



# Deep Dive Design pattern

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## Rajeev Gupta

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*“Too busy chopping wood to sharpen the axe”*

**Lib & Framework**

**BTech/MTech**



**12th class**



**Design patterns**

**10th class**



**SOLID**

**5th class**

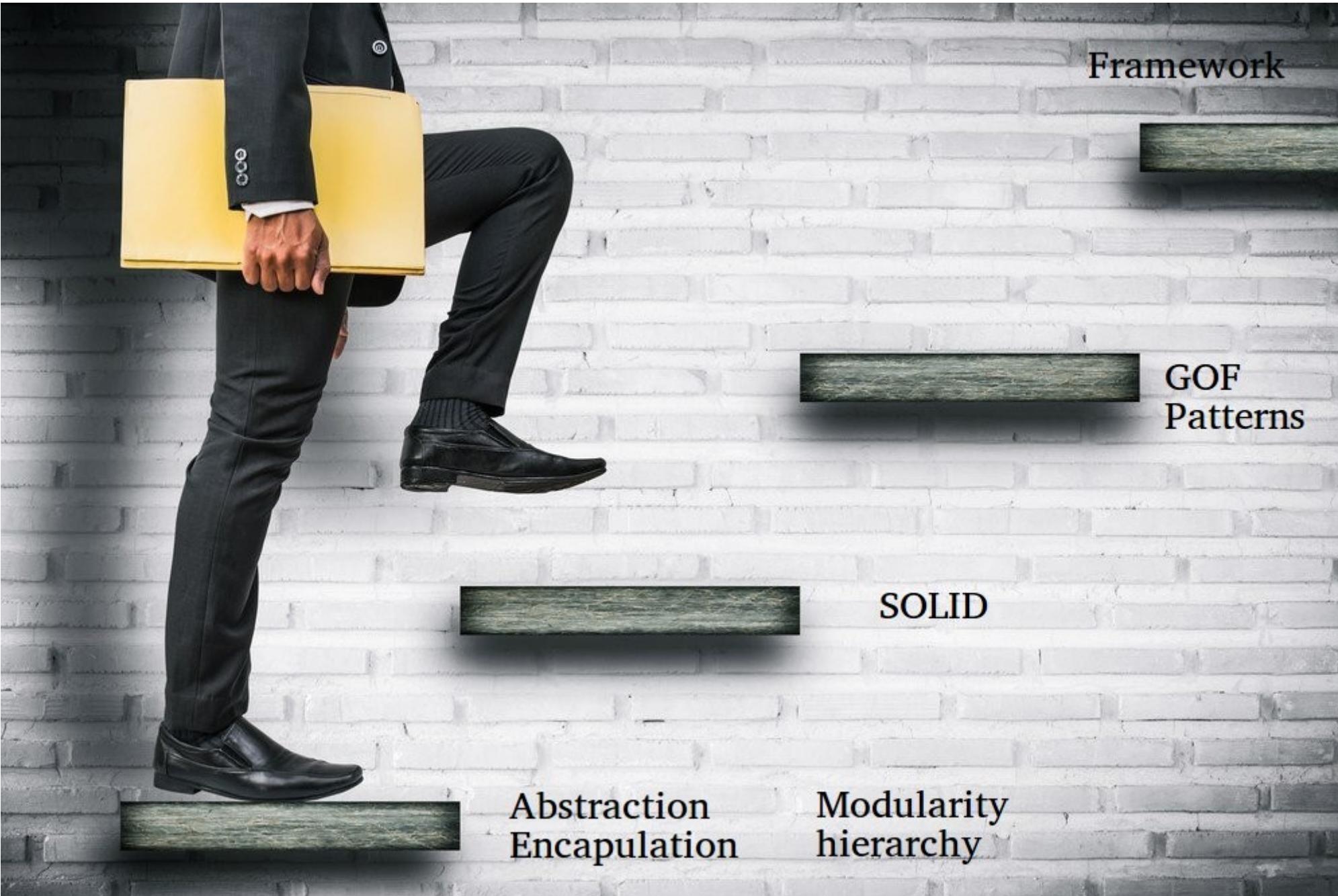


**clear understanding of OOPs concepts**

PRACTICE  
MAKES  
PERFECT



When watching experts perform  
it's easy to forget how much effort  
they've put into reaching high  
levels of achievement



Framework



GOF  
Patterns



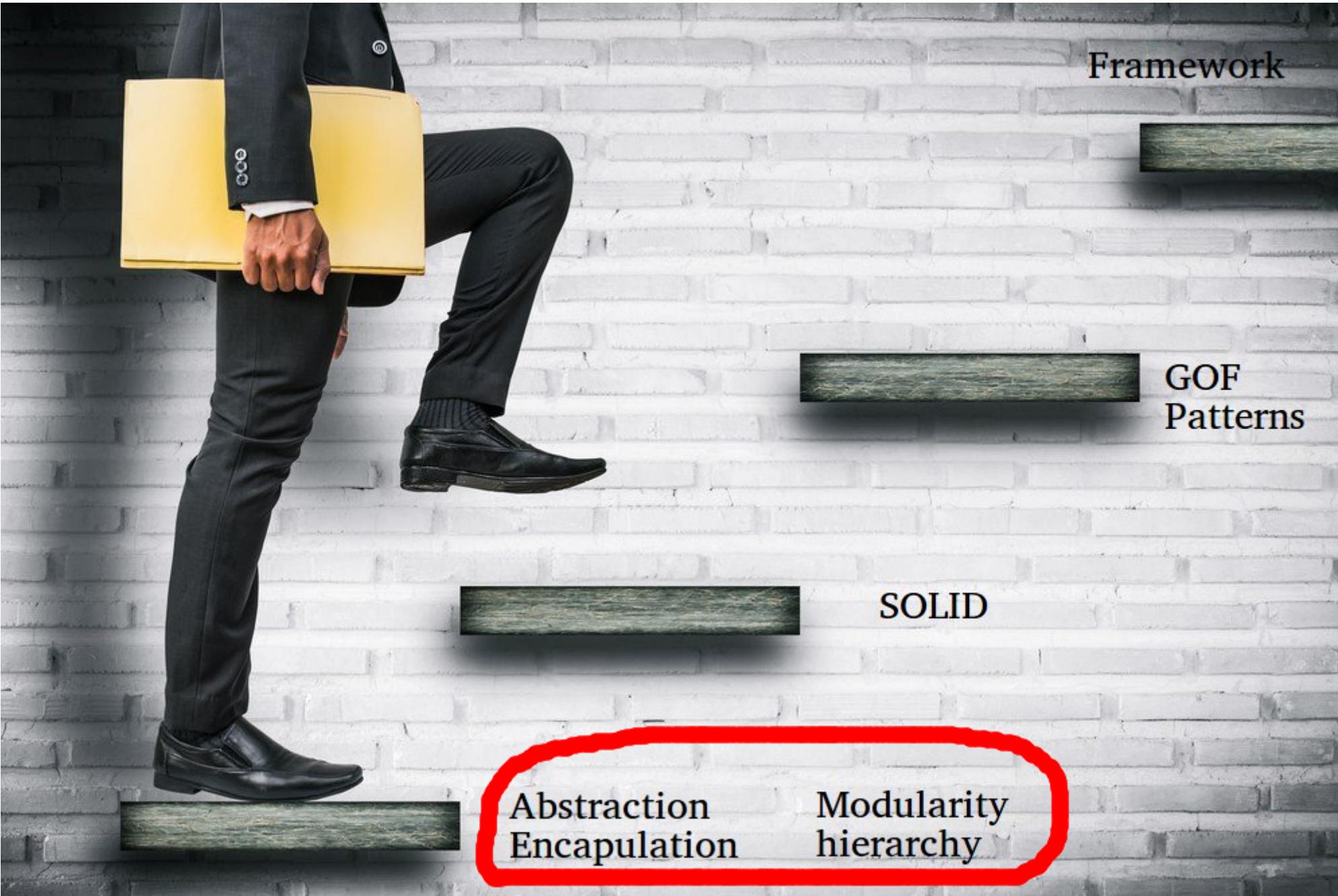
SOLID



Abstraction  
Encapsulation



Modularity  
hierarchy

A photograph of a man in a dark suit and black leather shoes walking up a set of grey stone steps. He is carrying a large, light-colored briefcase in his right hand. The background is a white brick wall.

