

⇒ Low Level design with projects

SOLID Principles :-

S - Single Responsibility Principle

O - Open / Closed Principle

L - Liskov Substitution Principle

I - Interface Segmented Principle

D - Dependency Inversion Principle

a class should have only one reason to change.

we should not modify any class, instead we should just extend other classes to override.

child class should only improve capabilities of par class and not narrow it down

client should not need to implement any unnecessary methods.

class should depend on interfaces rather than concrete classes.

1) Single Responsibility Principle

Problem

```
class Invoice {  
  
    private Marker marker; ✓  
    private int quantity;  
  
    public Invoice(Marker marker, int quantity) {  
        this.marker = marker;  
        this.quantity = quantity;  
    }  
  
    public int calculateTotal() {  
        int price = ((marker.price) * this.quantity);  
        return price;  
    }  
  
    public void printInvoice() {  
        //print the Invoice  
    }  
  
    public void saveToDB() {  
        // Save the data into DB  
    }  
}
```

we might need to change calc in future due to GST calc

This is one reason to change and we might need to change printInvoice in future, (like now we need to download invoice as well)

Also, saveToDB maybe in future we need to save in file instead of DB.

So, there are multiple reasons in this class to change in future.

So, this class is not following

Single responsibility Principle

Solution

→ So try to create each class so that each class will have only one reason to change.

```
1 class Invoice {  
2     private Marker marker;  
3     private int quantity;  
4  
5     public Invoice(Marker marker, int quantity) {  
6         this.marker = marker;  
7         this.quantity = quantity;  
8     }  
9  
10    public int calculateTotal() {  
11        int price = ((marker.price) * this.quantity);  
12        return price;  
13    }  
14}
```

```
1 class InvoiceDao {  
2     Invoice invoice;  
3  
4     public InvoiceDao(Invoice invoice) {  
5         this.invoice = invoice;  
6     }  
7  
8     public void saveToDB() {  
9         // Save into the DB  
10    }  
11}
```

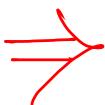
```
1 class InvoicePrinter {  
2     private Invoice invoice;  
3  
4     public InvoicePrinter(Invoice invoice) {  
5         this.invoice = invoice;  
6     }  
7  
8     public void print() {  
9         //print the invoice  
10    }  
11}
```

Note:- DAO :- data access layer

2) Open for extension but closed for modification

previous example :-

```
class InvoiceDao {  
    Invoice invoice;  
  
    public InvoiceDao(Invoice invoice) {  
        this.invoice = invoice;  
    }  
  
    public void saveToDB() {  
        // Save into the DB  
    }  
}
```



```
class InvoiceDao {  
    Invoice invoice;  
  
    public InvoiceDao(Invoice invoice) {  
        this.invoice = invoice;  
    }  
  
    public void saveToDB() {  
        // Save Invoice into DB  
    }  
  
    public void saveToFile(String filename) {  
        // Save Invoice in the File with the given name  
    }  
}
```

Note:- modified the same class for a new method , but
class was already tested and live in production, so
now production might have error.

So, instead of modifying the same class, extend it

Solution:-

```
interface InvoiceDao {  
    public void save(Invoice invoice);  
}
```



```
class DatabaseInvoiceDao implements InvoiceDao {  
  
    @Override  
    public void save(Invoice invoice) {  
        // Save to DB  
    }  
}
```

```
class FileInvoiceDao implements InvoiceDao {  
  
    @Override  
    public void save(Invoice invoice) {  
        // Save to file  
    }  
}
```

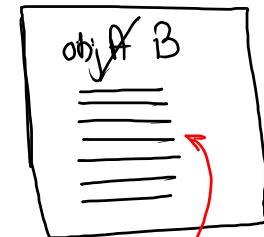
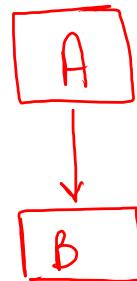
Now, same interface is implemented by both classes , either for DB or for file

So if anything extra comes later , then g will just extend the interface for another class instead of modifying any class.

