# DP

## Content

- Introduction
- O-O aspects
- Selected Patterns

# DP

Introduction

## What is the DP?

Design patterns are recurring solutions to design problems you see over and over.

Design patterns constitute a set of rules describing how to accomplish certain tasks in the realm of software development.

# DP

Introduction

## What is the DP?

DP is coming for :

- How to write a new program feature?
- Have all possible avenues considered?
- A more methodologically way to do the job
- Develop the best solution to the problem.

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Introduction

## Patterns Types

- Creational
- Structural
- Behavioral

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Introduction

## Creational Types

- Factory Method
- Abstract Factory
- Builder
- Prototype
- Singleton

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Introduction

## Structural Types

- Adapter
- Bridge
- Composite
- Decorator
- Façade
- Flyweight
-
- Proxy

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Introduction

## Behavioral Types

- Interpreter
- Template Method
- Chain of Responsibility
- Command
- Iterator
- Mediator
- Memento
- Observer
- State
- Strategy
- Visitor

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Introduction

## Patterns Classification

1. what a pattern does ?

- Creational patterns - concern the process of object creation
- Structural patterns - deal with the composition of classes or objects
- Behavioral patterns - characterize the ways classes or objects interact

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Introduction

## Patterns Classification

2. how the pattern is applied

- **Class patterns** - ‘is A’ relationships, static
- **Object patterns** - ‘has A’ relationships
- **Compound patterns** - deal with recursive object structures

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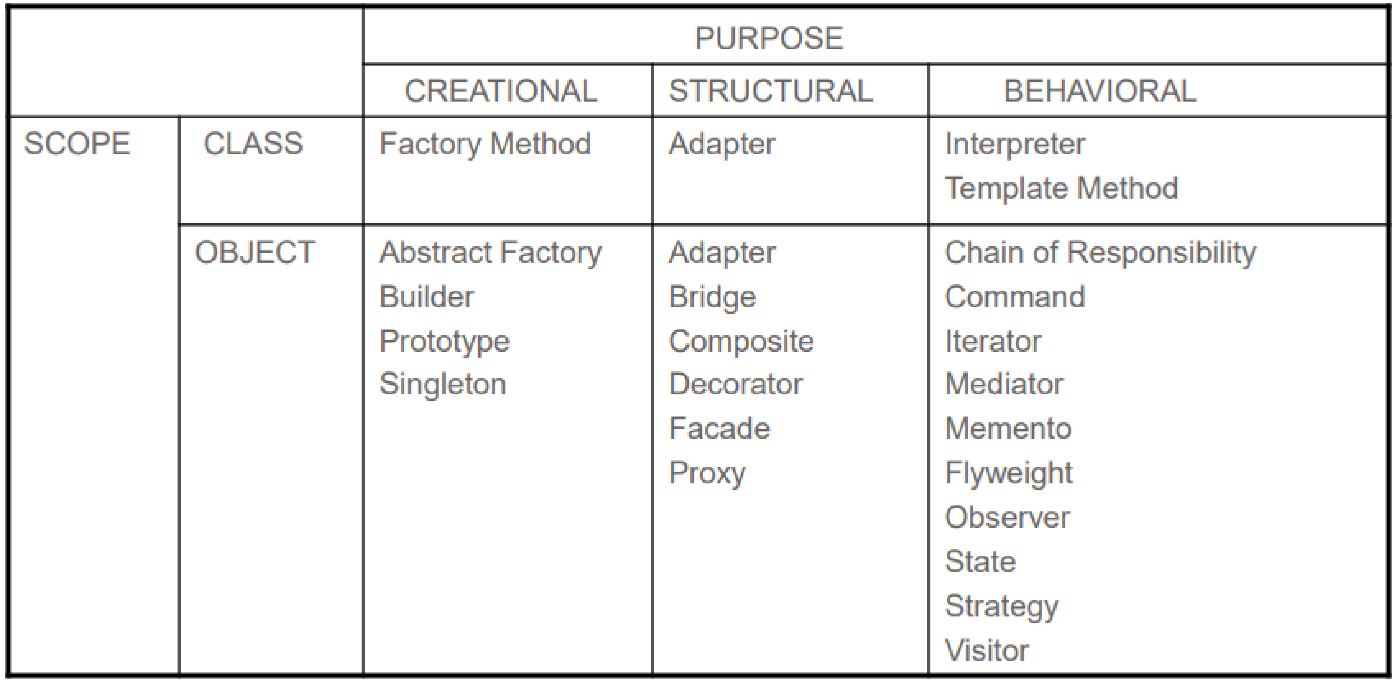
Introduction