Framework



GOF  
Patterns

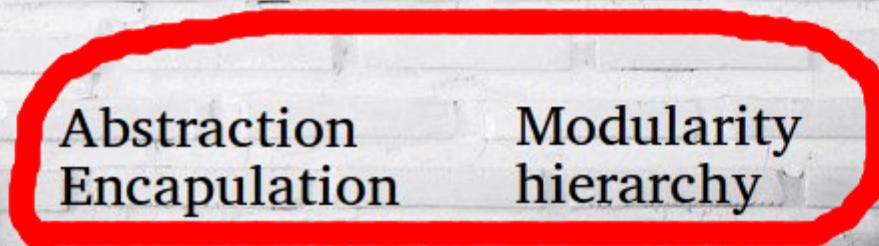


SOLID



Abstraction  
Encapsulation

Modularity  
hierarchy



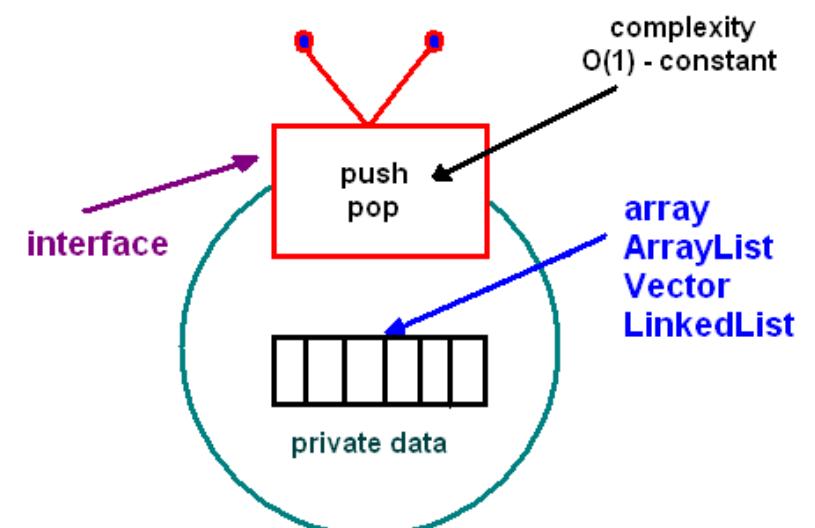
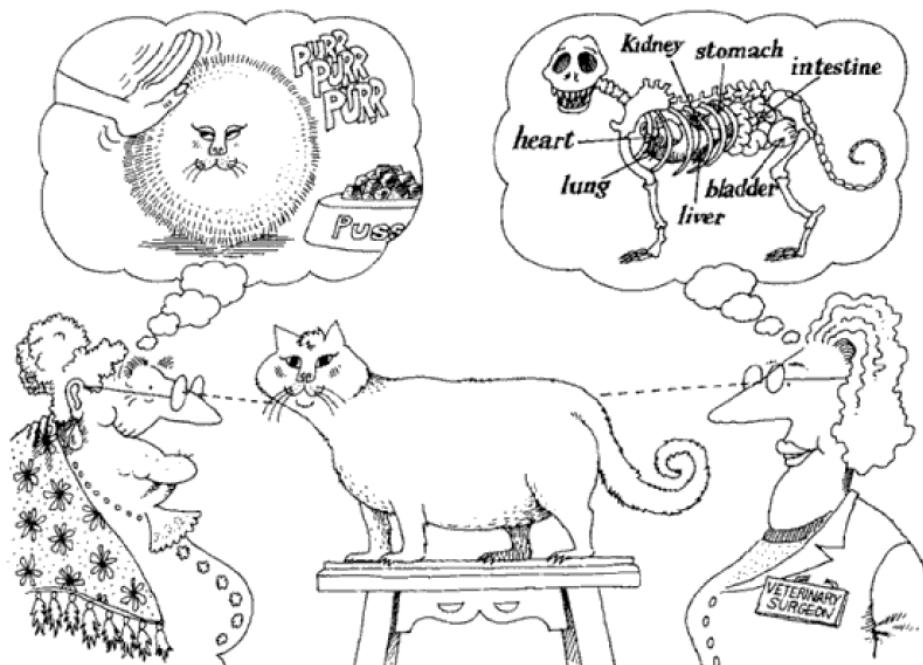
# Pillars of OO

- Abstraction
- Encapsulation
- Modularity
- Hierarchy



# Abstraction

Abstraction focuses upon the essential characteristics of some object, relative to the perspective of the viewer.



!! जाकी रही भावना  
जैसी ..  
प्रभु मूरत देखी तिन  
तैसी !!

# Encapsulation

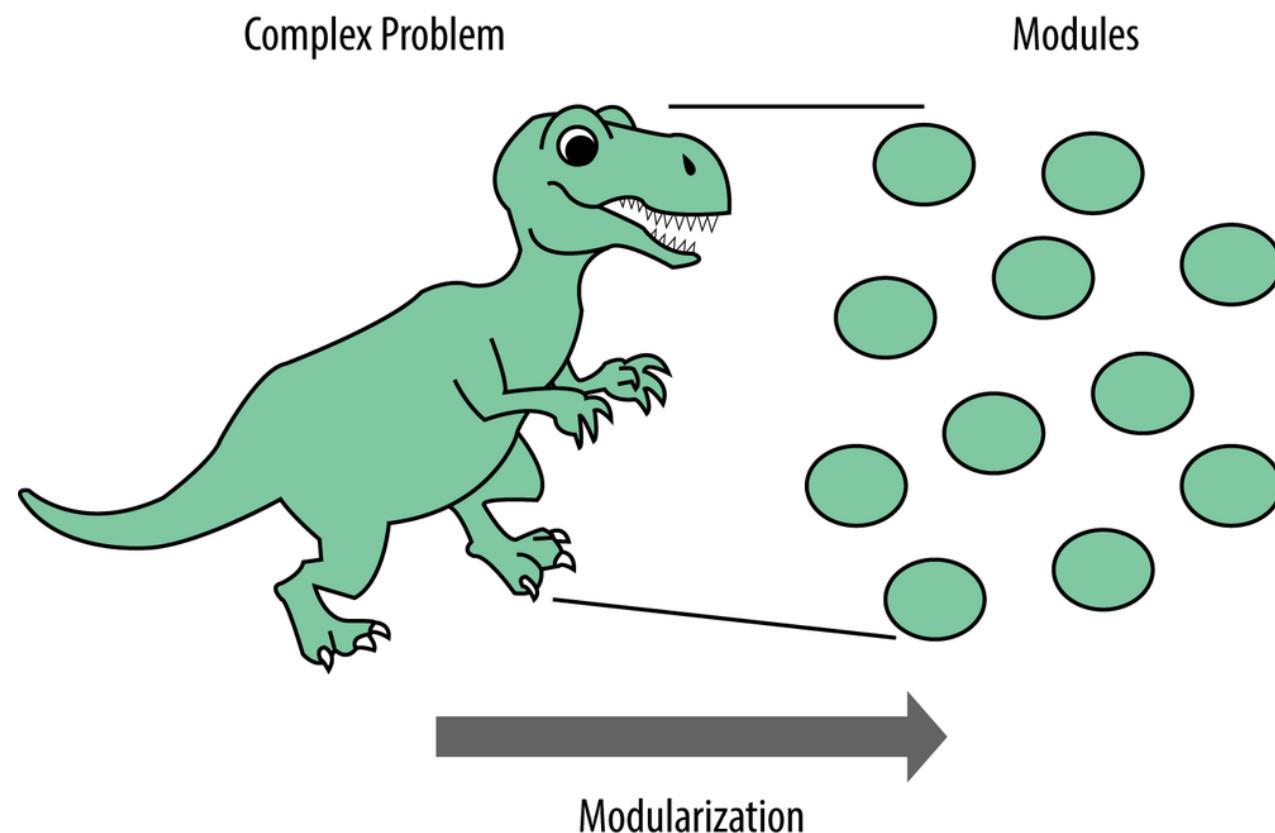
- Changing data in organized way, by using data hiding and applying business constraints
- Encapsulation= data hiding + constraints



