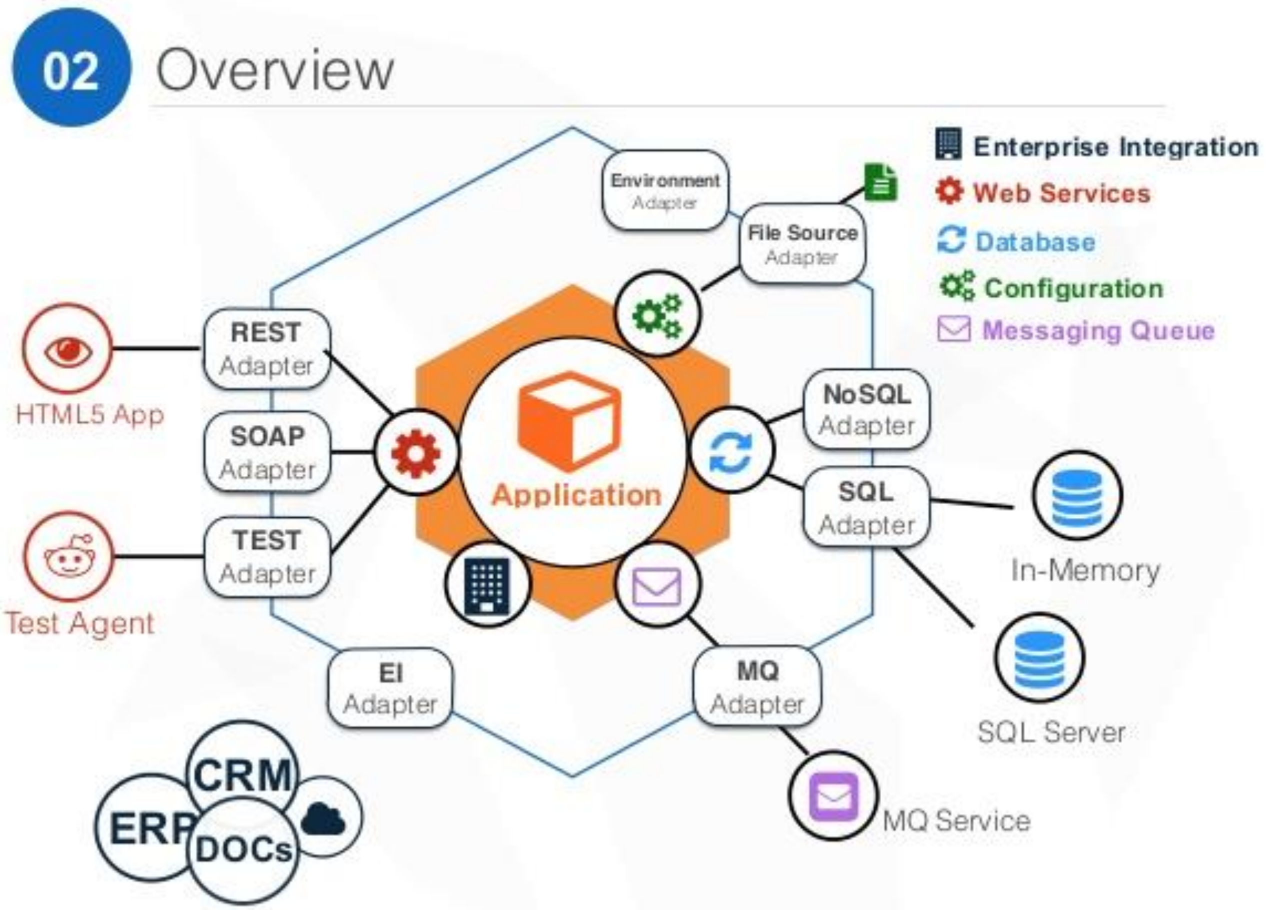
❖ Hexagonal architecture :

OUTSIDE <-> transformer <->

(application <-> domain)

[A. Cockburn]

Hexagonal Architecture



Source: https://www.slideshare.net/fabricioepa/hexagonal-architecture-for-java-applications

