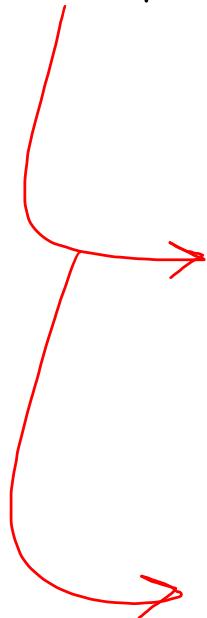


Pre - requisite



OOP's Concepts

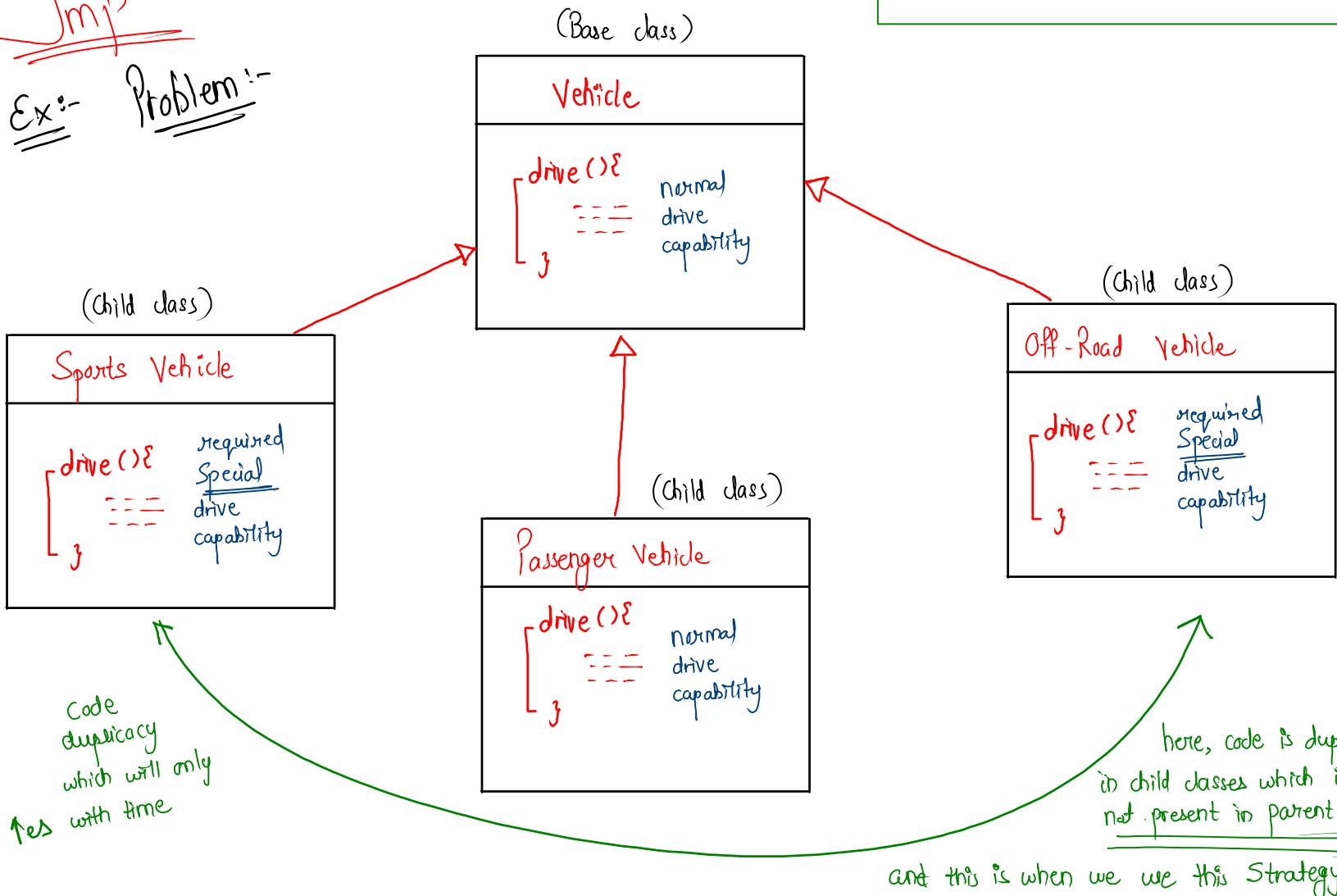
A red hand-drawn arrow pointing from the 'OOP's Concepts' text down towards the 'SOLID Principles' text.

SOLID Principles

⇒ Strategy Design Pattern

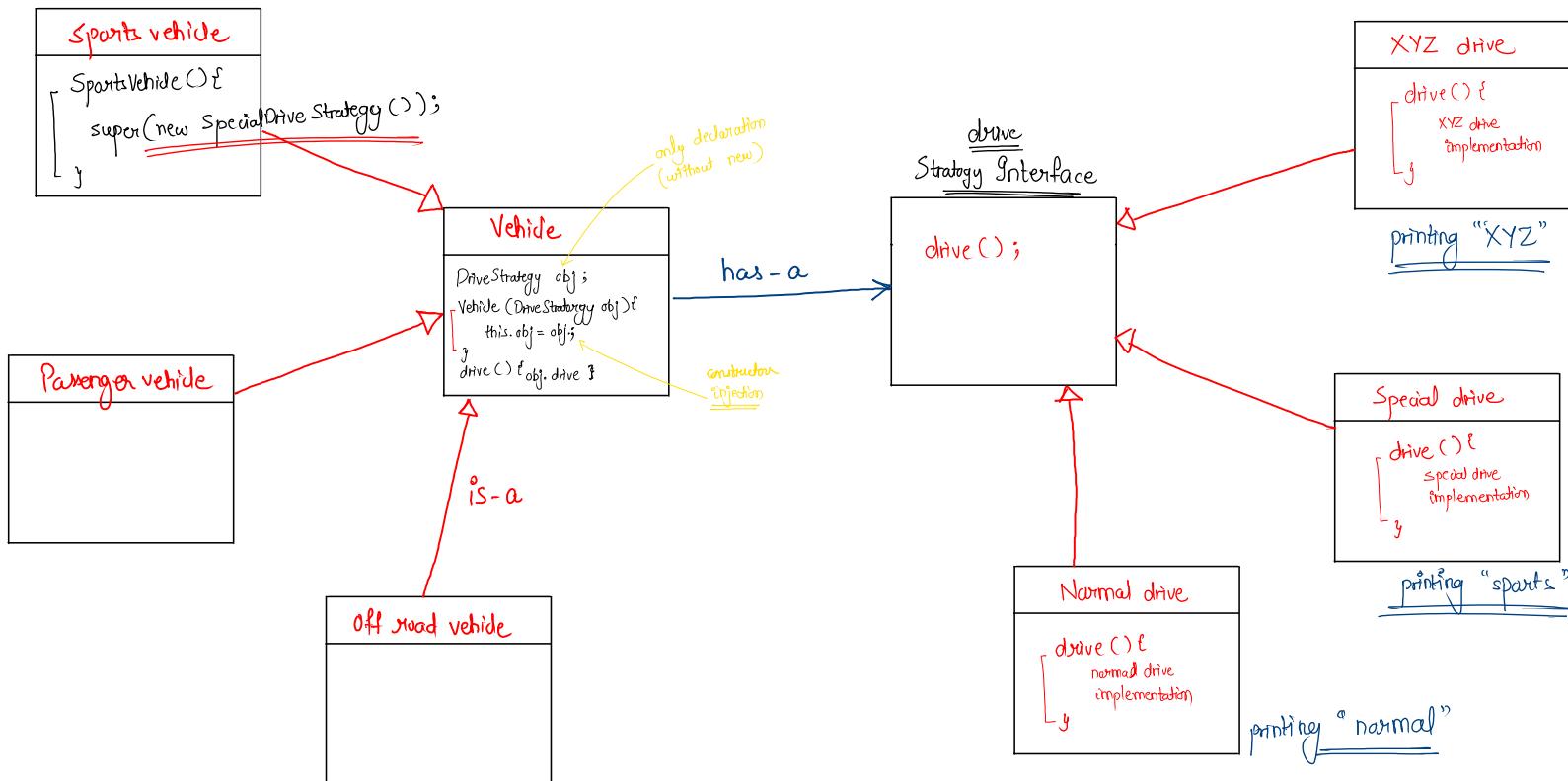
~~JMP~~

Ex:- Problem :-



Solution :-

Now we have DriveStrategy Interface, which is implementation 3 type of drive and we can use any of it while implementation Passenger, Offroad or Sports Vehicle.