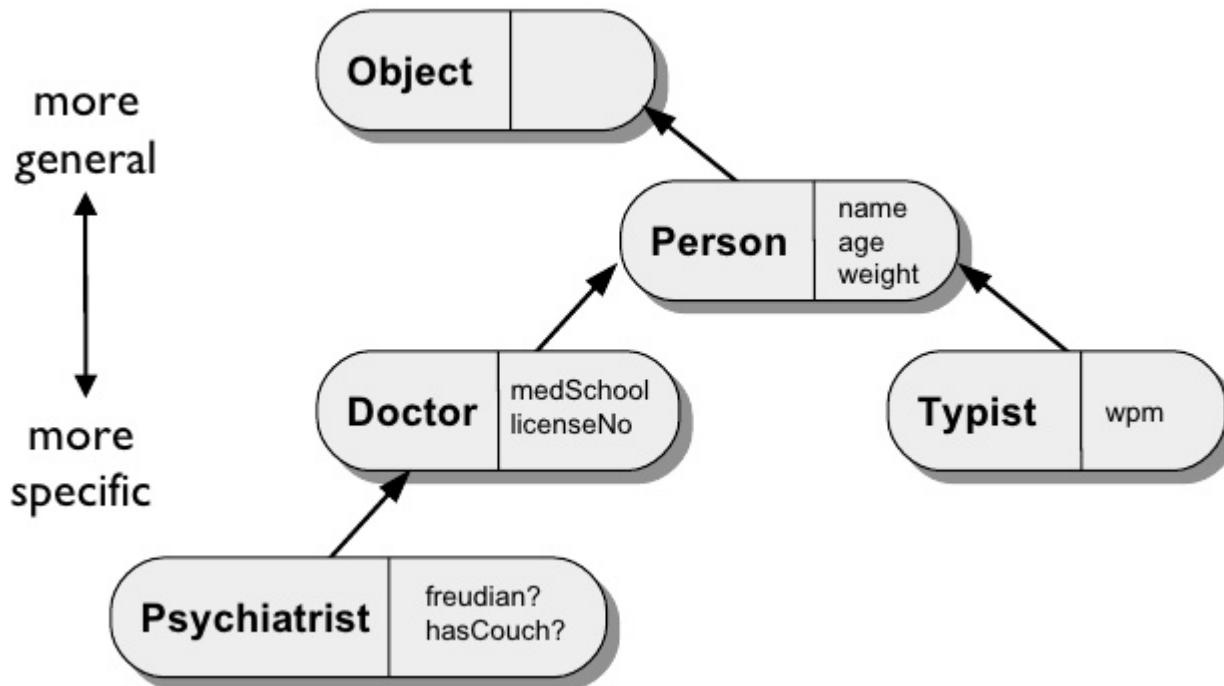
# Abstraction vs Abstraction

Abstraction	Encapsulation
Abstraction is a general concept formed by extracting common features from specific examples or The act of withdrawing or removing something <b>unnecessary</b> .	Encapsulation is the mechanism that binds together code and the data it manipulates, and keeps both <b>safe from outside interference</b> and <b>misuse</b> .
You can use abstraction using <b>Interface</b> and <b>Abstract Class</b>	You can implement encapsulation using <b>Access Modifiers</b> (Public, Protected & Private)
Abstraction solves the problem in <b>Design Level</b>	Encapsulation solves the problem in <b>Implementation Level</b>
For simplicity, abstraction means hiding implementation using Abstract class and Interface	For simplicity, encapsulation means hiding data using getters and setters

# Modularity



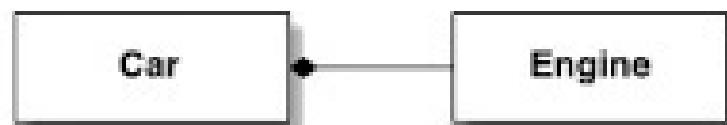
# Hierarchy



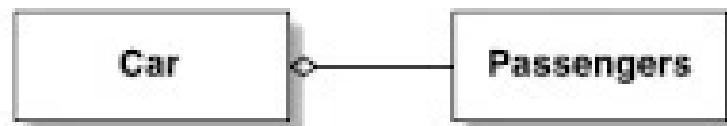
# UML 101

UML symbols

Association	Symbol
Composition	◆———
Aggregation	◇———
Inheritance	————→
Implementation	-----→

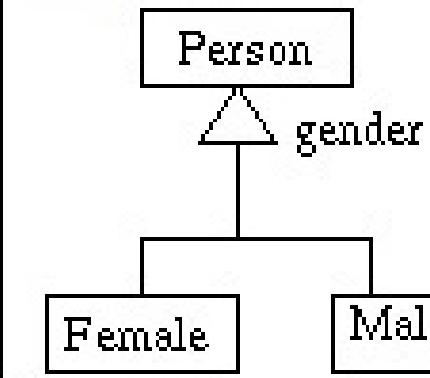


Composition: every car has an engine.

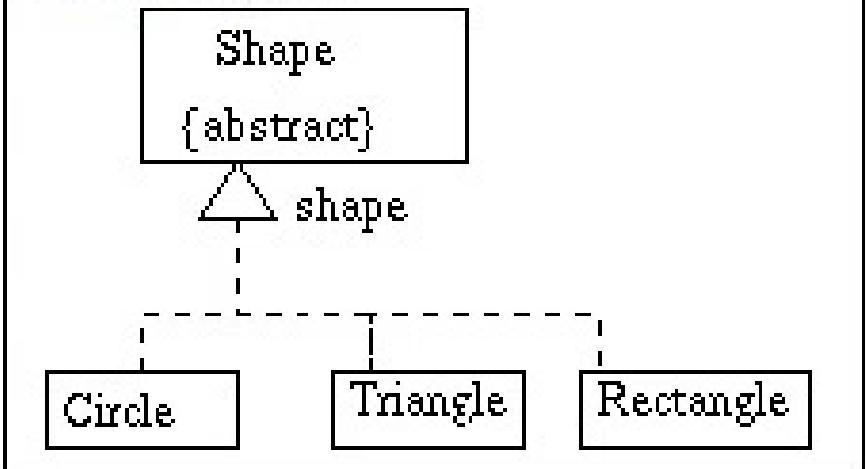


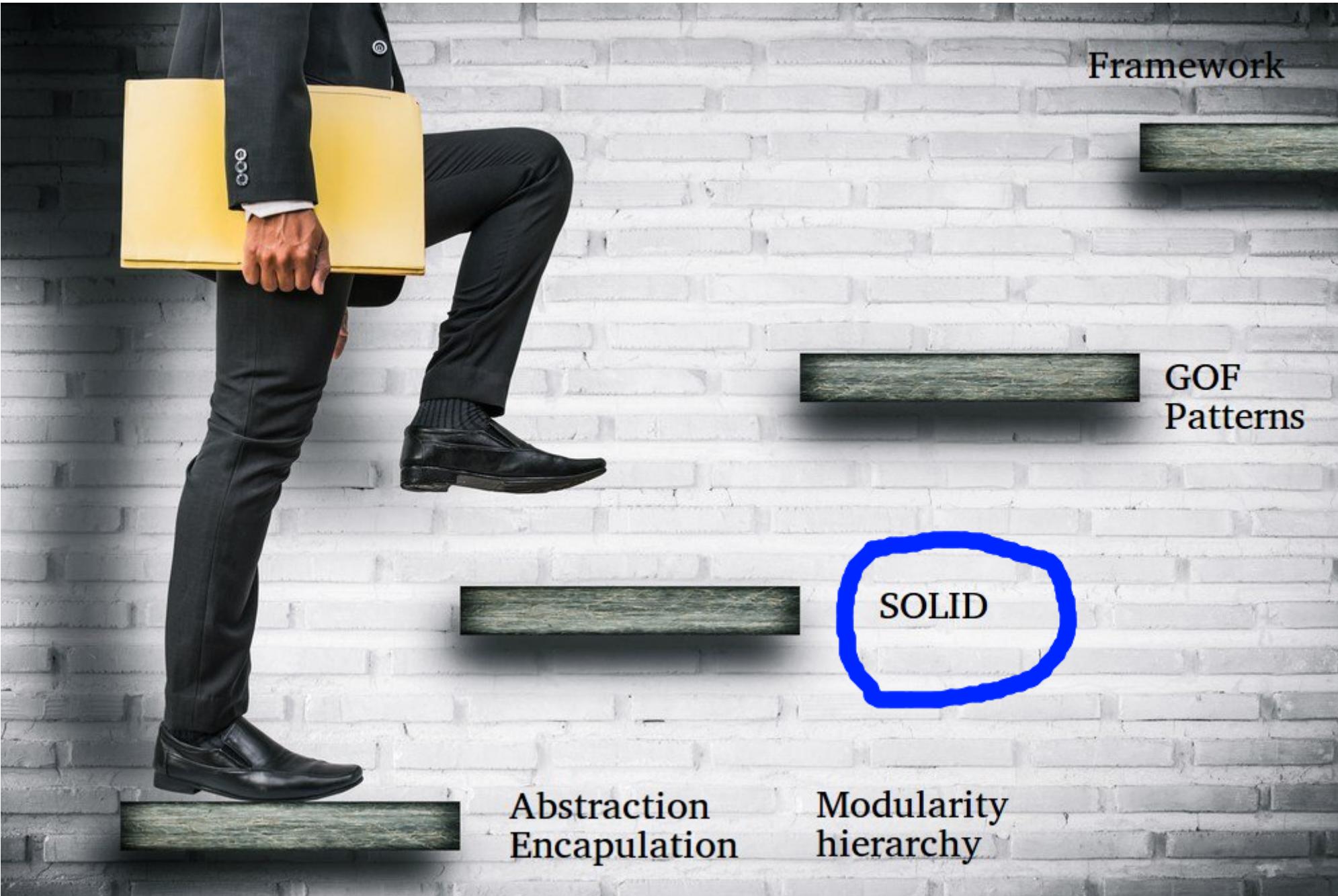
Aggregation: cars may have passengers, they come a