## Patterns Scopes and Purpose



| | | PURPOSE | | |
|---|---|---|---|---|
| | | CREATIONAL | STRUCTURAL | BEHAVIORAL |
| SCOPE | CLASS | Factory Method | Adapter | Interpreter<br>Template Method |
| | OBJECT | Abstract Factory<br>Builder<br>Prototype<br>Singleton | Adapter<br>Bridge<br>Composite<br>Decorator<br>Facade<br>Proxy | Chain of Responsibility<br>Command<br>Iterator<br>Mediator<br>Memento<br>Flyweight<br>Observer<br>State<br>Strategy<br>Visitor |

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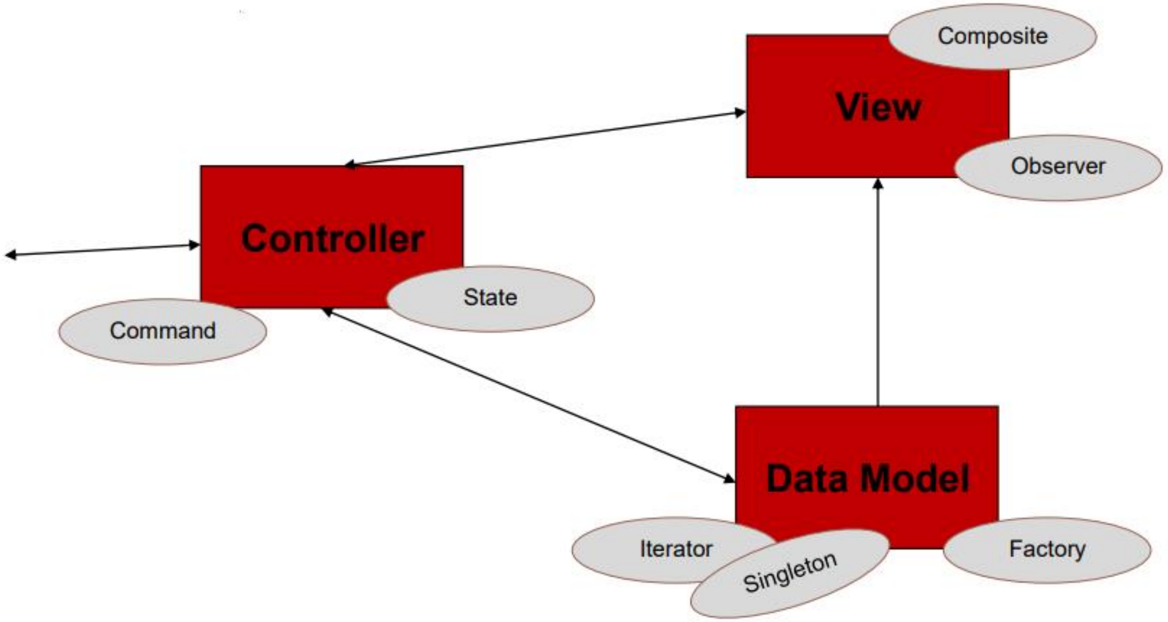
## Architecture VS. Design Patterns

Introduction



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O-O aspects

## agenda

- Object Oriented approach
- Object composition
- Problems of redundancy
- Defining Object roles
- Inheritance vs. Composition

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O-O aspects

## Object Oriented approach

- Keeping classes separated
- Avoid “reinventing the wheel”
- There are several strategies that OO use to achieve separation, among them encapsulation and inheritance.

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O-O aspects

## Object Composition

- object composition- “The construction of objects that contain others, encapsulation of several objects inside another one.”
- Inheritance is not the solution of every problem

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O-O aspects

## Problems of Redundancy

**Problem: Many elements in a system will share similar structures and/or functionality**

**Common solutions:**

Subroutines and modules

Inheritance

- Define new structure and/or functionality then define a static relationship with “parents” to use theirs
- Implementation (operations and attributes)
- Interface (sub-type)

Composition

- Combine common “parts” then define new structure and/or functionality as necessary