3) Liskov Substitution Principle :-



If Class B is subtype of Class A, then we should be able to replace object of A with B without breaking the behaviour of the program



~~gmp~~ Subclass should extend the capabilities of parent class not narrows it down.

all of it should still be working.

Ex:-

```
interface Bike {  
    void turnOnEngine();  
    void accelerate();  
}
```



```
class MotorCycle implements Bike {  
  
    boolean isEngineOn;  
    int speed;  
  
    public void turnOnEngine() {  
        //turn on the engine!  
        isEngineOn = true;  
    }  
  
    public void accelerate() {  
        //increase the speed  
        speed = speed + 10;  
    }  
}
```

```
class Bicycle implements Bike {  
  
    public void turnOnEngine() {  
        throw new AssertionError( detailMessage: "there is no engine" );  
    }  
  
    public void accelerate() {  
        //do something  
    }  
}
```

here, Bicycle class narrowed down properties of Bike because now we don't have turnOnEngine and we are getting error.

Problem :-

```
public class Vehicle {  
    public Integer getNumberOfWheels(){  
        return 2;  
    }  
    .  
    public Boolean hasEngine(){  
        return true;  
    }  
}
```

```
public class MotorCycle extends Vehicle{  
}
```

```
public class Car extends Vehicle{  
  
    @Override  
    public Integer getNumberOfWheels() {  
        return 4;  
    }  
}
```

```
public class Bicycle extends Vehicle{  
  
    public Boolean hasEngine(){  
        return null;  
    }  
}
```

returning null

client code

```
public class Main {  
    public static void main(String args[]){  
  
        List<Vehicle> vehicleList = new ArrayList<>();  
        vehicleList.add(new MotorCycle());  
        vehicleList.add(new Car());  
        vehicleList.add(new Bicycle());  
  
        for(Vehicle vehicle : vehicleList){  
            System.out.println(vehicle.hasEngine().toString());  
        }  
    }  
}
```

will give null pointer exception for Bicycle

(this has broke the code)

Solution:-

now, hasEngine is not present
for Bicycle

```
public class Vehicle {
    public Integer getNumberOfWheels(){
        return 2;
    }
}
```

Note:- Parent class should be having only very generic methods which are used by all.

```
public class EngineVehicle extends Vehicle{
    public boolean hasEngine(){
        return true;
    }
}
```

```
public class Bicycle extends Vehicle{}
```

```
public class EngineVehicle extends Vehicle{
    public boolean hasEngine(){
        return true;
    }
}
```

```
public class MotorCycle extends EngineVehicle{}
```

client code 1

```
public class Main {
    public static void main(String args[]){
        List<Vehicle> vehicleList = new ArrayList<>();
        vehicleList.add(new MotorCycle());
        vehicleList.add(new Car());
        vehicleList.add(new Bicycle());

        for(Vehicle vehicle : vehicleList){
            System.out.println(vehicle.getNumberOfWheels().toString());
        }
    }
}
```

will work bec Vehicle class have
this method

client code 2

```
public class Main {
    public static void main(String args[]){
        List<Vehicle> vehicleList = new ArrayList<>();
        vehicleList.add(new MotorCycle());
        vehicleList.add(new Car());
        vehicleList.add(new Bicycle());

        for(Vehicle vehicle : vehicleList){
            System.out.println(vehicle.hasEngine());
        }
    }
}
```

compilation error:- Vehicle class doesn't have
hasEngine method

client code 3

```
public class Main {
    public static void main(String args[]){
        List<EngineVehicle> vehicleList = new ArrayList<>();
        vehicleList.add(new MotorCycle());
        vehicleList.add(new Car());
        vehicleList.add(new Bicycle()); ★

        for(EngineVehicle vehicle : vehicleList){
            System.out.println(vehicle.hasEngine());
        }
    }
}
```

EngineVehicle class cannot make object of
Bicycle

4) Interface Segmented Principle



not

Interfaces should be such, that client should implement unnecessary functions they do not need