Inheritance



Implementation



A photograph of a man in a dark suit and black leather shoes walking on a grey brick wall. He is carrying a large, bright yellow folder or briefcase in his right hand. The background consists of a white brick wall with two small framed pictures hanging on it.

Framework

GOF  
Patterns

SOLID

Abstraction  
Encapsulation

Modularity  
hierarchy

We write code that is ...

Rigid



Fragile



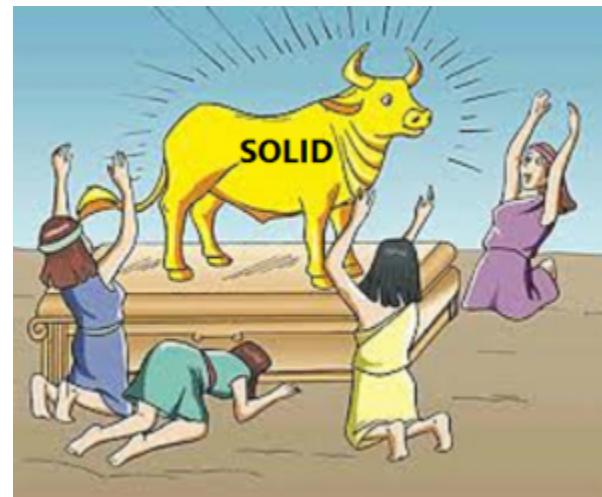
Immobile



Making everyone's life miserable



# So WHY SOLID?



# It helps us to write code that is ...

- Loosely coupled
- Highly cohesive
- Easily composable
- Reusable

# SOLID

Coined by Robert C  
Martin

Not new, existing  
principles brought  
together



# SOLID

**S**ingle Responsibility Principle (SRP)

**O**pen Closed Principle (OCP)

**L**iskov Substitution Principle (LSP)

**I**nterface Seggregation Principle (ISP)

**D**ependency Inversion Principle (DIP)

# Single Responsibility Principle



"There should be **NEVER** be more than **ONE** reason for a class to change"

# Open Closed Principle



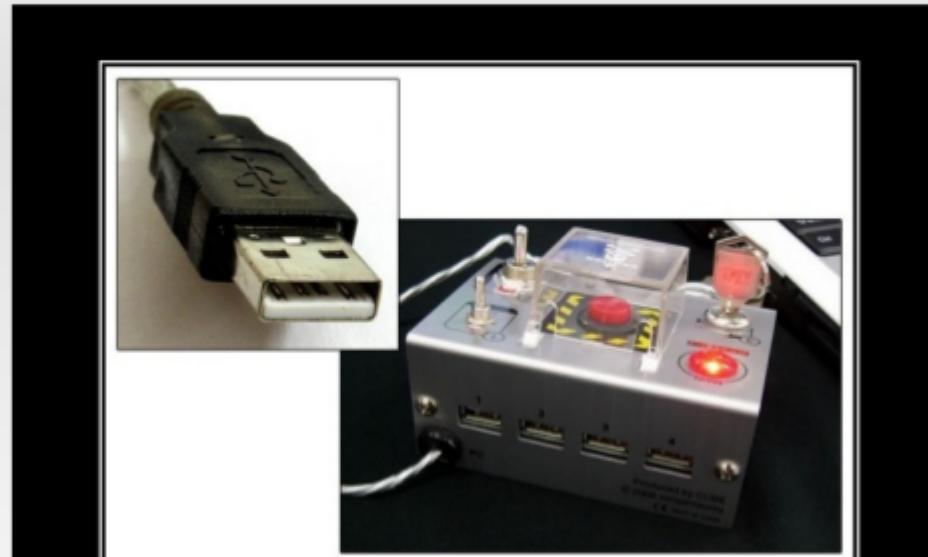
"Modules must be **OPEN** for extension,  
**CLOSED** for modification"

# Liskov Substitution Principle



"Base classes instances must be replaceable by the sub class instances without any change in the application"

# Interface Segregation Principle



## INTERFACE SEGREGATION PRINCIPLE

You Want Me To Plug This In, Where?

"Clients should not depend upon the interfaces they do not use"

How can we pollute the interfaces?  
OR

How do we end up creating Fat interfaces?

# Dependency Inversion Principle



## DEPENDENCY INVERSION PRINCIPLE

Would You Solder A Lamp Directly To The Electrical Wiring In A Wall?

"High level modules should not depend on the low level details modules, instead both should depend on abstractions"

# Top 10 Object Oriented Design Principles

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1. DRY (Don't repeat yourself) - avoids duplication in code.
2. Encapsulate what changes - hides implementation detail, helps in maintenance
3. Open Closed design principle - open for extension, closed for modification
4. SRP (Single Responsibility Principle) - one class should do one thing and do it well
5. DIP (Dependency Inversion Principle) - don't ask, let framework give to you
6. Favor Composition over Inheritance - Code reuse without cost of inflexibility
7. LSP (Liskov Substitution Principle) - Sub type must be substitutable for super type
8. ISP (Interface Segregation Principle) - Avoid monolithic interface, reduce pain on client side
9. Programming for Interface - Helps in maintenance, improves flexibility
10. Delegation principle - Don't do all things by yourself, delegate it