Note:- We just need to pass the object (let's say **SportsVehicle**) to **Vehical** (parent class) using **super()** and it will initialize the **obj** with that type

Client code

```
public class Main {  
    public static void main(String[] args) {  
        Vehide obj = new SportsVehide();  
        obj.drive(); // print sports  
  
        Vehide obj = new NormalDrive();  
        obj.drive(); // print normal  
    }  
}
```

→ Observer Design Pattern :- (Walmart interview) question

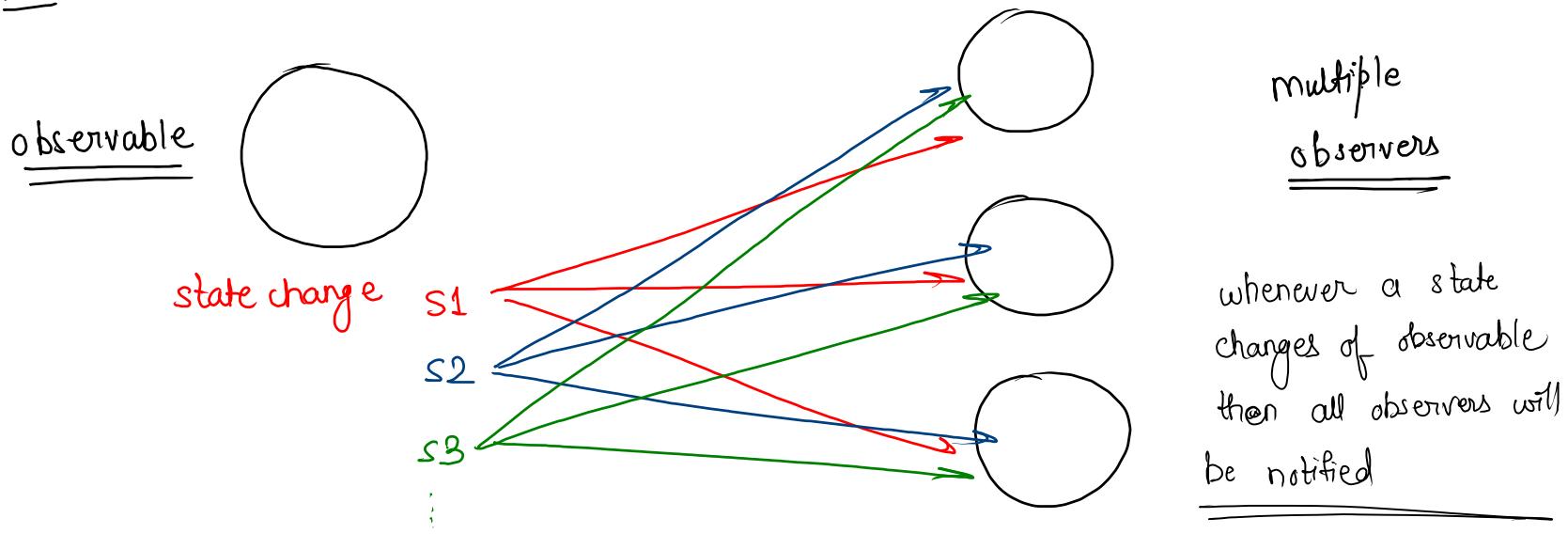
Jue)

amazon.com
product is unavailable
notify me button

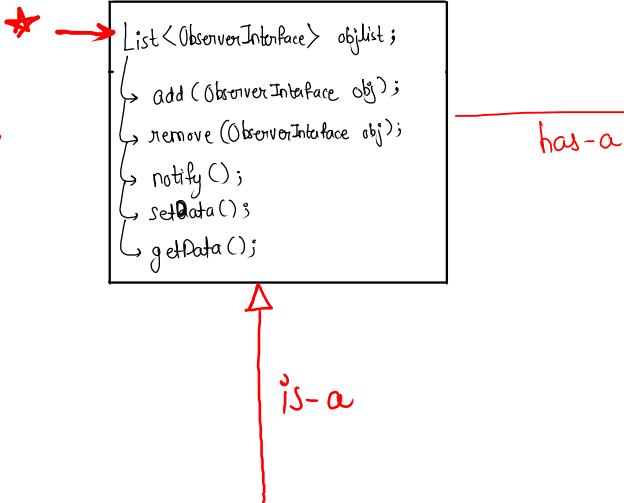
In amazon.com, we are looking for a product which is unavailable and there is a button of notify me?, so send notifications to customers when product is available.

Implement this button (LLD questions)

Note:- There are 2 states



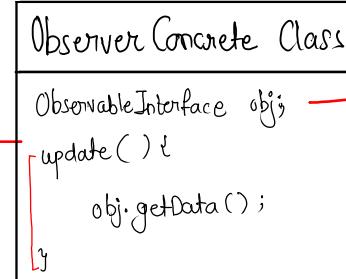
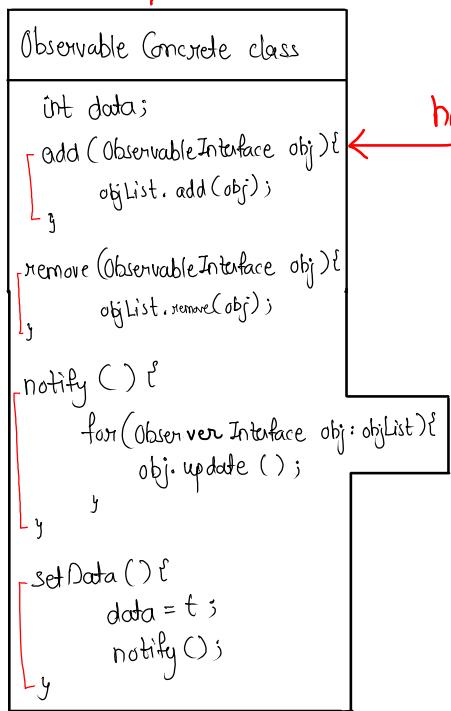
Observable Interface



Observer Interface

```
update();
```

there can
be multiple
concrete
classes



here this obj is used
to know that which
concrete class we are
referencing currently.

Note:- here task of notify() method is to
notify all the observers to call the
update method according the current
changes.

Example

A Weather station is updating current tempo every hour

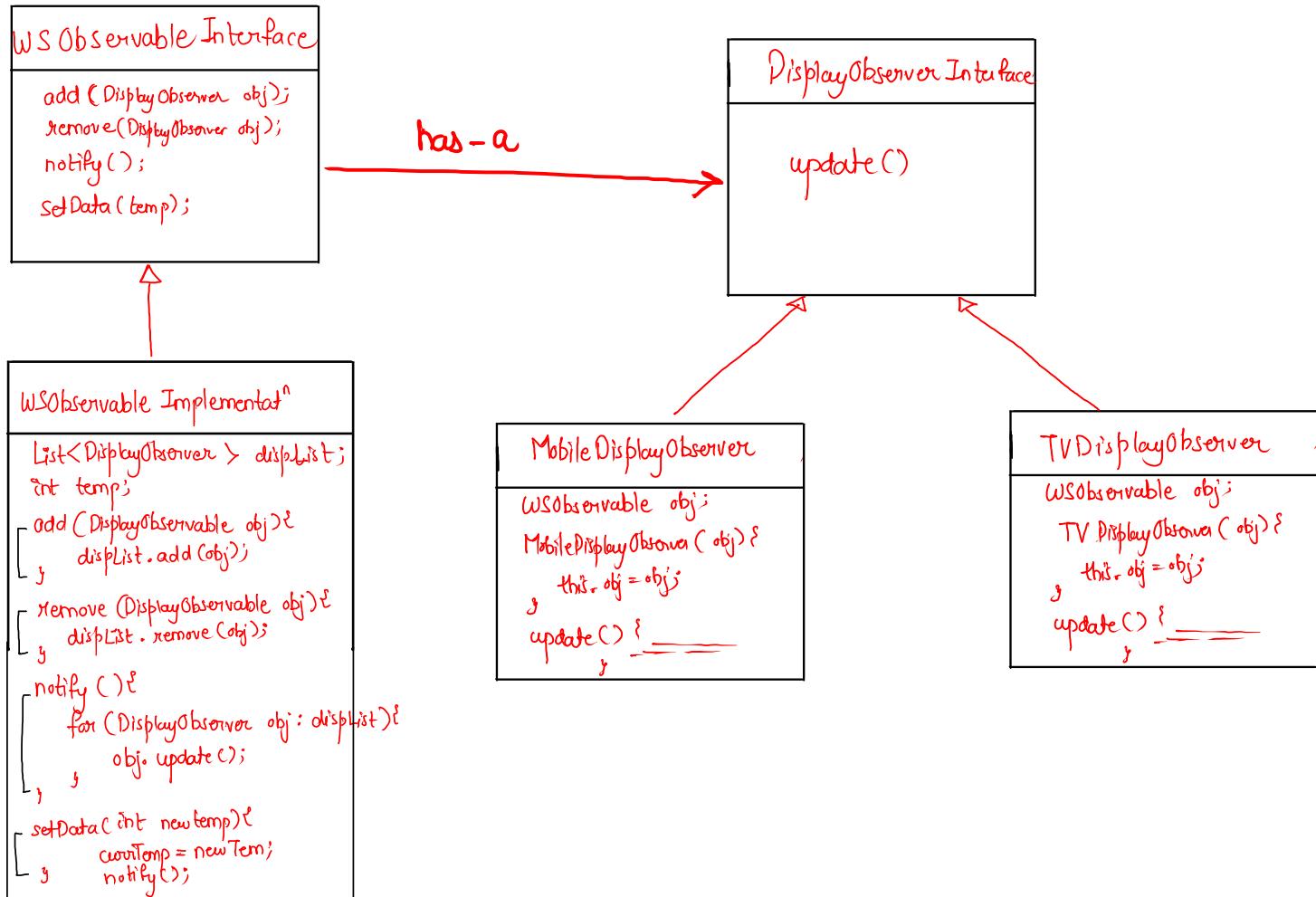
observed by

TV display observer
X

Mobile display observer

Solution

Note :- WS Observable = weather station observable



Solution of Walmart Interview Question :-

```
public interface StocksObservable {  
    public void add(NotificationAlertObserver observer);  
    public void remove(NotificationAlertObserver observer);  
    public void notifySubscribers();  
    public void setStockCount(int newStockAdded);  
    public int getStockCount();  
}
```