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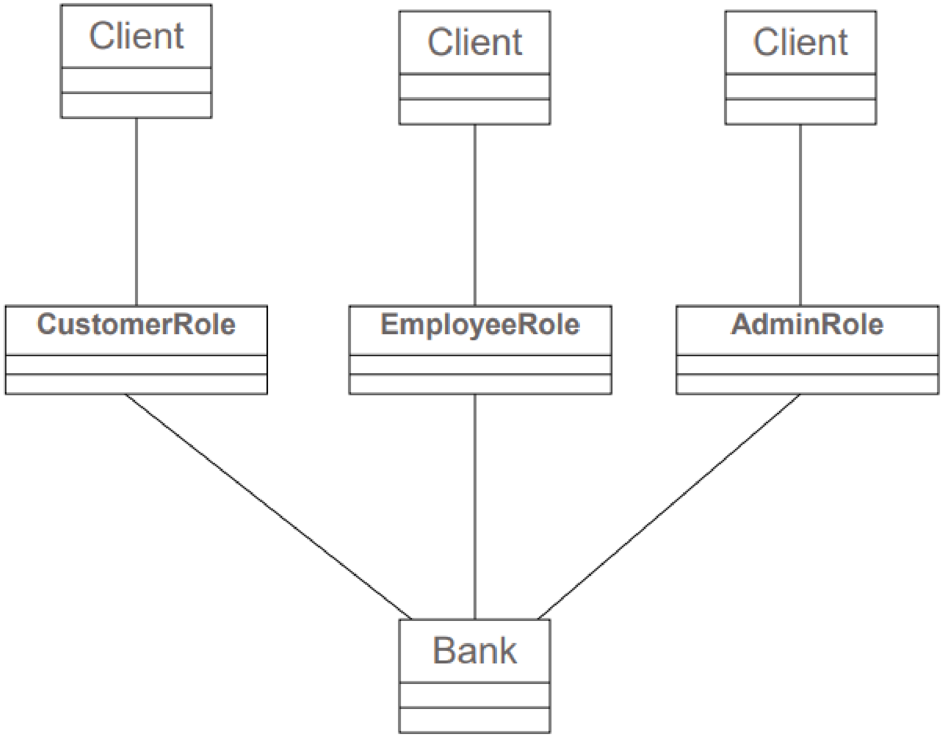
## Modules

Here, every new client type – forces a whole new module creation

O-O aspects



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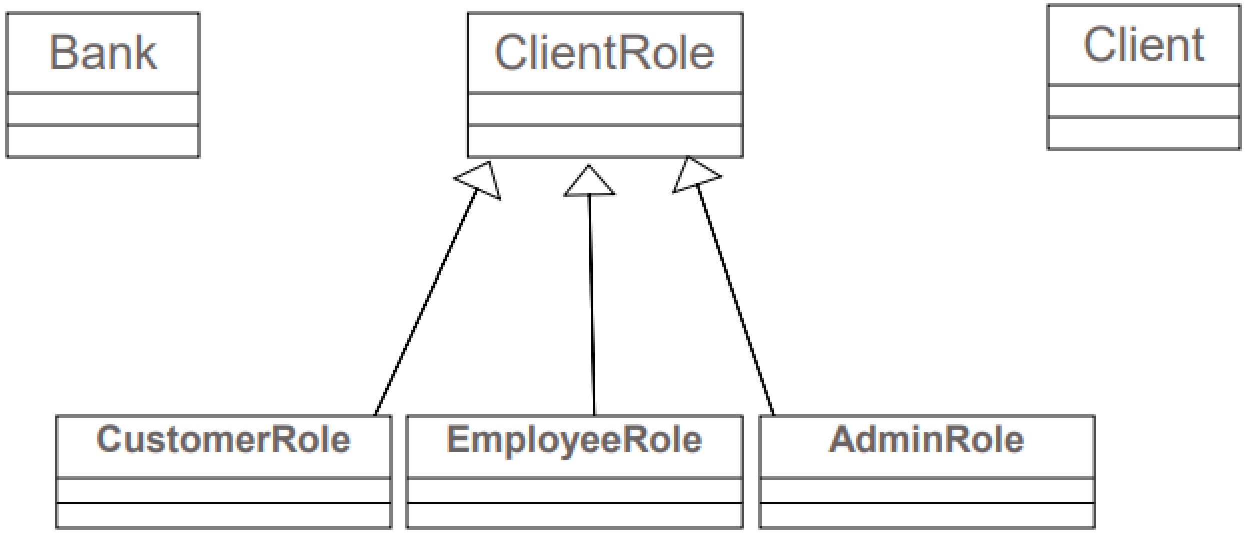
## Inheritance