Framework



GOF  
Patterns



SOLID

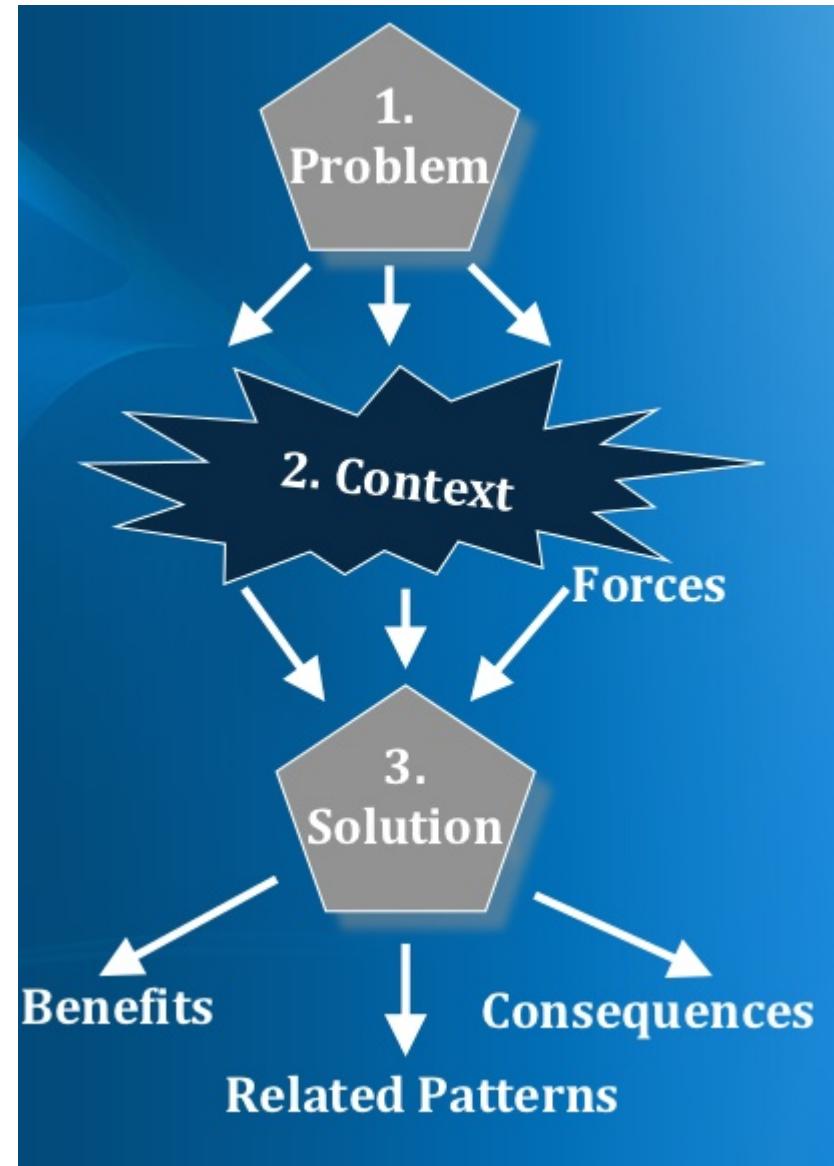
Abstraction  
Encapsulation

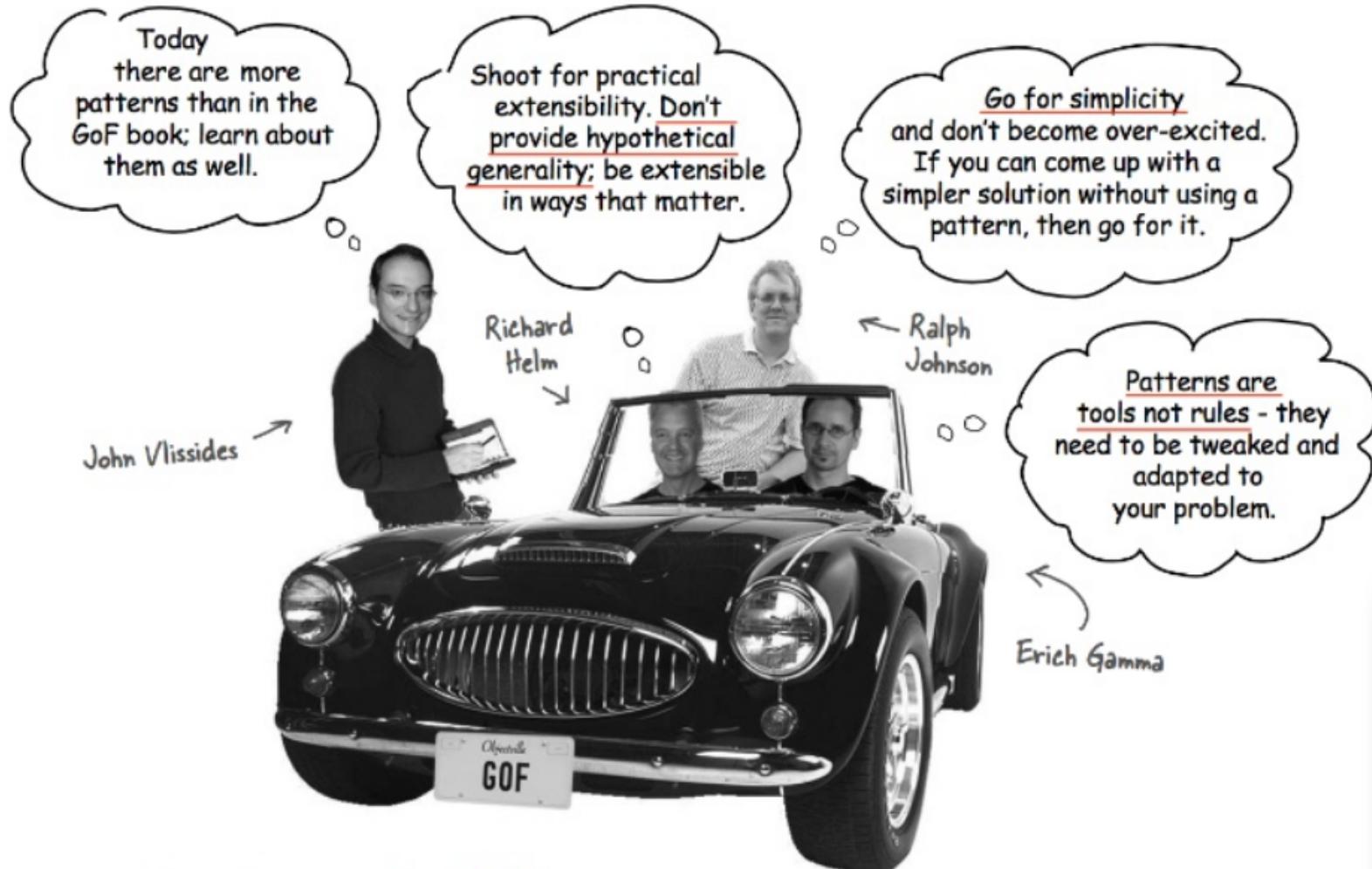
Modularity  
hierarchy



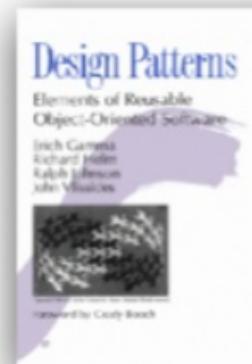
# Design pattern

- Proven way of doing things
- **Gang of 4 design patterns ???**
- **total 23 patterns**
- **Classification patterns**
  - 1. **Creational**
  - 2. **Structural**
  - 3. **Behavioral**





Keep it simple (KISS)



# DESIGN PATTERNS – CLASSIFICATION

Structural Patterns	Creational Patterns	Behavioral Patterns
<ul style="list-style-type: none"><li>• 1. Decorator</li><li>• 2. Proxy</li><li>• 3. Bridge</li><li>• 4. Composite</li><li>• 5. Flyweight</li><li>• 6. Adapter</li><li>• 7. Facade</li></ul>	<ul style="list-style-type: none"><li>• 1. Prototype</li><li>• 2. Factory Method</li><li>• 3. Singleton</li><li>• 4. Abstract Factory</li><li>• 5. Builder</li></ul>	<ul style="list-style-type: none"><li>• 1. Strategy</li><li>• 2. State</li><li>• 3. TemplateMethod</li><li>• 4. Chain of Responsibility</li><li>• 5. Command</li><li>• 6. Iterator</li><li>• 7. Mediator</li><li>• 8. Observer</li><li>• 9. Visitor</li><li>• 10. Interpreter</li><li>• 11. Memento</li></ul>

# Patterns classification

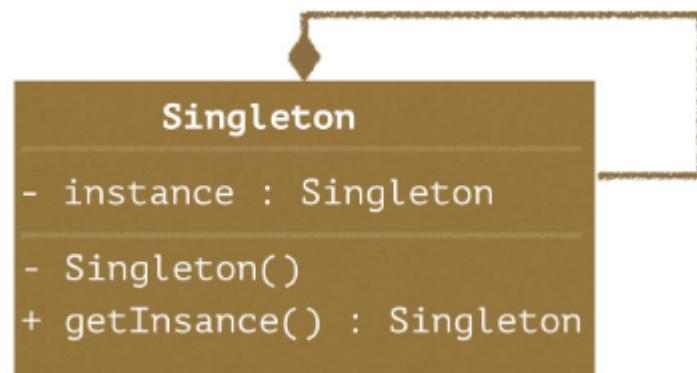
- **Creational patterns?**
  - What is the **best way to create object** as per requirement
- **Structural patterns?**
  - Structural Patterns describe **how objects and classes can be combined to form larger structures**
- **Behavioral Patterns?**
  - Behavioral patterns are those which are concerned with **interactions between the objects** ( talking to each other still loosely coupled)



**Creational  
Design  
Patterns**

# Singleton Design Pattern

“Ensure that a class has only one instance and provide a global point of access to it.”



