Design Defects and Restructuring

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Strategy / Policy Pattern

What is Decorator pattern?

Decorator is one of the 23 Design Patterns which were selected by the GoF (Gang of Four).

		Purpose		
		Creation	Structure	Behavior
Scope	Class	Factory Method		Interpreter Template
	Objects	Abstract Factory Builder Prototype Singleton	Adapter Bridge Composite Decorator Façade Flyweight Proxy	Chain of Responsibility Command Iterator Mediator Memento Observer State Strategy ⬅ Visitor

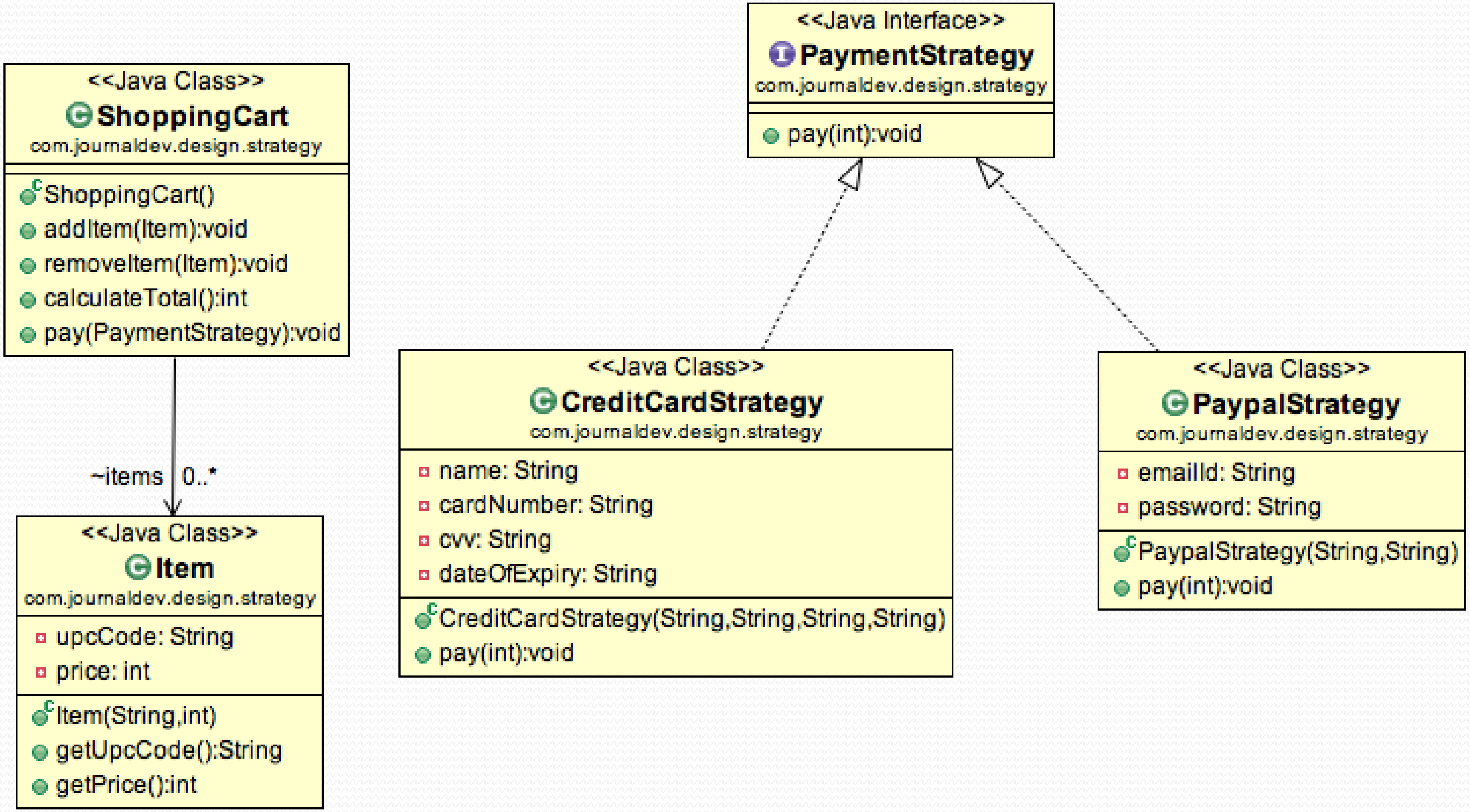
Strategy Pattern

- Strategy design pattern is **behavioral design pattern**.
- Used when we have multiple algorithm for a specific task and client decides the actual implementation to be used at runtime.
- Also known as **Policy Pattern**.
- We define multiple algorithms and let client application pass algorithm to be used as a parameter.
- Example : Collections.sort() method that takes Comparator parameter. Based on the different implementations of Comparator interfaces, the Objects are getting sorted in different ways.

```
public void sort(ArrayList<String> list, Comparator<String> comp) {
            Collections.sort(list);
            Collections.sort(list,Comparator.reverseOrder());
            Collections.sort(list,comp);
 }
```

Ex. 1: Strategy Pattern

- For our example, we will try to implement a simple Shopping Cart where we have two payment strategies – using Credit Card or using PayPal.