Here, every new client type is a new subtype of ClientRole

O-O aspects



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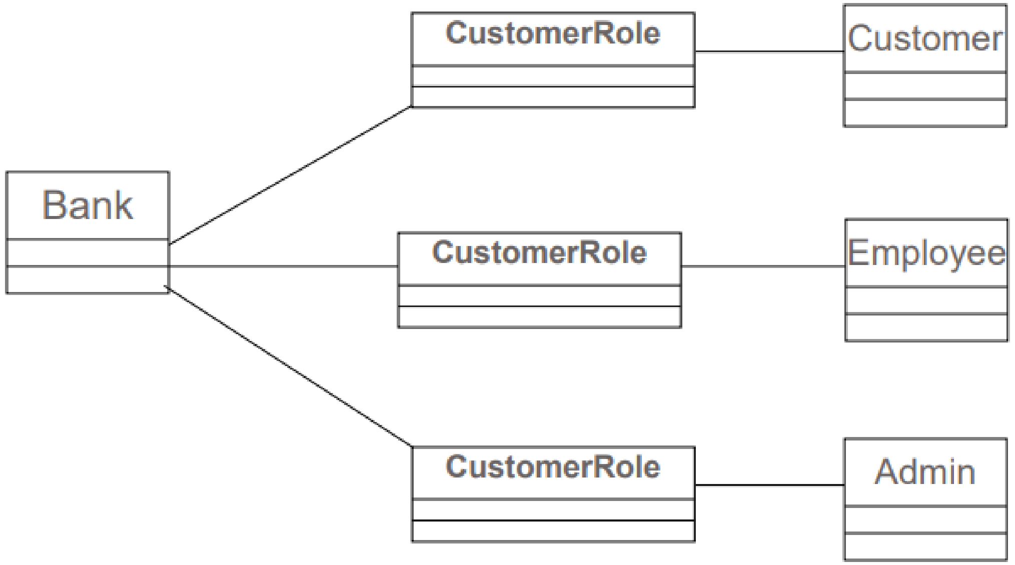
O-O aspects

## Inheritance

Here, client types are visitors of a consistent CustomerRole class used by the Bank



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Selected Patterns

## Creational Patterns

- Singleton Pattern
- Prototype pattern
- The Abstract Factory Pattern
- The Factory Method pattern
- Builder pattern

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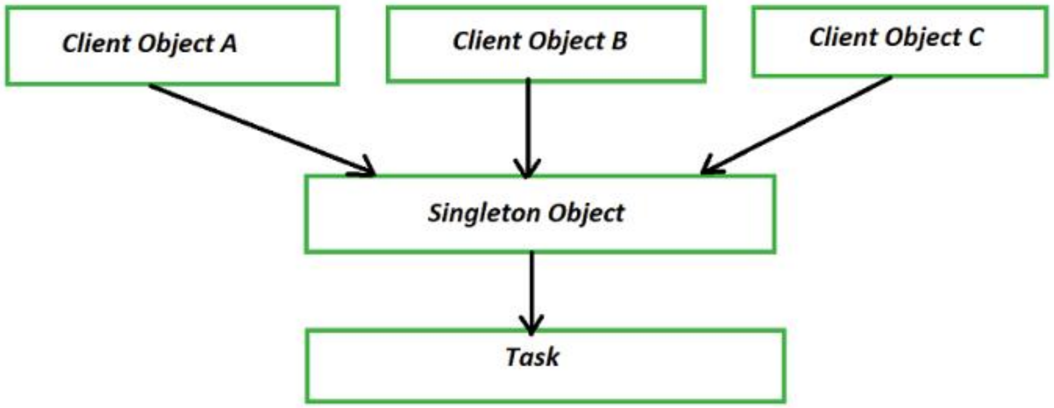
## The Singleton Pattern

Singleton



- One instantiation that is globally shared
- The class itself responsible for the creation and lifetime

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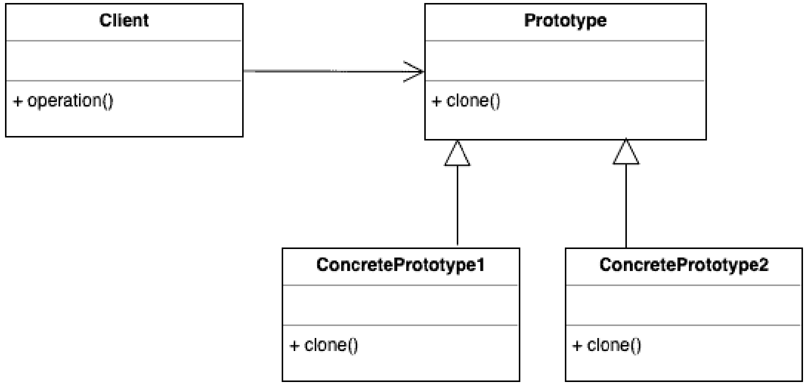
## The Protype Pattern

Protype



- Create copies of Objects in runtime without knowing their actual nature in advance
- Constructing new Object from a given Object – Clone