- `java.lang.Runtime#getRuntime()`
- `java.awt.Desktop#getDesktop()`
- `java.lang.System#getSecurityManager()`

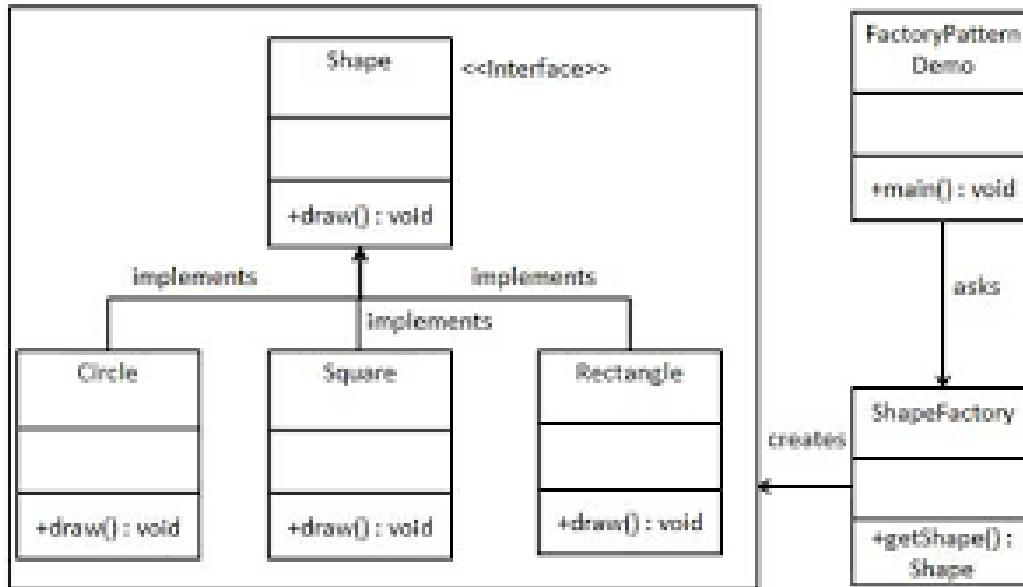
- ❖ Java Runtime class is used to *interact with java runtime environment*.
- ❖ Java Runtime class provides methods to execute a process, invoke GC, get total and free memory etc.
- ❖ There is only one instance of `java.lang.Runtime` class is available for one java application.
- ❖ The `Runtime.getRuntime()` method returns the singleton instance of `Runtime` class.

# Singleton Design Consideration

- # Eager initialization
- # Static block initialization
- # Lazy Initialization
- # Thread Safe Singleton
- # Serialization issue
- # Cloning issue
- # Using Reflection to destroy Singleton Pattern.
- # Enum Singleton
- # Best programming practices



# Factory design pattern



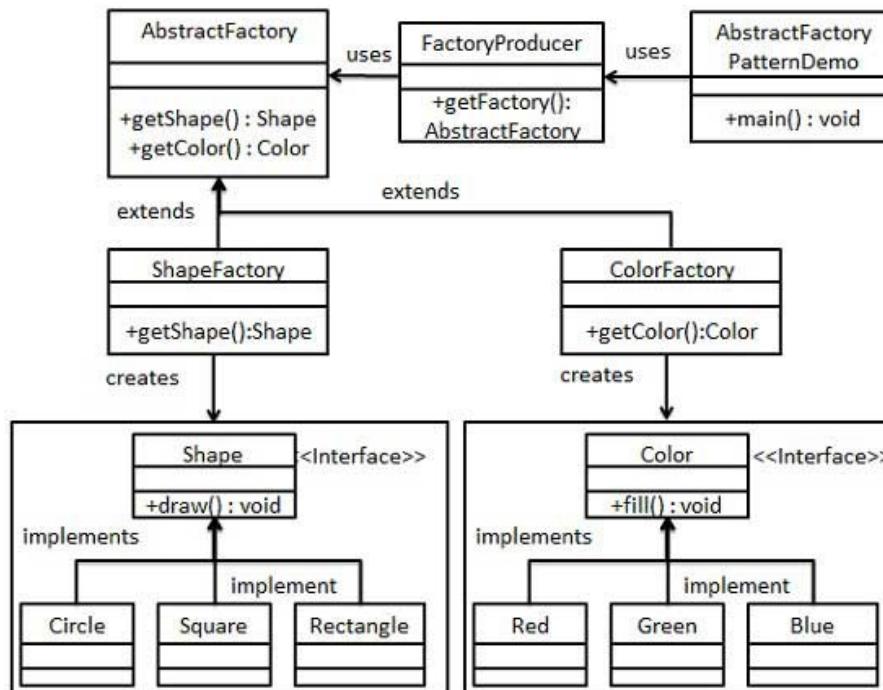
**Factory**(Simplified version of Factory Method) - Creates objects without exposing the instantiation logic to the client and Refers to the newly created object through a common interface.

**Factory Method** - Defines an interface for creating objects, but let subclasses to decide which class to instantiate and Refers to the newly created object through a common interface.

- `java.util.Calendar#getInstance()`
- `java.util.ResourceBundle#getBundle()`
- `java.text.NumberFormat#getInstance()`

# Abstract Factory

**Java: Abstract Factory.** **Abstract Factory** is a **creational design pattern**, which solves the problem of creating entire product families without specifying their concrete classes. **Abstract Factory** defines an interface for creating all distinct products, but leaves the actual product creation to concrete **factory** classes.



- `javax.xml.parsers.DocumentBuilderFactory#newInstance()`
- `javax.xml.transform.TransformerFactory#newInstance()`
- `javax.xml.xpath.XPathFactory#newInstance()`

# Builder Pattern

The Builder pattern can be used to ease the construction of a complex object from simple objects.



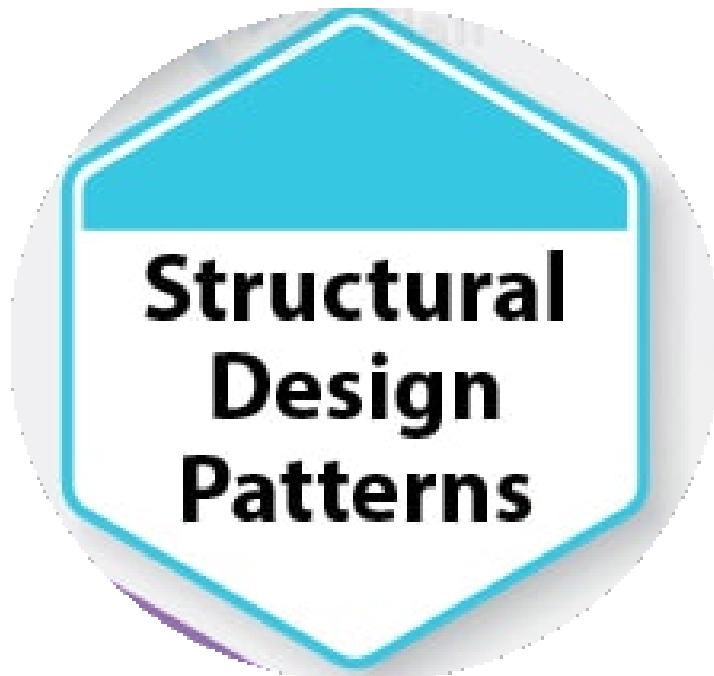
`java.lang.StringBuilder#append()` (unsynchronized)  
`java.lang.StringBuffer#append()` (synchronized)

# Prototype Pattern

Cloning of an object to avoid creation. If the cost of creating a new object is large and creation is resource intensive, we clone the object.