Hexagonal Architecture Principles

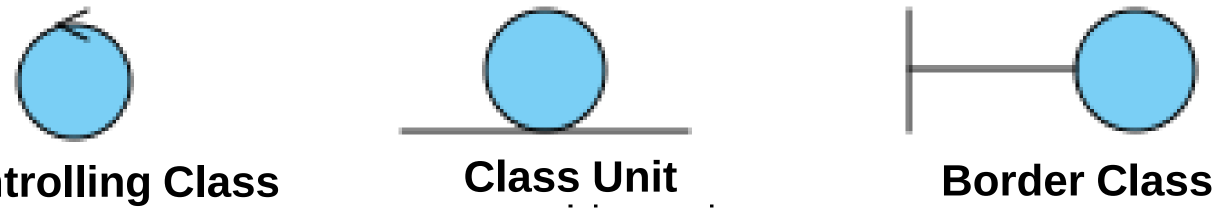
- ❖Allows an application to equally be driven by users, programs, automated test or batch scripts, and to be developed and tested in isolation from its eventual run-time devices and databases.
- ❖As events arrive from the outside world at a port, a technology-specific adapter converts it into a procedure call or message and passes it to the application
- ❖Application sends messages through ports to adapters, which signal data to the receiver (human or automated)
- ❖The application has a semantically sound interaction with all the adapters, without actually knowing the nature of the things on the other side of the adapters

Source: http://alistair.cockburn.us/Hexagonal+architecture

Analysis Classes Stereotypes

Analysis classes are used in the mapping and analysis of system architecture - they present rather different roles and responsibilities, than specific classes to be realized, and are independent of implementation technology:

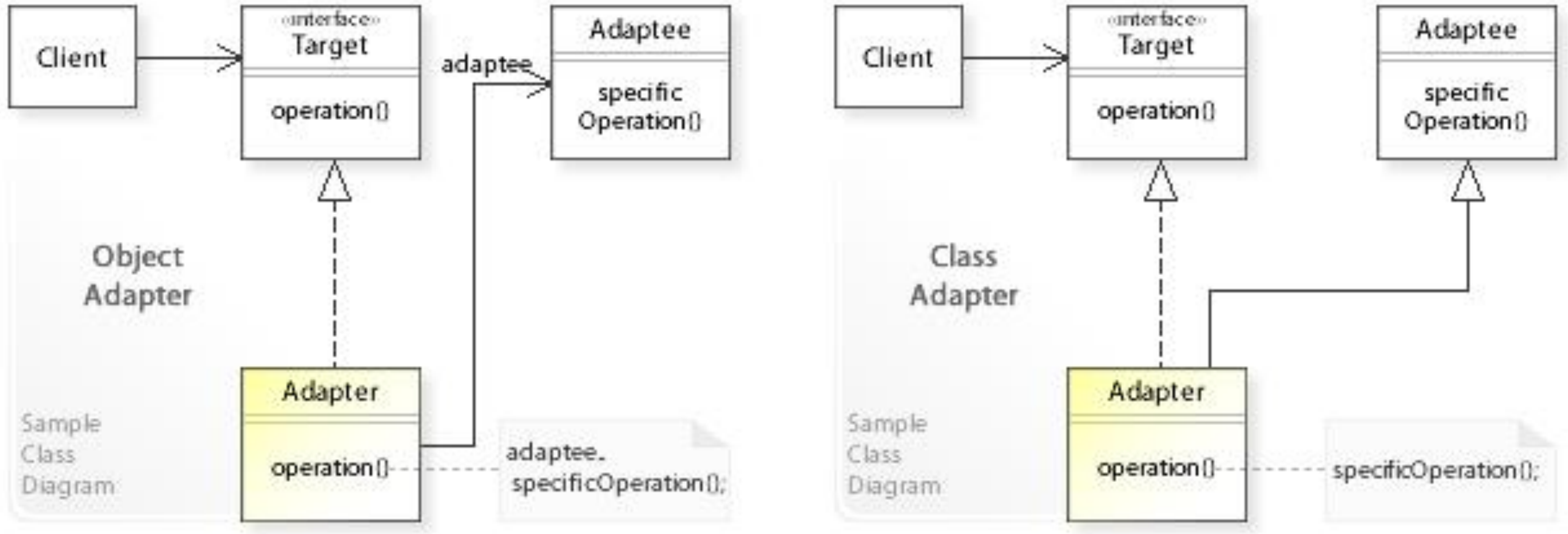
- <<controll>> - business logic
- <<entity>> - data
- <<boundary>> - user or system interface