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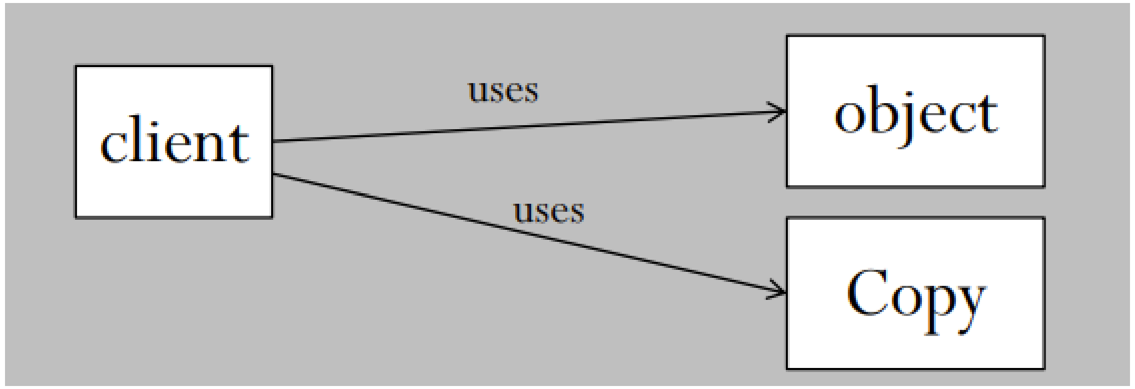
Prototype

## The Problem



- You don’t know the actual nature / type of Object when you process it for cloning
- You need to create similar objects (or identical, e.g. clone) from a given object

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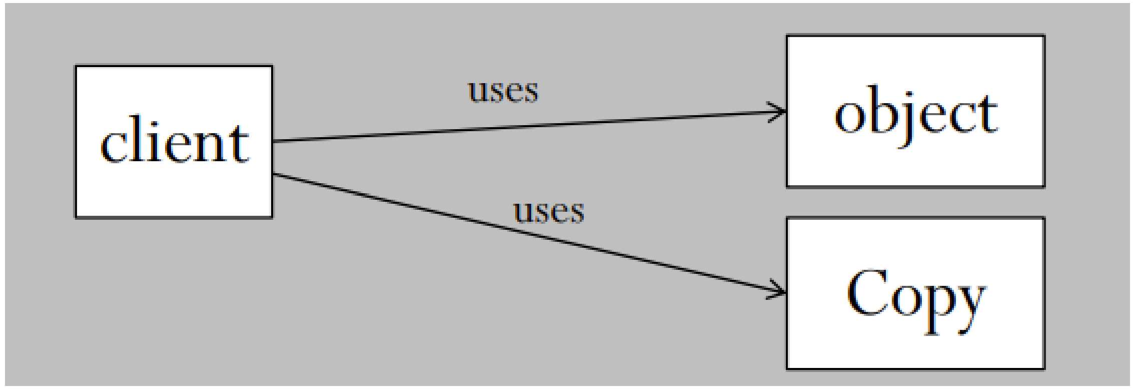
Prototype

## The Problem



Client is forced to :

- check the origin object type (class)
- call the origin class constructor to instantiate a copy instance
- verify everything is well copies and populated in that copy

To much time, performance and tightly coupling design…

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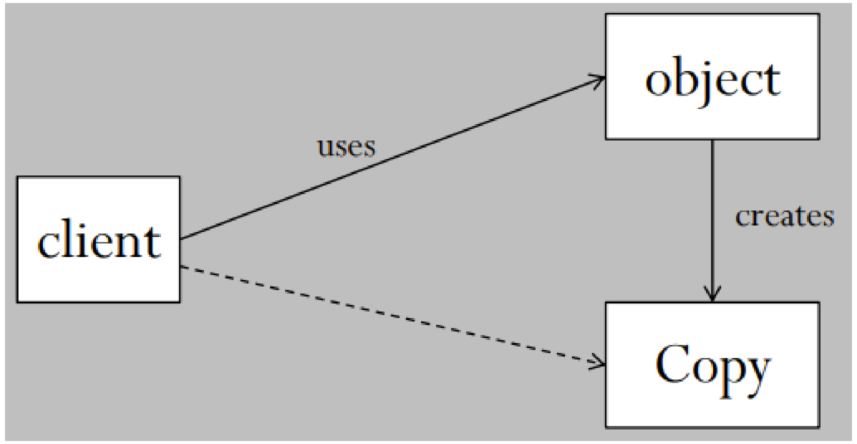
Prototype

## The Solution



- Client uses the origin object in order to construct a copy
- Object becomes a Factory of its own replications

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Abstract Factory

## The Abstract Factory  Patterns

- Abstracts the object creation.
- Let's extensibility.
- Provides an interface for creating families of related or dependent objects.

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Abstract Factory

## The Abstract Factory  Patterns

### The Problem

An office needs to process different types of reports before entering them into a database.

Each report has unique fields and requires different processing steps.

Additionally, a third type of report is in planning, and more types may be added in the future.

The goal is to design a **flexible** and **scalable** system that can handle these reports efficiently.

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## The Abstract Factory  Patterns

**The Solution:** Abstract Factory Design Pattern

Abstract Factory

- The Abstract Factory pattern provides an interface for creating families of related or dependent objects without specifying their concrete classes.
- This makes it easier to add new report types and processing steps without altering the existing system.