has-a

```
public interface NotificationAlertObserver {  
    public void update();  
}
```

```
public class IphoneObservableImpl implements StocksObservable{  
  
    public List<NotificationAlertObserver> observerList = new ArrayList<>();  
    public int stockCount = 0;  
  
    @Override  
    public void add(NotificationAlertObserver observer) { observerList.add(observer); }  
  
    @Override  
    public void remove(NotificationAlertObserver observer) { observerList.remove(observer); }  
  
    @Override  
    public void notifySubscribers() {  
        for(NotificationAlertObserver observer : observerList) {  
            observer.update();  
        }  
    }  
  
    public void setStockCount(int newStockAdded) {  
        if(stockCount == 0) {  
            notifySubscribers();  
        }  
        stockCount = stockCount + newStockAdded;  
    }  
  
    public int getStockCount() { return stockCount; }  
}
```

```
public class EmailAlertObserverImpl implements NotificationAlertObserver {  
  
    String emailId;  
    StocksObservable observable;  
  
    public EmailAlertObserverImpl(String emailId, StocksObservable observable){  
        this.observable = observable;  
        this.emailId = emailId;  
    }  
  
    @Override  
    public void update() {  
        sendMail(emailId, "product is in stock hurry up!");  
    }  
  
    private void sendMail(String emailId, String msg){  
        System.out.println("mail sent to:" + emailId);  
        //send the actual email to the end user  
    }  
}
```

```
public class MobileAlertObserverImpl implements NotificationAlertObserver{  
  
    String userName;  
    StocksObservable observable;  
  
    public MobileAlertObserverImpl(String emailId, StocksObservable observable){  
        this.observable = observable;  
        this.userName = emailId;  
    }  
  
    @Override  
    public void update() { sendMsgOnMobile(userName, "product is in stock hurry up!"); }  
  
    private void sendMsgOnMobile(String userName, String msg){  
        System.out.println("msg sent to:" + userName);  
        //send the actual email to the end user  
    }  
}
```

Note:- here, we have created a stockobservable which we are implementing using IphoneObservableImpl, and now we want to notify the update to all the required customer, for which we have 2 type :- either we can sent it through mobile phone or we can send it through email.

client code

```
public class Store {  
    public static void main(String args[]) {  
        StocksObservable iphoneStockObservable = new IphoneObservableImpl();  
  
        NotificationAlertObserver observer1 = new EmailAlertObserverImpl( emailId: "xyz1@gmail.com", iphoneStockObservable);  
        NotificationAlertObserver observer2 = new EmailAlertObserverImpl( emailId: "xyz2@gmail.com", iphoneStockObservable);  
        NotificationAlertObserver observer3 = new MobileAlertObserverImpl( emailId: "xyz_username", iphoneStockObservable);  
  
        iphoneStockObservable.add(observer1);  
        iphoneStockObservable.add(observer2);  
        iphoneStockObservable.add(observer3);  
  
        iphoneStockObservable.setStockCount(10);  
    }  
}
```

*this will notify all through email or mobile
and update stock count by +10*

Decorator Design Pattern

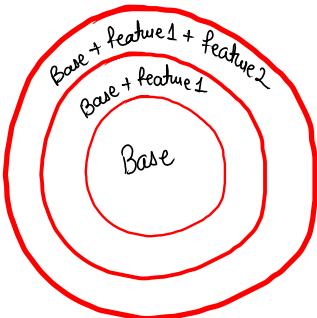
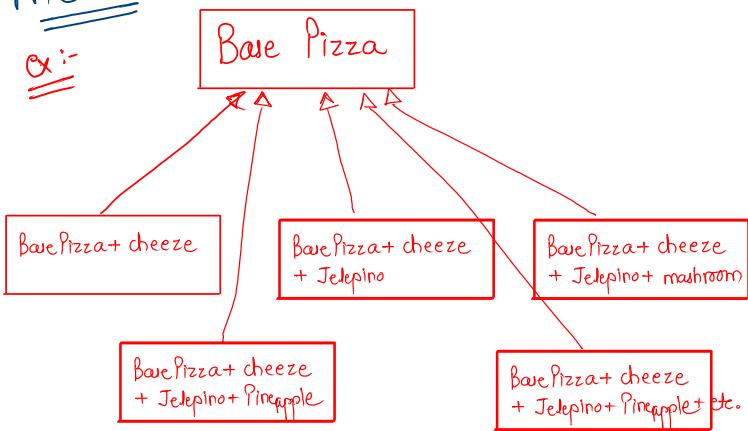
Ex:- Coffee machine design, pizza design,
etc In question

Why do we need decorator pattern?

To avoid class explosion

means:-

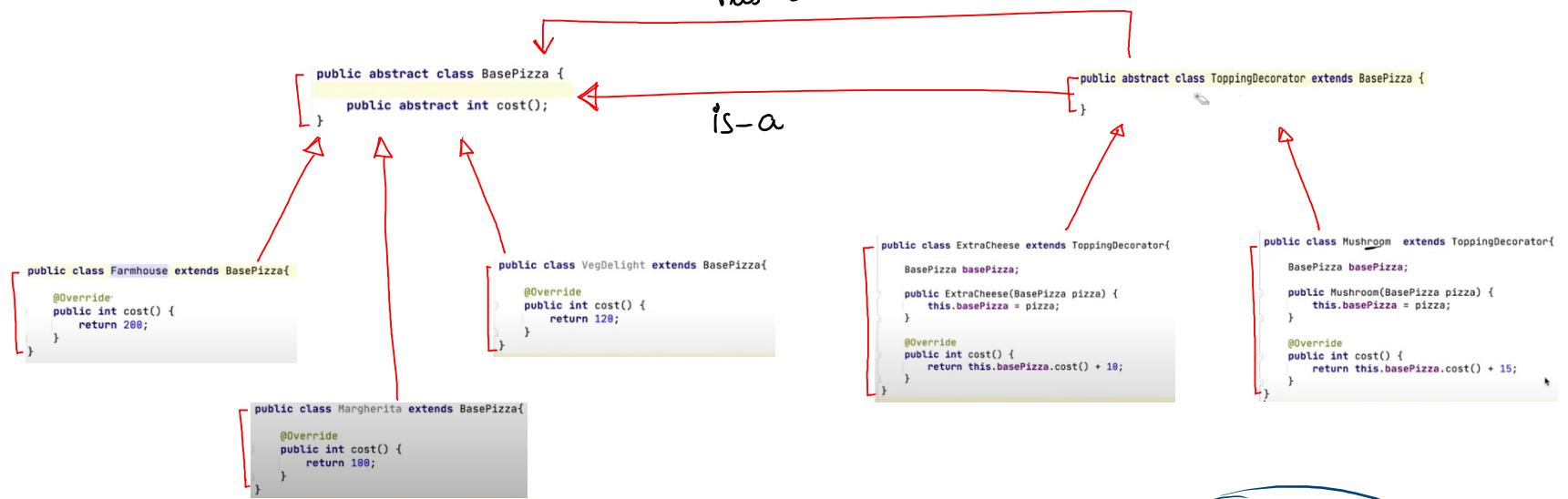
Ex:-



This is where decorator pattern comes into picture where base is same and we can keep adding features on top of it which will also work like a base for another feature to be added on top of it.

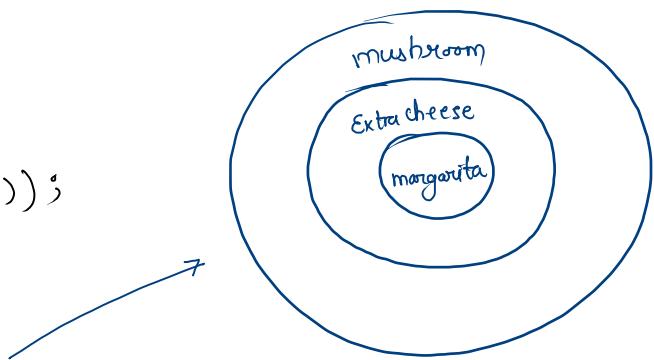
Like, that how many different classes are we going to make with different combination, so it will be very difficult to manage.