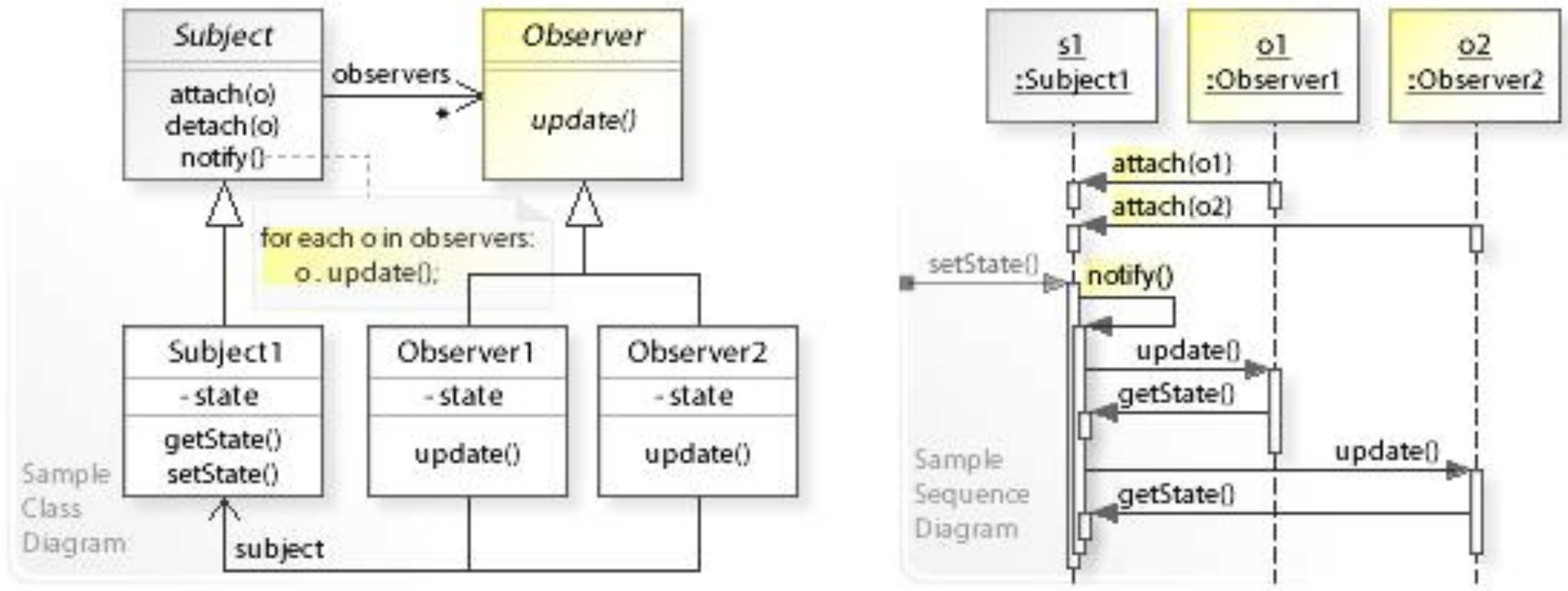
Advantages of Using Interfaces

- Interfaces cleanly separate requirements type of the object from many possible implementations and make our code more universal and usable
- Reusable Design Pattern: Adapter – It allows to adapt existing realization interface that is required in our application
- Inheritance (expansion) of interfaces
- Reusable Design Pattern: Factory Method – creating reusable client code, isolated from the specifics of the particular server implementation