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Abstract Factory

## The Abstract Factory  Patterns

**The Solution:**

1. **Define Abstract Product Interfaces-** Define an interface for each type of report and its processing steps.

```
// Report interface
public interface Report {
            void generateReport();
            void saveToDatabase();
           }
```

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## The Abstract Factory  Patterns

Abstract Factory

**The Solution:**

2. **Concrete Product Implementations** – implement the report interface for each specific report type

```
// Report Type A
public class ReportTypeA implements Report {

    @Override
    public void generateReport() {
            System.out.println("Generating Report Type A..."); }

    @Override
    public void saveToDatabase() {
            System.out.println("Saving Report Type A to database..."); }
}
```

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## The Abstract Factory  Patterns

Abstract Factory

**The Solution:**

3. **Abstract Factory Interface -** Define an abstract factory interface for creating reports.

```
public interface ReportFactory {
   Report createReport();
}
```

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# The Abstract Factory  Patterns

Abstract Factory

## The Solution:

4. **Concrete Factory Implementations-** implement the ReportFactory interface for each specific report type.

```
// Factory for Report Type A
public class ReportTypeAFactory implements ReportFactory {
          @Override public Report createReport() {
                              return new ReportTypeA(); }
          }

// Factory for Report Type B
public class ReportTypeBFactory implements ReportFactory {
          @Override public Report createReport() {
                              return new ReportTypeB(); }
}
```

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Abstract Factory

## The Abstract Factory  Patterns

### The Solution:

5. **Client Code -** Use the abstract factory to create and process reports without depending on the specific report types.

```
public class ReportProcessor {
  private ReportFactory reportFactory;

  public ReportProcessor(ReportFactory reportFactory) {
    this.reportFactory = reportFactory;}

  public void processReport() {
    Report report = reportFactory.createReport();
    report.generateReport();
    report.saveToDatabase();}
}
```

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Abstract Factory

## The Abstract Factory  Patterns

### The Solution:

5. **Main App-** demonstrate the use of the abstract factory pattern.

```
public class Main {
public static void main(String[] args) {
ReportFactory reportTypeAFactory =
                              new ReportTypeAFactory();
ReportProcessor processorA =
                              new ReportProcessor(reportTypeAFactory);
processorA.processReport();
ReportFactory reportTypeBFactory =
                              new ReportTypeBFactory();
ReportProcessor processorB =
                    new ReportProcessor(reportTypeBFactory);
processorB.processReport(); }}
```

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Abstract Factory

## The Abstract Factory  Patterns

**Benefits:**

- **Modularity**: Each report type is encapsulated in its own class, making the codebase more modular and easier to maintain.
- **Scalability**: Adding a new report type involves creating a new concrete product class and a corresponding factory class, with no changes to the existing code.
- **Flexibility**: The client code works with factories and reports through their abstract interfaces, making it easy to extend the system with new report types.

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Abstract Factory

## The Abstract Factory  Patterns

**Extending the System:**

To add a new report type (e.g., ReportTypeC):

1. Create a new concrete report class that implements the Report interface.

2. Create a new factory class that implements the ReportFactory interface and returns an instance of the new report class.

3. Update the client code to use the new factory class when needed.

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Factory Method

## The Factory Method  Patterns

- The Factory Method pattern is a creational design pattern
- It’s providing an interface for creating objects in a superclass.
- It’s allowing subclasses to alter the type of objects that will be created.
- It’s done by defining a method for creating objects, which subclasses can override to instantiate the appropriate class.

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## Structural Patterns

Selected Patterns

- Adapter pattern
- Facade Pattern
- The Bridge Pattern
- Composite Pattern
- Proxy Pattern
- Decorator pattern

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Adapter

## The Adapter Patterns

- Wrap up existing classes inside a new target interface.
- Helps in the reuse of existing class with a different interface.
- Achieving it by converting an existing interface to a new interface.

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Facade

## The Facade Patterns

- Facade defines a higher-level interface that makes the subsystem easier to use.
- Provides a simplified interface and minimizes the dependency between subsystem.

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Composite

## The Composite Patterns

- Compose objects into tree structures
- Let's clients treat individual and compositions of object uniformly
- Complex object out of elementary objects
- Explains the context and forces when a pattern can be applied

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Proxy

## The Proxy Patterns

- Proxy Provide a surrogate or placeholder for another object to control access to it.
- A proxy controls access to another object.
- Can also defer the full cost of creation.
- Types:
  - Cache Proxy
  - Count Proxy
  - Protection Proxy
  - Remote Proxy
  - Virtual Proxy

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Selected Patterns

## Behavioral Patterns

- Iterator Pattern
- Strategy Pattern
- State Pattern
- Command Pattern
- Mediator Pattern
- Observer Pattern
- Visitor Pattern
- Chain of responsibility

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## The Iterator Patterns

Iterator

- Iterator is browsing a collection of entities without dealing with its implementation.
- Accesses the elements of an object collection sequentially.
- Done without exposing its underlying representation.