→ famous example (Note:- a decorator is both is-a & has-a which is why it able to create many layers of objects)



Client code

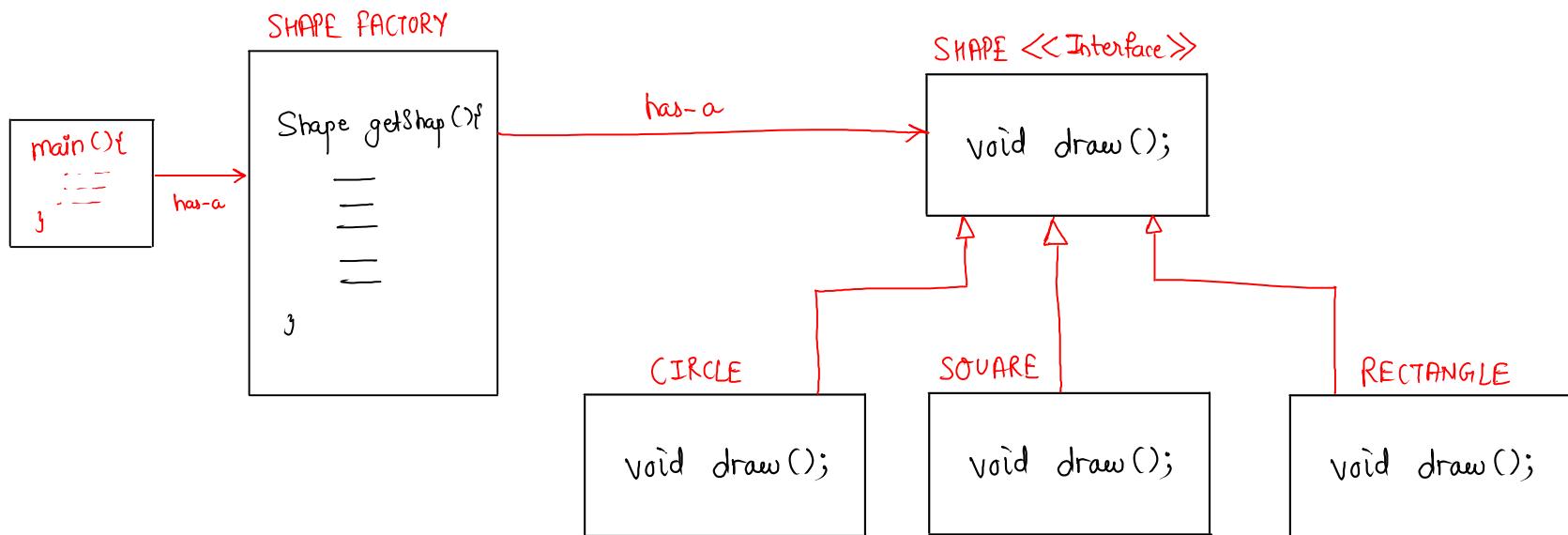
↳ Pizza pizza = new ExtraCheese(new Margarita());
 pizza.cost() // $100 + 10 = 110$



↳ Pizza pizza = new Mushroom(new ExtraCheese(new Margarita()))); // 3 decorators
 pizza.cost() // $100 + 10 + 15 = 125$

⇒ Factory Pattern ~~V. gmp~~

↳ factory pattern provides an interface for creating objects in a superclass while allowing subclass to specify the type of object they create.



Example code

```
public class MainClass {  
    public static void main(String args[]) {  
        ShapeFactory shapeFactoryObj = new ShapeFactory();  
        Shape shapeObj = shapeFactoryObj.getShape( input: "CIRCLE" );  
        shapeObj.draw();  
    }  
}
```



```
public class ShapeFactory {  
    Shape getShape(String input) {  
        switch (input) {  
            case "CIRCLE":  
                return new Circle();  
            case "RECTANGLE":  
                return new Rectangle();  
            default:  
                return null;  
        }  
    }  
}
```

```
public interface Shape {  
    void draw();  
}
```

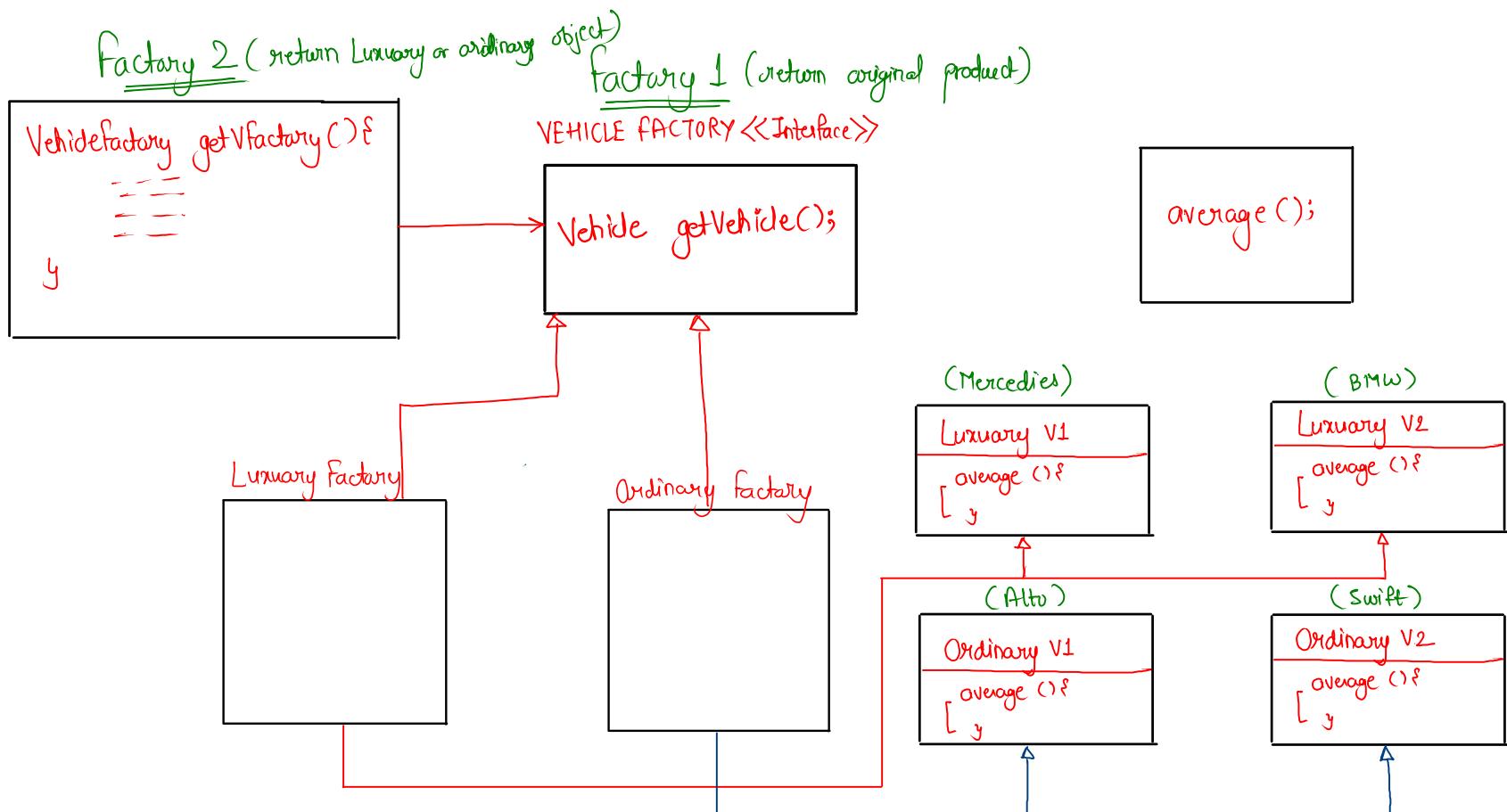
```
public class Rectangle implements Shape{  
    @Override  
    public void draw() {  
        System.out.println("rectangle");  
    }  
}
```

```
public class Circle implements Shape{  
    @Override  
    public void draw() {  
        System.out.println("circle");  
    }  
}
```

Note:- we might need to create same object in many places in some cond,
in that scenario to avoid duplicacy we use factory design pattern

\Rightarrow Abstract Factory Pattern :- (It's a factory of factory)

↳ we can use this pattern, when we have many different patterns and we can group them separately.