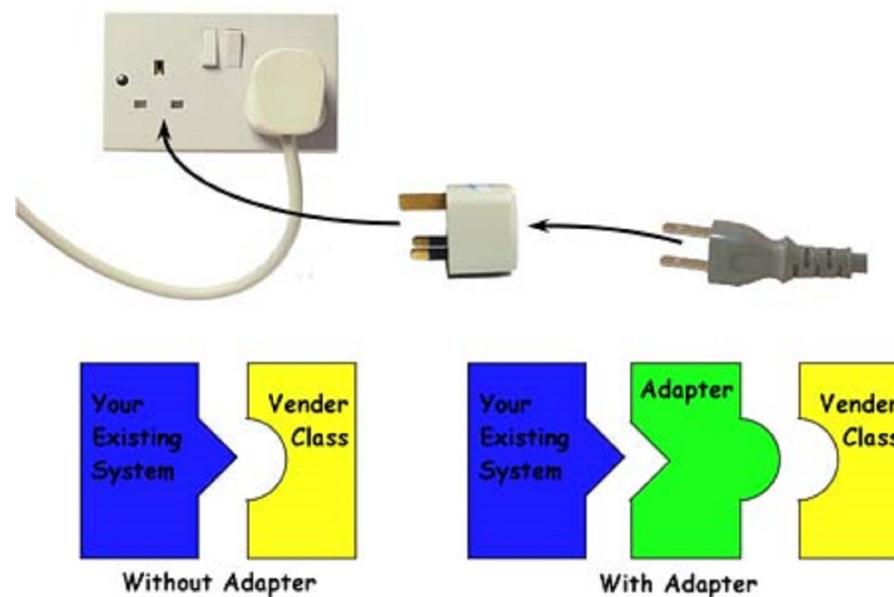
- `java.lang.Object#clone()` (the class has to implement `java.lang.Cloneable`)



**Structural  
Design  
Patterns**

# Adapter Pattern

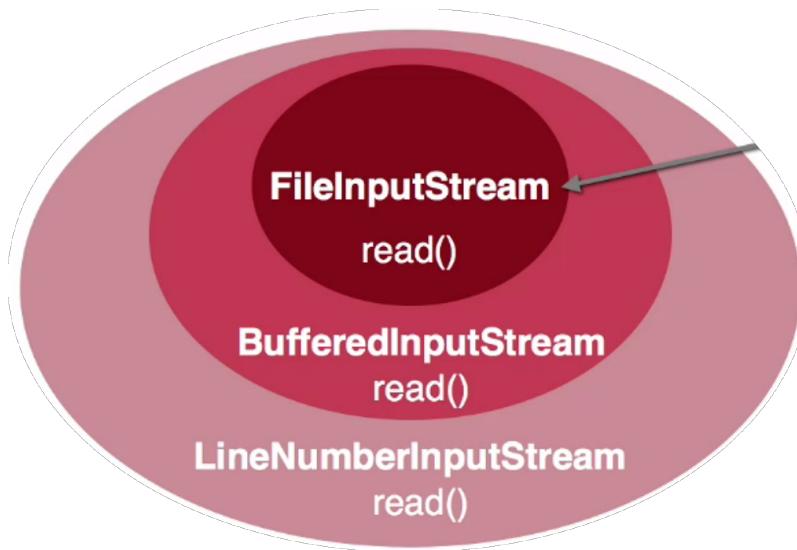
The Adapter pattern is used so that two unrelated interfaces can work together.



- `java.util.Arrays#asList()`
- `java.util.Collections#list()`
- `java.util.Collections#enumeration()`
- `java.io.InputStreamReader(InputStream)` (returns a `Reader`)
- `java.io.OutputStreamWriter(OutputStream)` (returns a `Writer`)

# Decorator design pattern

Series of wrapper class that define functionality, In the Decorator pattern, a decorator object is wrapped around the original object.



**Adding behaviour statically or dynamically**  
**Extending functionality without effecting the behaviour of other objects.**  
**Adhering to Open for extension, closed for modification.**

All subclasses of `java.io.InputStream`, `OutputStream`, `Reader` and `Writer` have a constructor taking an instance of same type.

`java.util.Collections`, the `checkedXXX()`, `synchronizedXXX()` and `unmodifiableXXX()` methods.

`javax.servlet.http.HttpServletRequestWrapper` and `HttpServletResponseWrapper`

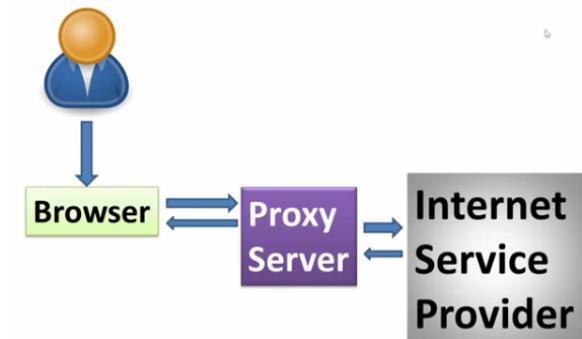
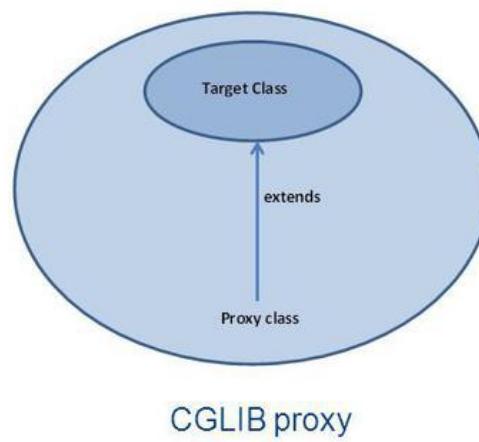
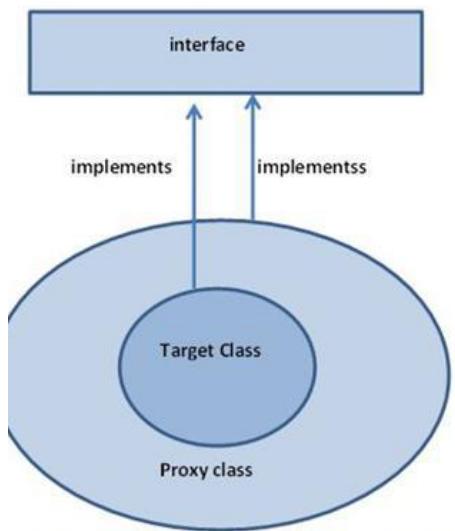
`javax.swing.JScrollPane`

# Proxy design pattern

Proxy pattern, a class represents functionality of another class. This type of design pattern comes under structural pattern. In short, a proxy is a wrapper or agent object that is being called by the client to access the real serving object behind the scenes.



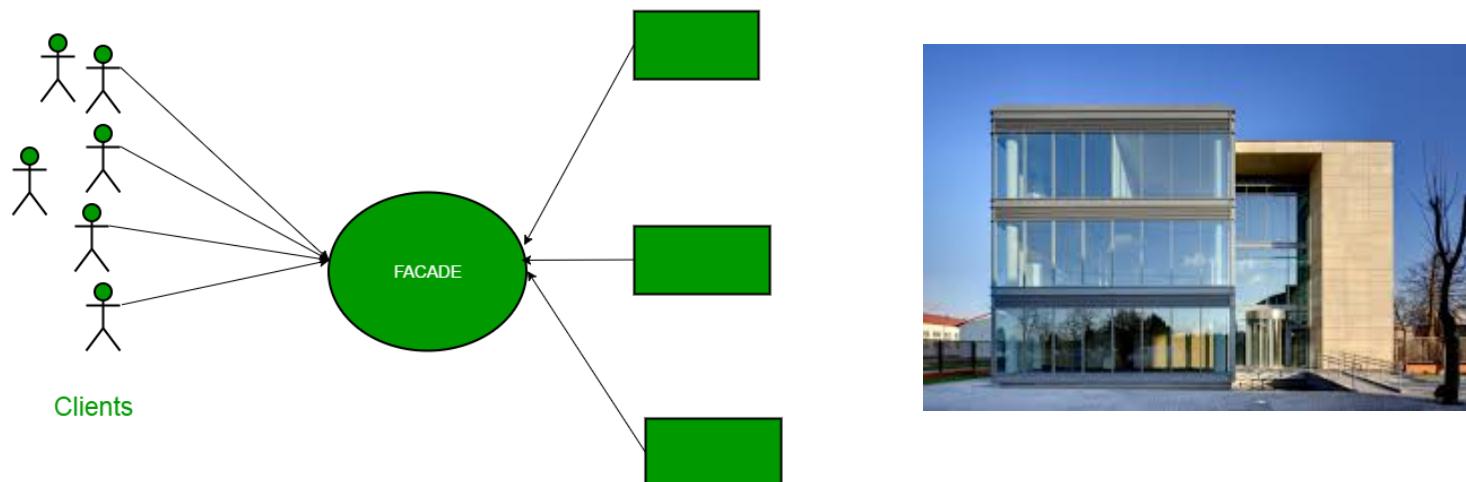
- In Spring Framework AOP is implemented by creating proxy object for your service.