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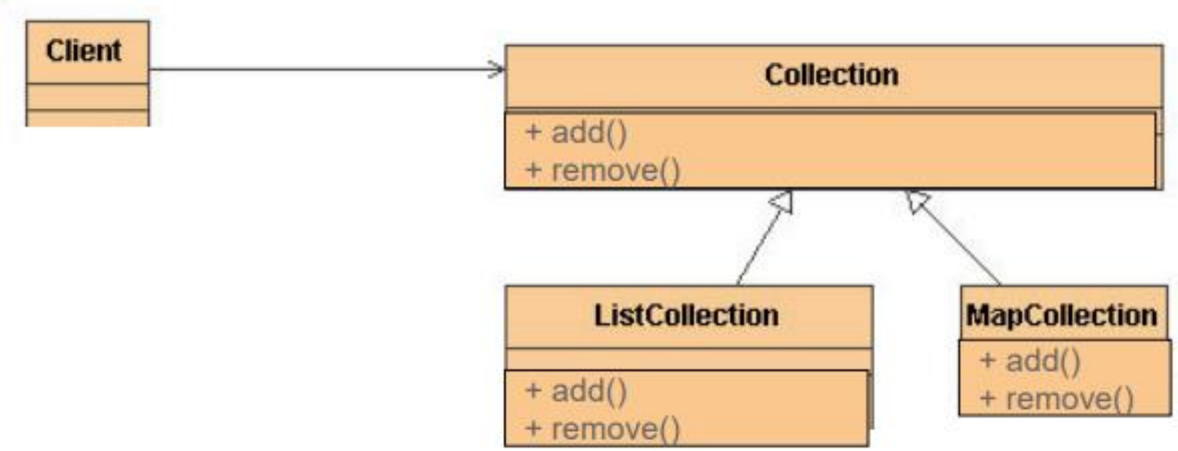
Iterator

## The Problem

- Clients needs to be familiar with code and logic



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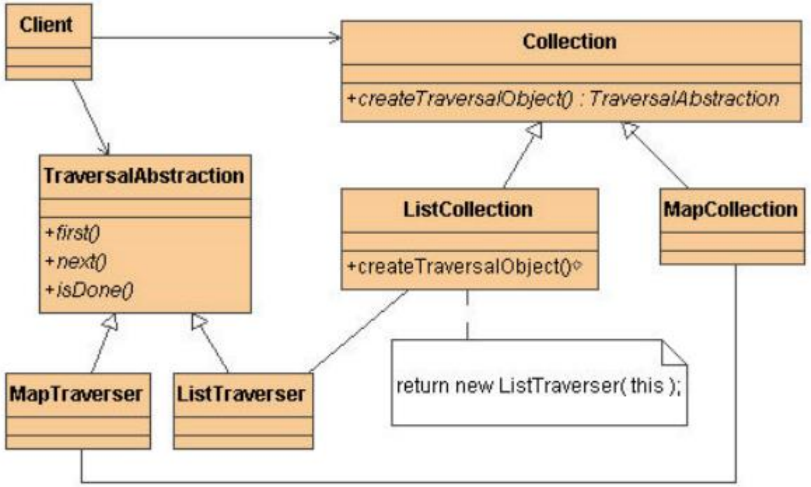
## The Solution

Iterator



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State

## The State Patterns

- Allow an object to alter its behavior when its internal state changes , The object which appear to change its class.
- “Implementing discrete object states using explicit classes“
- An object’s behavior depends on its state, and it must change its behavior at run-time depending on that state.
- Operations have large, multipart conditional statements that depend on the object’s state