Ques Design Tic-Tac-Toe Game

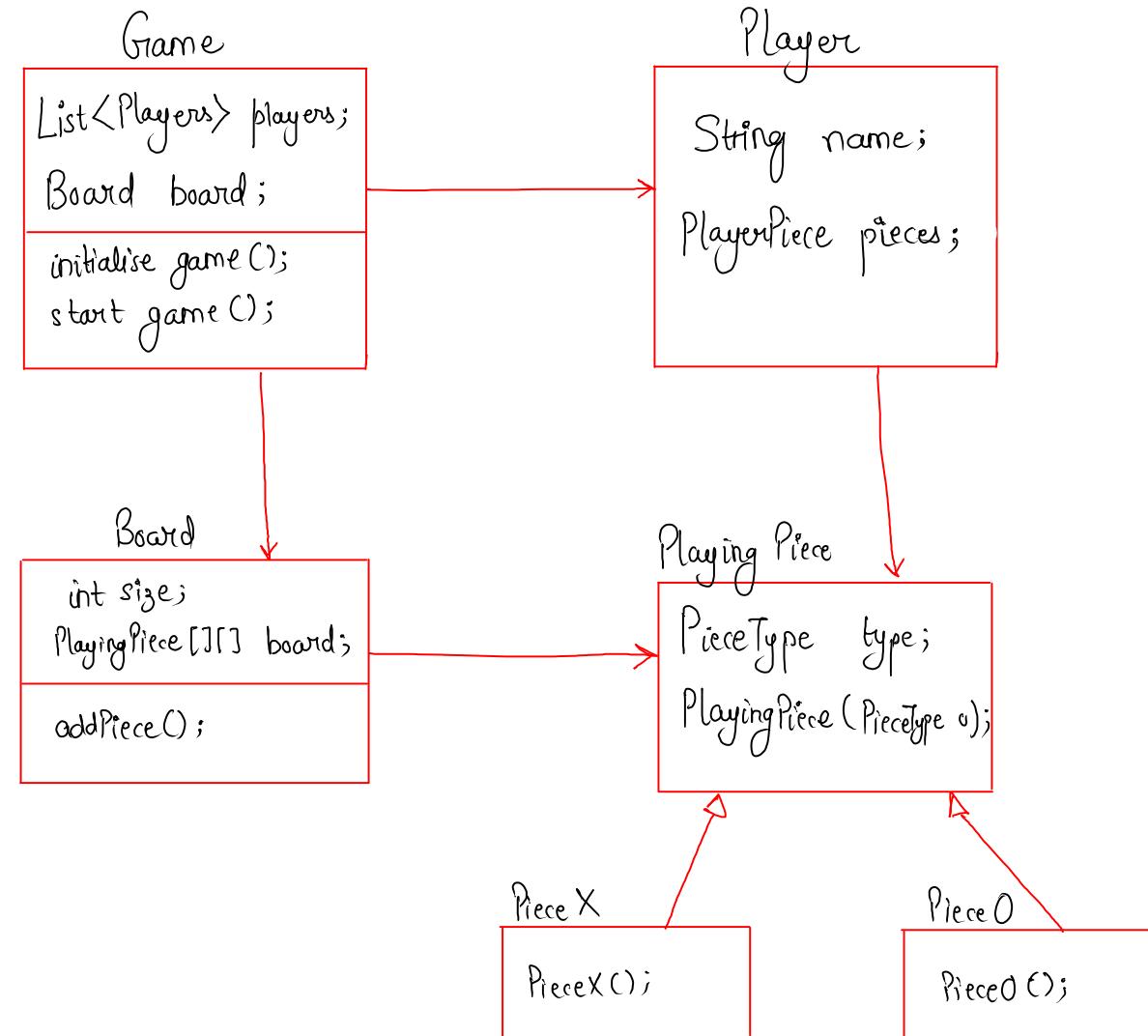
UML Diagram :-

enum PieceType {

X,

O;

y



~~Complete code~~

Game

```
public class Board {  
    public int size;  
    public PlayingPiece[][] board;  
  
    public Board(int size) {  
        this.size = size;  
        board = new PlayingPiece[size][size];  
    }  
  
    public boolean addPiece(int row, int column, PlayingPiece playingPiece) {  
  
        if(board[row][column] != null) {  
            return false;  
        }  
        board[row][column] = playingPiece;  
        return true;  
    }  
  
    public List<Pair<Integer, Integer>> getFreeCells() {  
        List<Pair<Integer, Integer>> freeCells = new ArrayList<>();  
  
        for (int i = 0; i < size; i++) {  
            for (int j = 0; j < size; j++) {  
                if (board[i][j] == null) {  
                    Pair<Integer, Integer> rowColumn = new Pair<>(i, j);  
                    freeCells.add(rowColumn);  
                }  
            }  
        }  
  
        return freeCells;  
    }  
    public void printBoard() {  
  
        for (int i = 0; i < size; i++) {  
            for (int j = 0; j < size; j++) {  
                if (board[i][j] != null) {  
                    System.out.print(board[i][j].pieceType.name() + " ");  
                } else {  
                    System.out.print("   ");  
                }  
            }  
            System.out.print(" | ");  
        }  
        System.out.println();  
    }  
}
```

```
public class Player {  
  
    public String name;  
    public PlayingPiece playingPiece;  
  
    public Player(String name, PlayingPiece playingPiece) {  
        this.name = name;  
        this.playingPiece = playingPiece;  
    }  
  
    public String getName() {  
        return name;  
    }  
  
    public void setName(String name) {  
        this.name = name;  
    }  
  
    public PlayingPiece getPlayingPiece() {  
        return playingPiece;  
    }  
  
    public void setPlayingPiece(PlayingPiece playingPiece) {  
        this.playingPiece = playingPiece;  
    }  
}
```

```
public class PlayingPiece {  
  
    public PieceType pieceType;  
  
    PlayingPiece(PieceType pieceType) {  
        this.pieceType = pieceType;  
    }  
}
```

```
public enum PieceType {  
    X,  
    O;  
}
```

```
public class PlayingPieceO extends PlayingPiece {  
  
    public PlayingPieceO() {  
        super(PieceType.O);  
    }  
}
```

```
public class PlayingPieceX extends PlayingPiece {  
  
    public PlayingPieceX() {  
        super(PieceType.X);  
    }  
}
```

Game :-

```

public class TicTactoeGame {

    Deque<Player> players;
    Board gameBoard;

    public void initializeGame(){
        //creating 2 Players
        players = new LinkedList<>();
        PlayingPieceX crossPiece = new PlayingPieceX();
        Player player1 = new Player("Player1", crossPiece);

        PlayingPieceO noughtsPiece = new PlayingPieceO();
        Player player2 = new Player("Player2", noughtsPiece);

        players.add(player1);
        players.add(player2);

        //initializeBoard
        gameBoard = new Board(3);
    }

    public String startGame(){
        boolean noWinner = true;
        while(noWinner){

            //take out the player whose turn is and also put the player in the list back
            Player playerTurn = players.removeFirst();

            //get the free space from the board
            gameBoard.printBoard();
            List<Pair<Integer, Integer>> freeSpaces = gameBoard.getFreeCells();
            if(freeSpaces.isEmpty()){
                noWinner = false;
                continue;
            }

            //read the user input
            System.out.print("Player:" + playerTurn.name + " Enter row,column: ");
            Scanner inputScanner = new Scanner(System.in);
            String s = inputScanner.nextLine();
            String[] values = s.split(",");
            int inputRow = Integer.valueOf(values[0]);
            int inputColumn = Integer.valueOf(values[1]);

            //place the piece
            boolean placedAddedSuccessfully = gameBoard.addPiece(inputRow, inputColumn, playerTurn.playingPiece);
            if(!placedAddedSuccessfully){
                //player can not insert the piece into this cell, player has to choose another cell
                System.out.println("Incorect position chosen, try again");
                players.addFirst(playerTurn);
                continue;
            }
            players.addLast(playerTurn);

            boolean winner = isThereAWinner(inputRow, inputColumn, playerTurn.playingPiece.pieceType);
            if(winner){
                return playerTurn.name;
            }
        }
        return "tie";
    }

    public boolean isThereAWinner(int row, int column, PieceType pieceType) {
        boolean rowMatch = true;
        boolean columnMatch = true;
        boolean diagonalMatch = true;
        boolean antiDiagonalMatch = true;

        //need to check in row
        for(int i=0;i<gameBoard.size();i++){
            if(gameBoard.board[row][i] == null || gameBoard.board[row][i].pieceType != pieceType){
                rowMatch = false;
            }
        }

        //need to check in column
        for(int i=0;i<gameBoard.size();i++) {
            if(gameBoard.board[i][column] == null || gameBoard.board[i][column].pieceType != pieceType) {
                columnMatch = false;
            }
        }

        //need to check diagonals
        for(int i=0, j=0; i<gameBoard.size();i++,j++){
            if(gameBoard.board[i][j] == null || gameBoard.board[i][j].pieceType != pieceType) {
                diagonalMatch = false;
            }
        }

        //need to check anti-diagonals
        for(int i=0, j=gameBoard.size()-1; i<gameBoard.size();i++,j--){
            if(gameBoard.board[i][j] == null || gameBoard.board[i][j].pieceType != pieceType) {
                antiDiagonalMatch = false;
            }
        }

        return rowMatch || columnMatch || diagonalMatch || antiDiagonalMatch;
    }
}