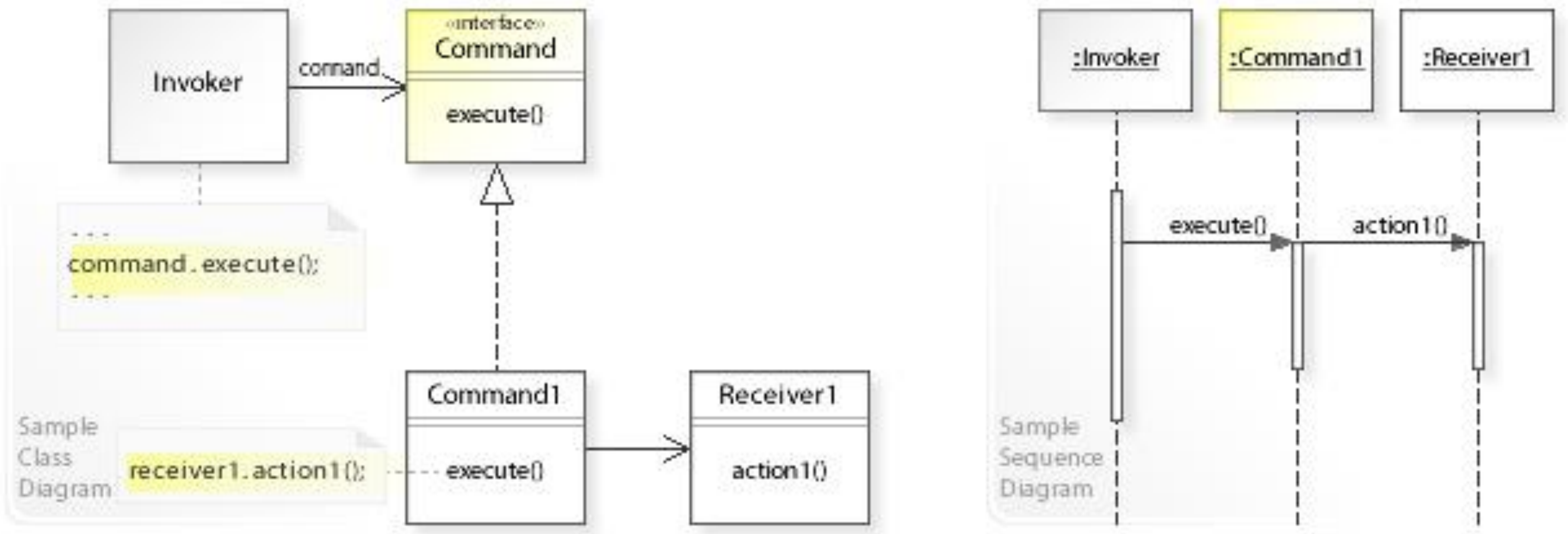
Adaptor Design Pattern



Observer Design Pattern



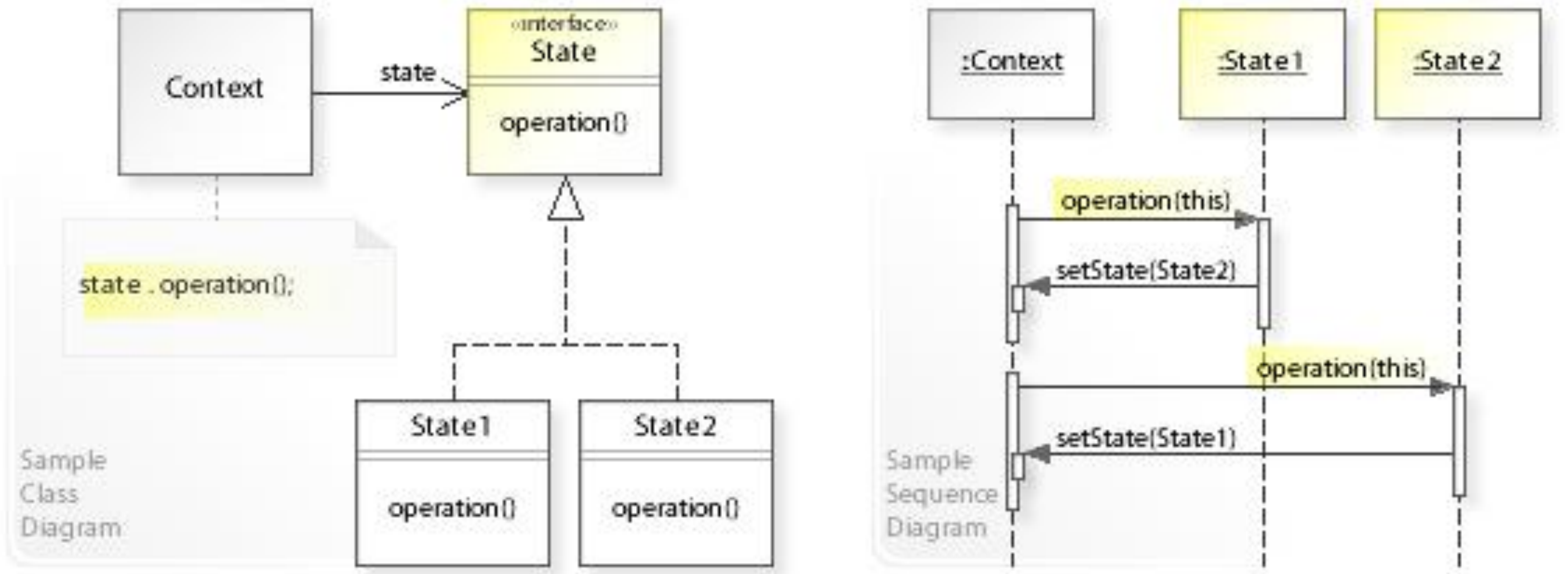
Command Design Pattern



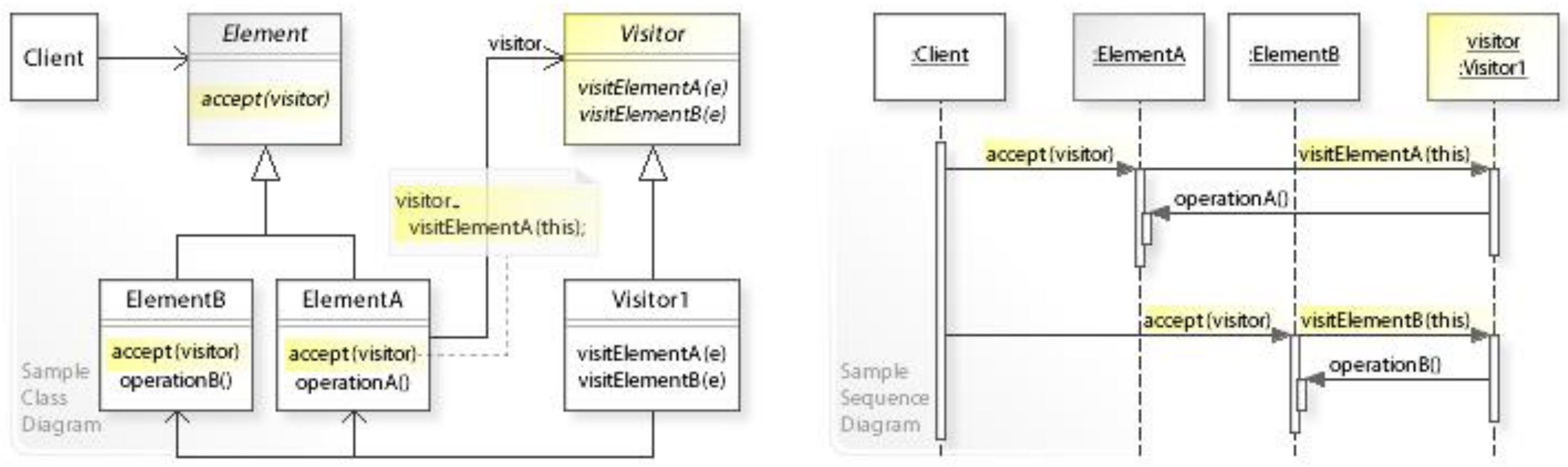
State Design Pattern

- An object should change its behavior when its internal state changes.
- State-specific behavior should be defined independently. That is, adding new states should not affect the behavior of existing states.
- Define separate (state) objects that encapsulate state-specific behavior for each state. That is, define an interface (state) for performing state-specific behavior, and define classes that implement the interface for each state.
- A class delegates state-specific behavior to its current state object instead of implementing state-specific behavior directly.

State Design Pattern



Visitor Design Pattern



Thank's for Your Attention!

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