`java.lang.reflect.Proxy`  
`java.rmi.*`  
`javax.ejb.EJB` (explanation here)  
`javax.inject.Inject` (explanation here)  
`javax.persistence.PersistenceContext`

# Facade pattern

The **facade pattern** (also spelled as **façade**) is a **software-design pattern** commonly used with object-oriented programming. The name is an analogy to an architectural **façade**. A **facade** is an object that provides a simplified interface to a larger body of code, such as a class library.



- `javax.faces.context.FacesContext`, it internally uses among others the abstract/interface types `LifeCycle`, `ViewHandler`, `NavigationHandler` and many more without that the enduser has to worry about it (which are however overrideable by injection).
- `javax.faces.context.ExternalContext`, which internally uses `ServletContext`, `HttpSession`, `HttpServletRequest`, `HttpServletResponse`, etc.



# **Behavioral Design Patterns**

# Iterator design pattern

**"The Iterator**

Pattern provides a way to access the elements of an aggregate object sequentially without exposing the underlying representation"

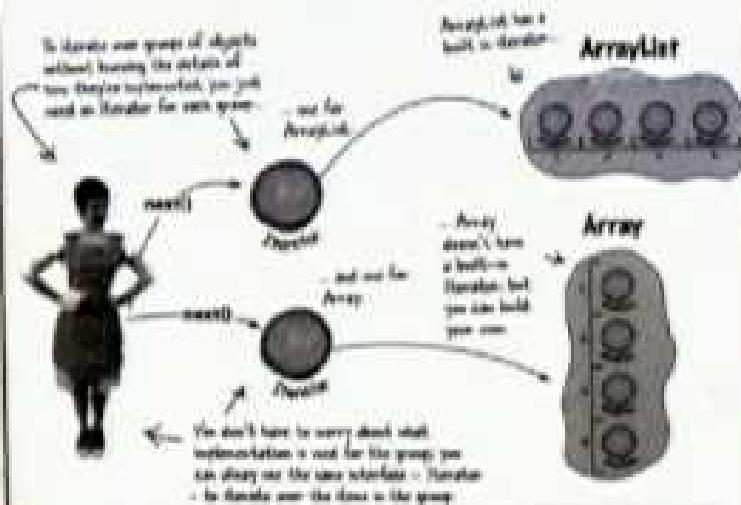
Head First  
Design Patterns  
Poster  
O'Reilly,  
ISBN 0-596-10214-3



336, 257

## Iterator

The Iterator Pattern provides a way to access the elements of an aggregate object sequentially without exposing its underlying representation.



# Strategy pattern /policy pattern

**Strategy** - Define a family of algorithms, encapsulate each one, and make them interchangeable. Strategy lets the algorithm vary independently from clients that use it.

The screenshot shows a shopping cart interface with two items: a pink t-shirt and a blue blouse. The right side features an 'Order Summary' section with a promotional banner for a shoe sale.

ITEM	PRICE	QUANTITY	TOTAL
Lana Leopard Lace Tee Style: 570113309 SKU: 451004831976 Color: Summerberry Size: Size 1 (8/10, S)	\$55.00	1	\$55.00
Easy Cotton Tyree Shirt Style: 570105245 SKU: 451004495130 Color: Mysterious Blue Size: Size 1.5 (10, S)	\$39.50	1	\$39.50

**Order Summary**

ITEM SUBTOTAL	\$94.50
ESTIMATED TOTAL (BEFORE TAX) \$94.50	

Promotion Code  **APPLY**

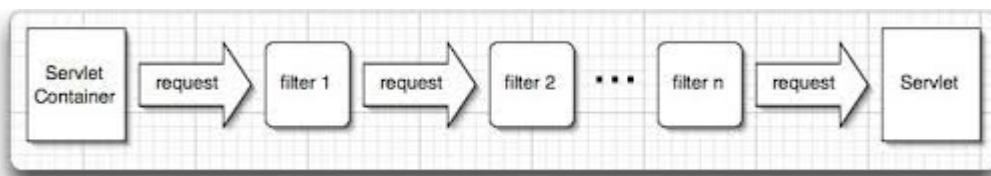
**Need Help?**  
We're happy to offer international shoppers with English Customer Support!  
**CLICK TO CHAT** **CLICK TO CALL**

The two best words ever?  
**shoe SALE!**  
**50% OFF**  
Select Styles  
[> SHOP THE SALE](#) [\\*Details](#)

- `java.util.Comparator#compare()`, executed by among others `Collections#sort()`.
- `javax.servlet.http.HttpServlet`, the `service()` and all `doXXX()` methods take `HttpServletRequest` and `HttpServletResponse` and the implementor has to process them (and not to get hold of them as instance variables!).

# Chain of Responsibility

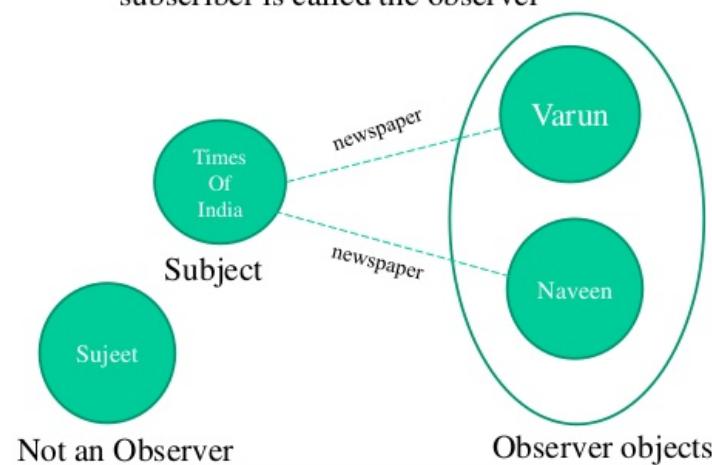
Chain of responsibility pattern is used to achieve loose coupling in software design where a request from client is passed to a chain of objects to process them.



# Observer Design pattern

Observer design pattern is useful when you are interested in the state of an object and want to get notified whenever there is any change.

- Publisher + Subscribers = observer pattern
- In observer pattern publisher is called the subject and subscriber is called the observer



- `java.util.Observer / java.util.Observable` (rarely used in real world though)
- All implementations of `java.util.EventListener` (practically all over Swing thus)
- `javax.servlet.http.HttpSessionBindingListener`
- `javax.servlet.http.HttpSessionAttributeListener`
- `javax.faces.event.PhaseListener`

# Template Design Pattern

**Template Method** - Define the skeleton of an algorithm in an operation, deferring some steps to subclasses / Template Method lets subclasses redefine certain steps of an algorithm without letting them to change the algorithm's structure.

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Your assistance in completing this form in a gratis approach, your honest feedback will help us to serve you better and enable us to work on improving our service standards. Thank you.

Customer Name:

Address:

Destination:

Amount:

Excellent  Good  Fair  Poor

1. Supplier's management and assistance  
2. Order's Punctuality  
3. How would you rate the quality of our product?  
A. Staff's performance and attitude  
B. Delivery of order without damage/defect  
C. Address & Distance of office  
D. How will you rate our overall quality of our packing and moving?  
E. How would you like to recommend us to others?

Your comments: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: September 03, 2013



Foundation



Pillars



Walls



Windows

Template Method [Build a House]

- 1) Building foundation
- 2) Building pillars
- 3) Building walls
- 4) Building windows



Concrete House



Wooden House

spring  
JDBC

# Pattern vs. Framework

- Pattern is a set of guidelines on how to architect the application
- When we implement a pattern we need to have some classes and libraries
- **Thus, pattern is the way you can architect your application.**
- Framework helps us to follow a particular pattern when we are building a web application
- These prebuilt classes and libraries are provided by the MVC framework.
- **Framework provides foundation classes and libraries.**



# Library vs Framework