```

Client Code

main

```

public class Main {

    public static void main(String args[]) {
        TicTacToeGame game = new TicTacToeGame();
        game.initializeGame();
        System.out.println("game winner is: " + game.startGame());
    }
}

```

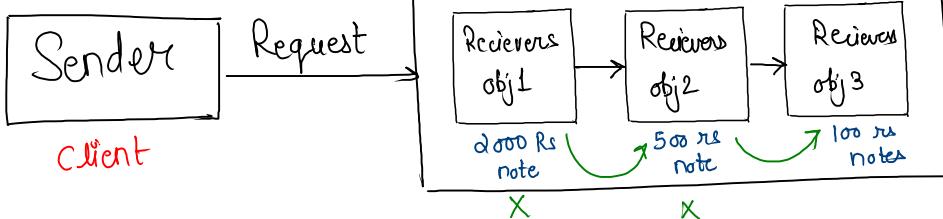
⇒ Chain of responsibility Design Pattern

~~Application usage :-~~

- ATM / Vending machine
- Design logger (Amazon)

structure

Ex:- you (withdraw 2000)

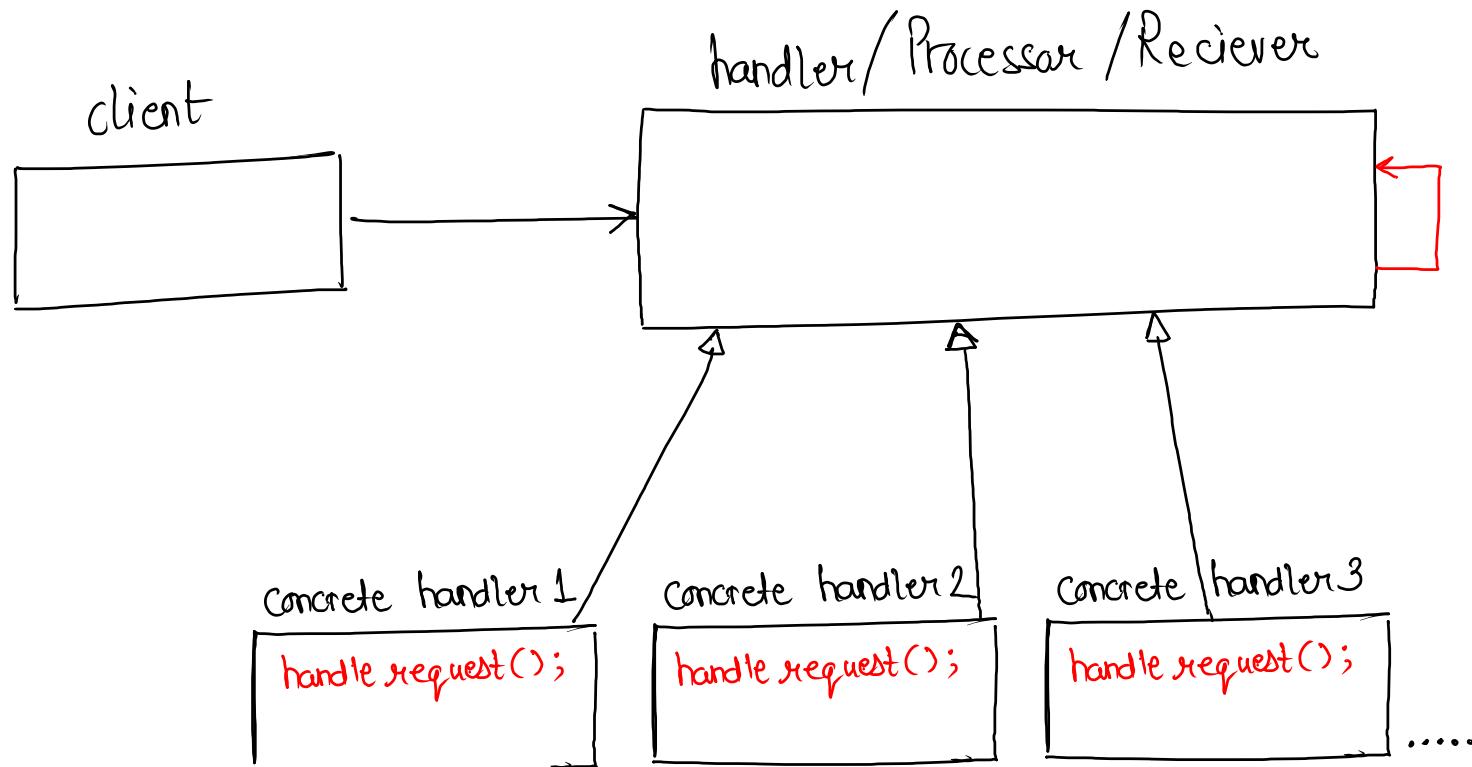


Note:- This type of design is used when we client sends a request and it doesn't matter that who is completing that request

Ex:-

in example, we want to withdraw 2000, so we send a request and if obj1 doesn't have enough amount then it sends the request for remaining amount to next object. and if total amount is not enough then return insufficient amount.

Structure



One Design logger

```
Logger obj = new Logger();
```

```
obj.log(Info, "msg");  
obj.log(Debug, "msg");  
obj.log(Error, "msg");
```

Code

```
public class Main {  
    public static void main(String args[]) {  
        LogProcessor logObject = new InfoLogProcessor(new DebugLogProcessor(new ErrorLogProcessor(nextLogProcessor: null)));  
  
        logObject.log(LogProcessor.ERROR, message: "exception happens");  
        logObject.log(LogProcessor.DEBUG, message: "need to debug this ");  
        logObject.log(LogProcessor.INFO, message: "just for info ");  
    }  
}
```

if info then print , else check next obj Debug and then
error and lastly null

here this chaining is imp

```
public abstract class LogProcessor {  
    public static int INFO = 1;  
    public static int DEBUG = 2;  
    public static int ERROR = 3;  
  
    LogProcessor nextLoggerProcessor;  
  
    LogProcessor(LogProcessor loggerProcessor) {  
        this.nextLoggerProcessor = loggerProcessor;  
    }  
  
    public void log(int logLevel, String message) {  
        if (nextLoggerProcessor != null) {  
            nextLoggerProcessor.log(logLevel, message);  
        }  
    }  
}
```

here constructor is already storing
next logger processor

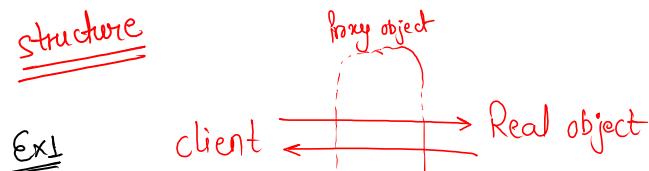
```
public class InfoLogProcessor extends LogProcessor{  
    InfoLogProcessor(LogProcessor nexLogProcessor){  
        super(nexLogProcessor);  
    }  
  
    public void log(int logLevel, String message){  
        if(logLevel == INFO) {  
            System.out.println("INFO: " + message);  
        } else{  
            super.log(logLevel, message);  
        }  
    }  
}
```

```
public class ErrorLogProcessor extends LogProcessor{  
    ErrorLogProcessor(LogProcessor nexLogProcessor) { super(nexLogProcessor); }  
  
    public void log(int logLevel, String message){  
        if(logLevel == ERROR) {  
            System.out.println("ERROR: " + message);  
        } else{  
            super.log(logLevel, message);  
        }  
    }  
}
```

```
public class DebugLogProcessor extends LogProcessor{  
    DebugLogProcessor(LogProcessor nexLogProcessor) { super(nexLogProcessor); }  
  
    public void log(int logLevel, String message){  
        if(logLevel == DEBUG) {  
            System.out.println("DEBUG: " + message);  
        } else{  
            super.log(logLevel, message);  
        }  
    }  
}
```

⇒ Proxy Design Pattern (very commonly used)

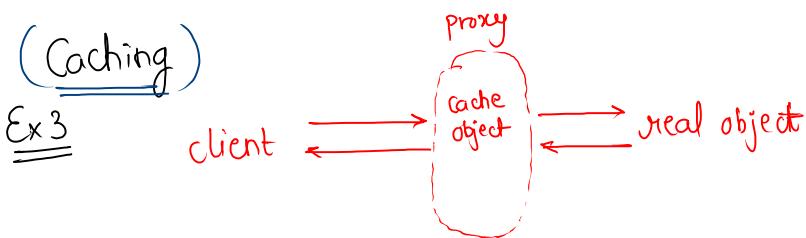
structure



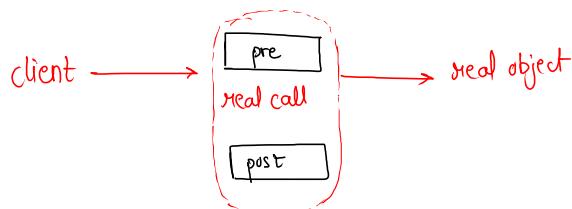
(Internet Restriction)