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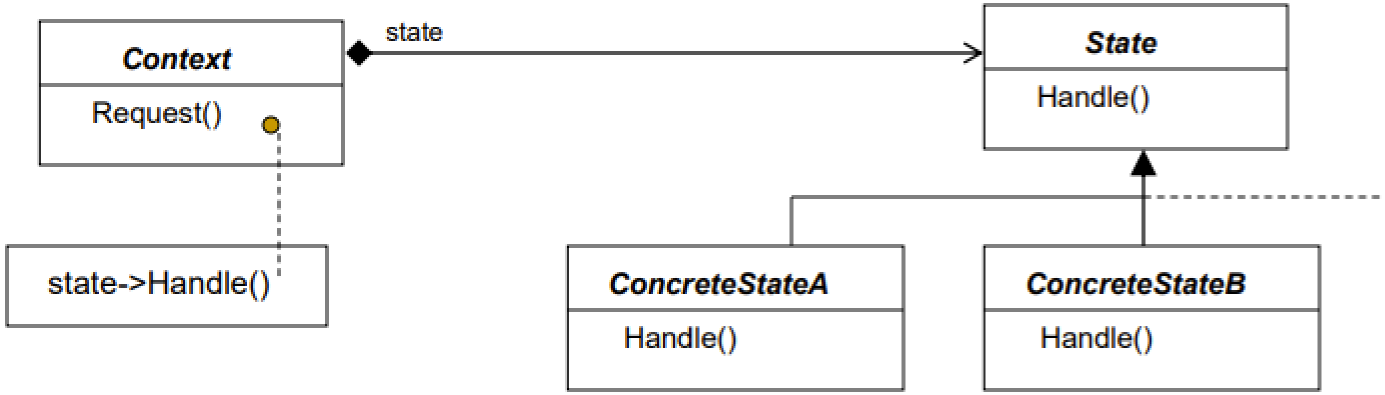
State

## The State Patterns



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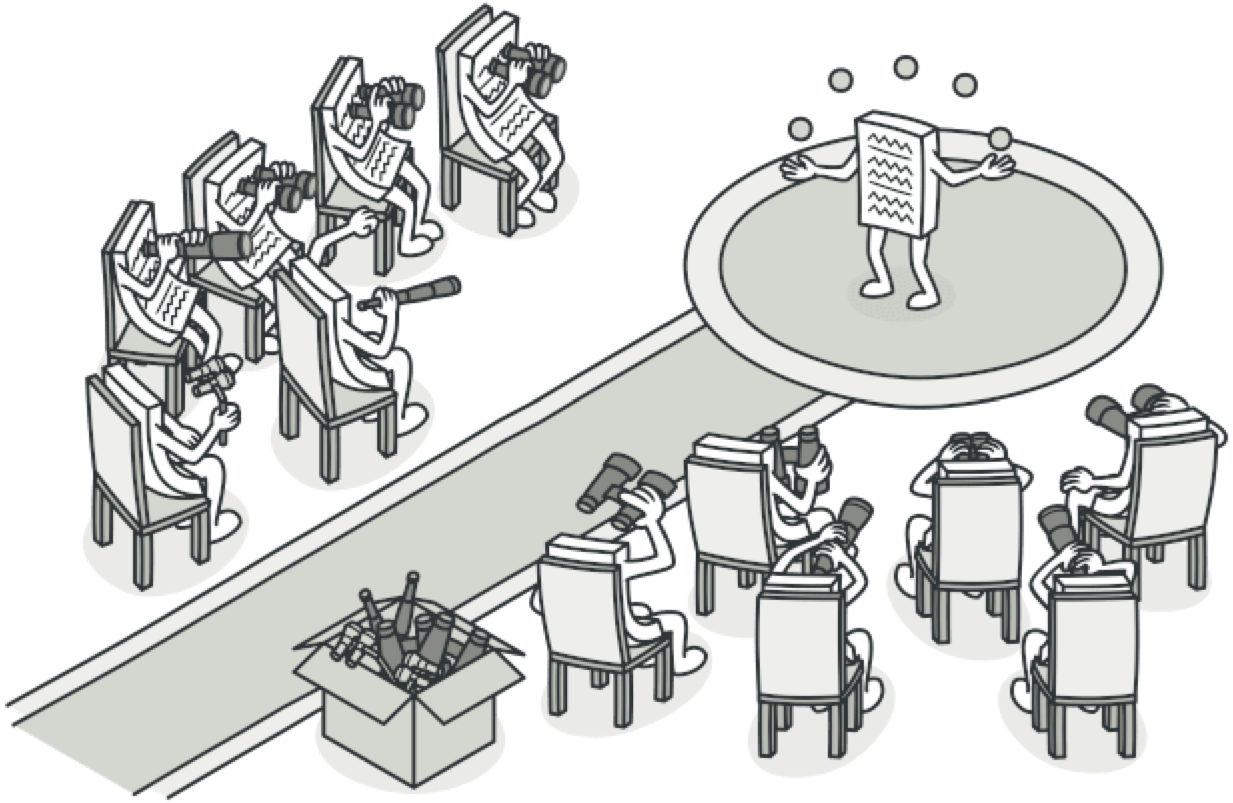
## The Observer Patterns

observer



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observer

## The Observer Patterns

- Creates a publish-subscribe relationship.
- Observers can register to receive events from the subject.
- Define a one-to-many dependency between objects
- When one object changes state, all its dependents are notified and updated automatically

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Thank You !!