Ex:-

```
interface RestaurantEmployee {  
    void washDishes();  
    void serveCustomers();  
    void cookFood();  
}
```

```
class waiter implements RestaurantEmployee {
```

```
    public void washDishes(){  
        //not my job  
    }
```

```
    public void serveCustomers() {  
        //yes and here is my implementation  
        System.out.println("serving the customer");  
    }
```

```
    public void cookFood(){  
        // not my job  
    }
```

not a waiter job then
should he implement it

Solution:-

```
[ interface WaiterInterface {  
    void serveCustomers();  
    void takeOrder();  
}
```

```
[ interface ChefInterface {  
    void cookFood();  
    void decideMenu();  
}
```



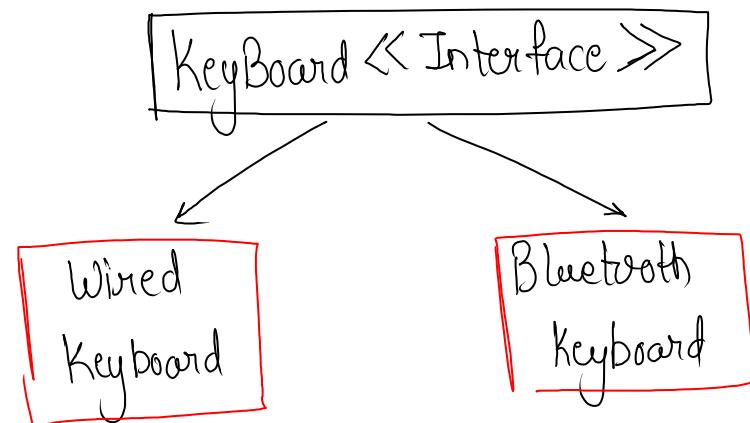
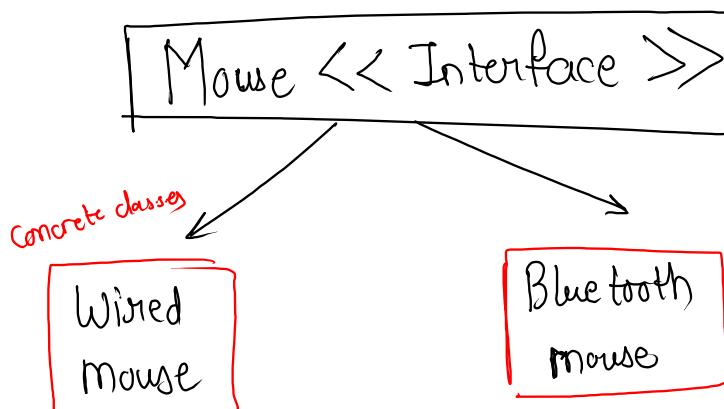
```
[ class waiter implements WaiterInterface {  
    ✓ public void serveCustomers() {  
        System.out.println("serving the customer");  
    }  
    ✓ public void takeOrder(){  
        System.out.println("taking orders");  
    }  
}
```

now, waiter is only implementing what it needs to implement

5) Dependency Inversion Principle



Class should depend on interfaces rather than concrete classes



This is the scenario

Problem :-

```
class MacBook {  
    private final WiredKeyboard keyboard;  
    private final WiredMouse mouse;  
  
    public MacBook() {  
        keyboard = new WiredKeyboard();  
        mouse = new WiredMouse();  
    }  
}
```

object that we have created are of type concrete class, so now in future if we want to make our macbook have bluetooth mouse then we cannot have its properties.

Solution:-

```
class MacBook {  
    private final Keyboard keyboard;  
    private final Mouse mouse;  
  
    public MacBook(Keyboard keyboard, Mouse mouse) {  
        this.keyboard = keyboard;  
        this.mouse = mouse;  
    }  
}
```

now objects are of interface type and now can have properties of both bluetooth and wired mouse and keyboard.

Advantages :-

- avoid duplicate code
- Easy to maintain
- Easy to understand
- Flexible software
- Reduce complexity.