(Caching)



(Preprocessing & postprocessing)



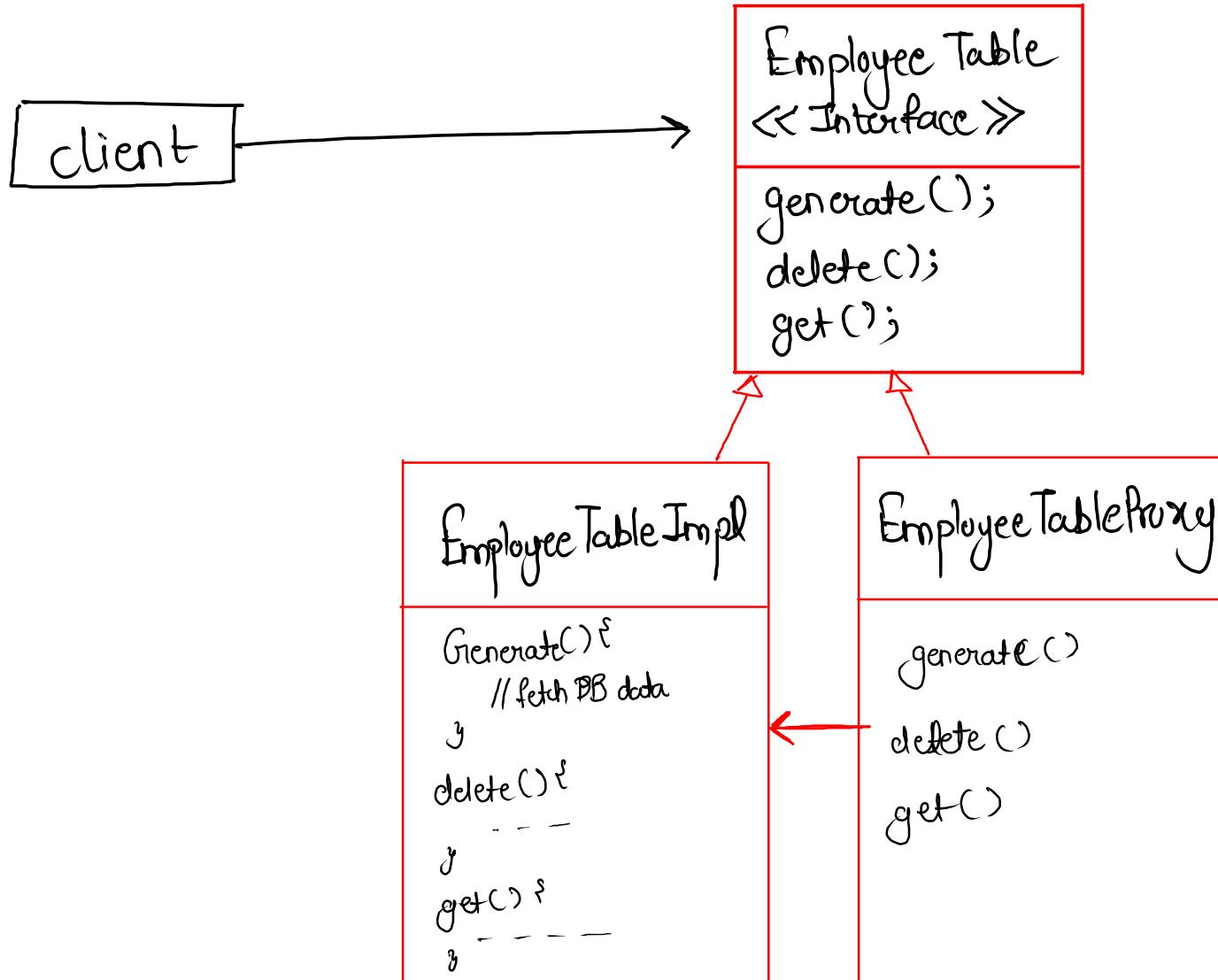
If a client wants to access the real object then proxy object is always inbetween and access the request before approving it.

here, when a user wants to access the internet, it passes through proxy which has a blocklist that which servers are blocked.

Caching is another example of proxy design pattern, because here as well we first have a proxy in b/w client & real object to check does cache already have the result.

If we want to perform any task before or after the calling is being done.

structure



Code

```
public class ProxyDesignPattern {  
    public static void main(String args[]) {  
        try {  
            EmployeeDao empTableObj = new EmployeeDaoProxy();  
            empTableObj.create("USER", new EmployeeDo());  
            System.out.println("Operation successful");  
        } catch (Exception e) {  
            System.out.println(e.getMessage());  
        }  
    }  
}
```

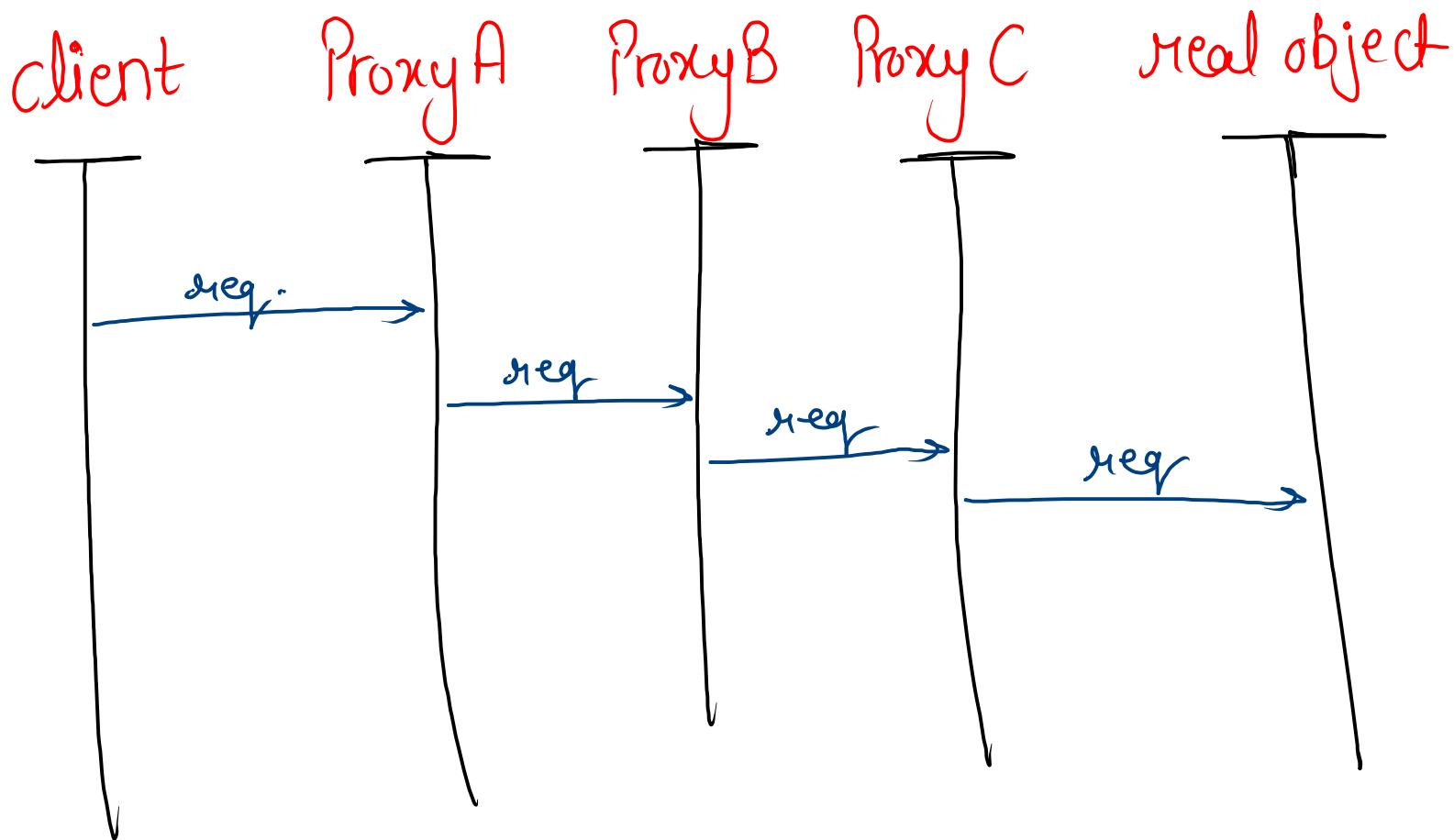
```
public interface EmployeeDao {  
    public void create(String client, EmployeeDo obj) throws Exception;  
    public void delete(String client, int employeeId) throws Exception;  
    public EmployeeDo get(String client, int employeeId) throws Exception;  
}
```

```
public class EmployeeDaoImpl implements EmployeeDao {  
    @Override  
    public void create(String client, EmployeeDo obj) throws Exception {  
        //creates a new Row  
        System.out.println("created new row in the Employee table");  
    }  
    @Override  
    public void delete(String client, int employeeId) throws Exception {  
        //delete a Row  
        System.out.println("deleted row with employeeID:" + employeeId);  
    }  
    @Override  
    public EmployeeDo get(String client, int employeeId) throws Exception {  
        //fetch row  
        System.out.println("fetching data from the DB");  
        return new EmployeeDo();  
    }  
}
```

Gmp

```
public class EmployeeDaoProxy implements EmployeeDao {  
    EmployeeDao employeeDaoObj;  
    EmployeeDaoProxy() {  
        employeeDaoObj = new EmployeeDaoImpl();  
    }  
    @Override  
    public void create(String client, EmployeeDo obj) throws Exception {  
        if(client.equals("ADMIN")) {  
            employeeDaoObj.create(client, obj);  
            return;  
        }  
        throw new Exception("Access Denied");  
    }  
    @Override  
    public void delete(String client, int employeeId) throws Exception {  
        if(client.equals("ADMIN")) {  
            employeeDaoObj.delete(client, employeeId);  
            return;  
        }  
        throw new Exception("Access Denied");  
    }  
    @Override  
    public EmployeeDo get(String client, int employeeId) throws Exception {  
        if(client.equals("ADMIN") || client.equals("USER")) {  
            return employeeDaoObj.get(client, employeeId);  
        }  
    }  
}
```

Note :- We can have as many Proxy as we want
and proxyA will treat proxyB as a real object



⇒ LLD of handling NULL (null object design pattern)

Problem :- what will happen when vehicle obj. appear as null.

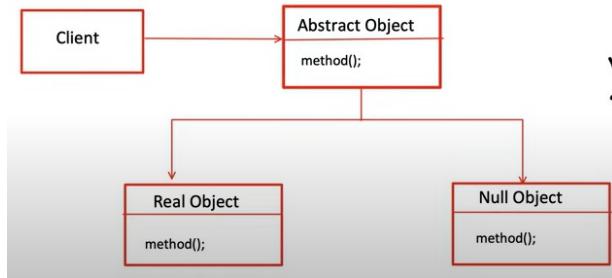
```
private static void printVehicleDetails(Vehicle vehicle){  
    System.out.println("Seating Capacity: " + vehicle.getSeatingCapacity());  
    System.out.println("Fuel Tank Capacity: " + vehicle.getTankCapacity());  
}
```

Solution :- But we can't put this check in every single place.

```
private static void printVehicleDetails(Vehicle vehicle) {  
    if (vehicle != null) {  
        System.out.println("Seating Capacity: " + vehicle.getSeatingCapacity());  
        System.out.println("Fuel Tank Capacity: " + vehicle.getTankCapacity());  
    }  
}
```

- Null object design pattern
 - A null object replaces null return type
 - no need to put if check for checking null everytime.
 - null object reflects do nothing or default behaviour.

⇒ UML diagram



client code

```

public class Main {
    public static void main(String args[]){
        Vehicle vehicle = VehicleFactory.getVehicleObject( typeOfVehicle: "Car");
        printVehicleDetails(vehicle);
    }
    private static void printVehicleDetails(Vehicle vehicle) {
        System.out.println("Seating Capacity: " + vehicle.getSeatingCapacity());
        System.out.println("Fuel Tank Capacity: " + vehicle.getTankCapacity());
    }
}
  
```

Note:- now we are returning a null object which are reflecting a default behaviour instead of giving error back.

```

public interface Vehicle {
    int getTankCapacity();
    int getSeatingCapacity();
}

public class VehicleFactory {
    static Vehicle getVehicleObject(String typeOfVehicle){
        if("Car".equals(typeOfVehicle)) {
            return new Car();
        }
        return new NullVehicle();
    }
}
  
```

simple factory design

```

public class Car implements Vehicle{
    @Override
    public int getTankCapacity() { return 40; }

    @Override
    public int getSeatingCapacity() { return 5; }
}
  
```

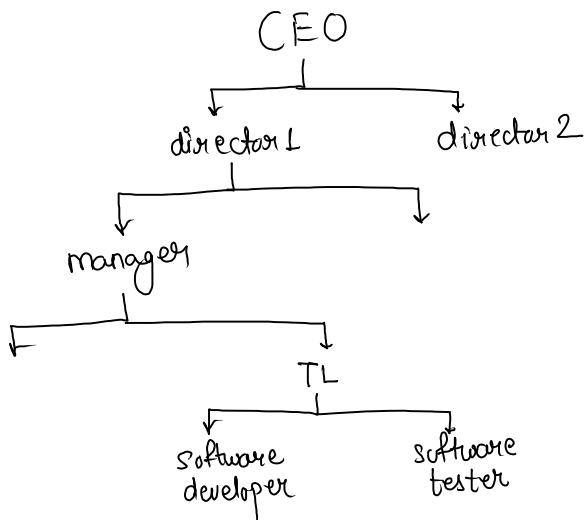
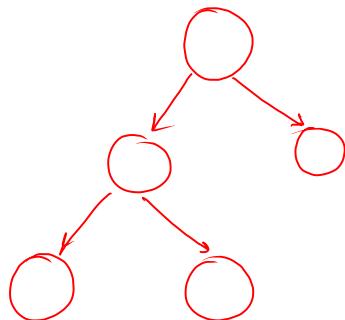
```

public class NullVehicle implements Vehicle{
    @Override
    public int getTankCapacity() { return 0; }

    @Override
    public int getSeatingCapacity() { return 0; }
}
  
```

→ Composite design pattern (Object inside object)

for ex:- a tree structure



(a tree structure)

Ques we want to create file system

file class

```
public class File {  
    String fileName;  
  
    public File(String name) { this.fileName = name; }  
  
    public void ls(){  
        System.out.println("file name " + fileName);  
    }  
}
```

problem:- here we have to create many instance of writing if-else, and better way is to use Composite design pattern.

directory class

```
public class Directory {  
    String directoryName;  
    List<Object> objectList;  
  
    public Directory(String name){  
        this.directoryName = name;  
        objectList = new ArrayList<>();  
    }  
  
    public void add(Object object) { objectList.add(object); }  
  
    public void ls(){  
        System.out.println("Directory Name: " + directoryName);  
        for(Object obj: objectList) {  
  
            if(obj instanceof File) {  
                ((File) obj).ls();  
            }  
            else if(obj instanceof Directory) {  
                ((Directory) obj).ls();  
            }  
        }  
    }  
}
```

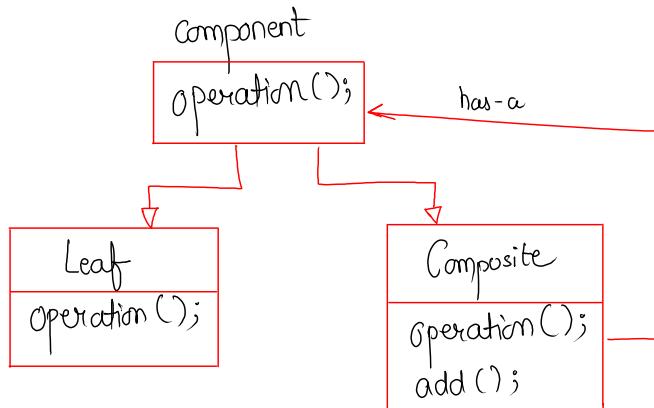
file or directory

file or directory

file or directory

UML diagram

leaf node
of tree



Composite object is which
is containing object of itself

client code

```

public class Main {
    public static void main(String args[]){
        Directory movieDirectory = new Directory( name: "Movie");
        FileSystem border = new File( name: "Border");
        movieDirectory.add(border);

        Directory comedyMovieDirectory = new Directory( name: "ComedyMovie");
        File hulchul = new File( name: "Hulchul");
        comedyMovieDirectory.add(hulchul);
        movieDirectory.add(comedyMovieDirectory);

        movieDirectory.ls();
    }
}
  
```

Interface

```

public interface FileSystem {
    public void ls();
}
  
```

```

public class File implements FileSystem{
    String fileName;

    public File(String name) { this.fileName = name; }

    public void ls(){
        System.out.println("file name " + fileName);
    }
}
  
```

```

public class Directory implements FileSystem {
    String directoryName;
    List<FileSystem> fileSystemList;

    public Directory(String name){
        this.directoryName = name;
        fileSystemList = new ArrayList<>();
    }

    public void add(FileSystem fileSystemObj) { fileSystemList.add(fileSystemObj); }

    public void ls(){
        System.out.println("Directory name " + directoryName);
        for(FileSystem fileSystemObj : fileSystemList){
            fileSystemObj.ls();
        }
    }
}
  
```

file system list

now we don't need to
check if-else cond here,
because `ls()` function is present in the interface itself