Ex. 1: Strategy Pattern

- Step 1: create the interface for strategy pattern

```
public interface PaymentStrategy {
        public void pay(int amount);
}
```

- Step 2: create concrete implementation of algorithms for payment using credit/debit card or through paypal.

```
public class CreditCardStrategy implements PaymentStrategy {
private String name;
private String cardNumber;
private String cvv;
private String dateOfExpiry;
public CreditCardStrategy(String nm,String ccNum,String cvv,String expDate){
    this.name=nm;
    this.cardNumber=ccNum;
    this.cvv=cvv;
    this.dateOfExpiry=expDate;
}
@Override
public void pay(int amount) {
    System.out.println(amount +" paid with credit/debit card");
}
}
```

Ex. 1: Strategy Pattern

- Step 3: create concrete implementation of algorithms for payment using paypal.

```
public class PaypalStrategy implements PaymentStrategy {
    private String emailId;
    private String password;
    public PaypalStrategy(String email, String pwd){
        this.emailId=email;
        this.password=pwd;
    }
    @Override
    public void pay(int amount) {
        System.out.println(amount + " paid using Paypal.");
    }
}
```

Ex. 1: Strategy Pattern

- Step 4: create **item** class

```
public class Item {
    private String upcCode;
    private int price;
    public Item(String upc, int cost){
        this.upcCode=upc;
        this.price=cost;
    }
    public String getUpcCode() {
        return upcCode;
    }
    public int getPrice() {
        return price;
    }
}
```

Ex. 1: Strategy Pattern

Step 5: create ShoppingCart class

```
import java.util.ArrayList;
import java.util.List;
public class ShoppingCart {
List<Item> items;
public ShoppingCart(){
    this.items=new ArrayList<Item>();
}
public void addItem(Item item){
    this.items.add(item);
}
public void removeItem(Item item){
    this.items.remove(item);
}
public int calculateTotal(){
    int sum = 0;
    for(Item item : items){
    sum += item.getPrice();
    }
    return sum;
}
public void pay(PaymentStrategy paymentMethod){
    int amount = calculateTotal();
    paymentMethod.pay(amount);
}
}
```

Ex. 1: Strategy Pattern

- Step 6:

```
public class ShoppingCartTest {
public static void main(String[] args) {
ShoppingCart cart = new ShoppingCart();
Item item1 = new Item("Timato Catchup",100);
Item item2 = new Item("7up",40);
cart.addItem(item1);
cart.addItem(item2);
//pay by paypal
cart.pay(new PaypalStrategy("myemail@example.com", "mypwd"));
//pay by credit card
cart.pay(new CreditCardStrategy("Salman Lakhani",
"1234567890123456", "786", "12/15"));
}
}
```

- Output:

```
140 paid using Paypal.
140 paid with credit/debit card
```

Strategy

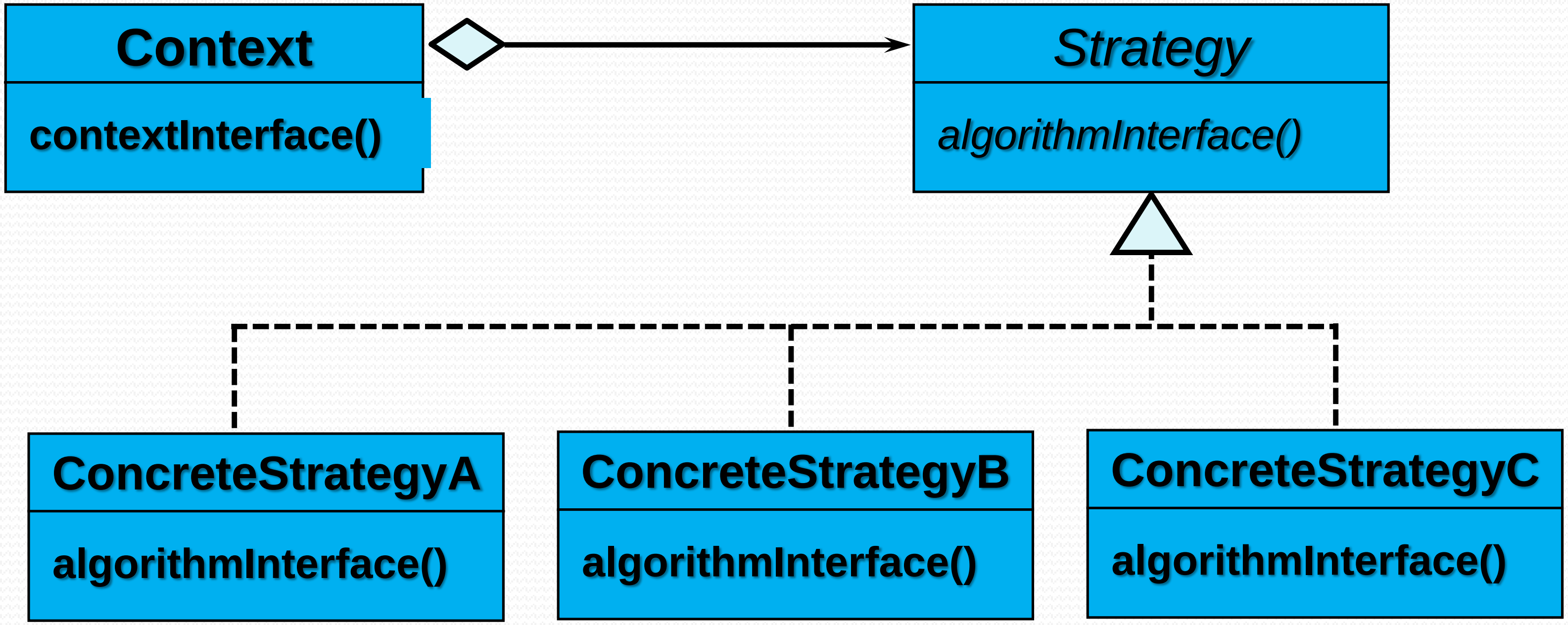
In a Strategy design pattern, you will:

- Define a family of algorithms
- Encapsulate each one
- Make them interchangeable

You should use Strategy when:

- You have code with a lot of algorithms
- You want to use these algorithms at different times
- You have algorithm(s) that use data the client should not know about

Strategy Class Diagram



Context

contextInterface()

Strategy

algorithmInterface()

ConcreteStrategyA

algorithmInterface()

ConcreteStrategyB

algorithmInterface()

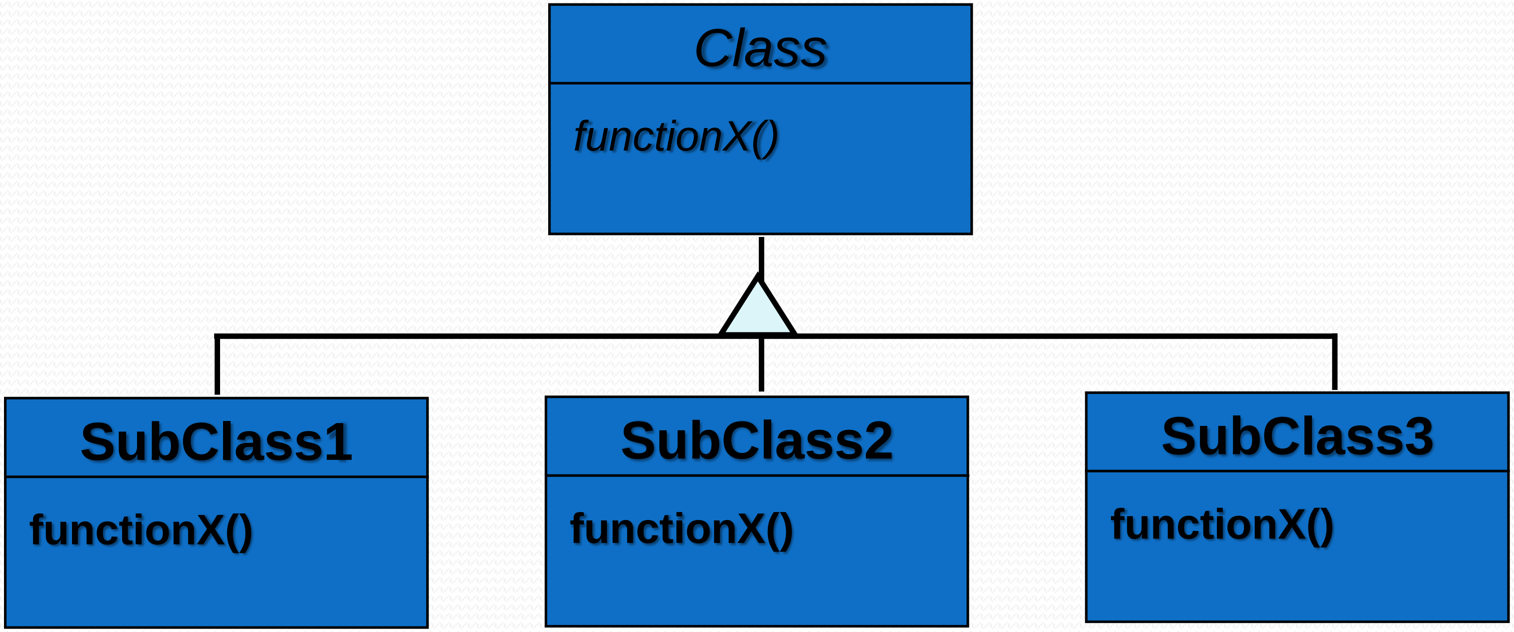
ConcreteStrategyC

algorithmInterface()

Strategy vs. Subclassing

- Strategy can be used in place of subclassing
- Strategy is more dynamic
- Multiple strategies can be mixed in any combination where subclassing would be difficult

Subclassing



Class

functionX()

SubClass1

functionX()

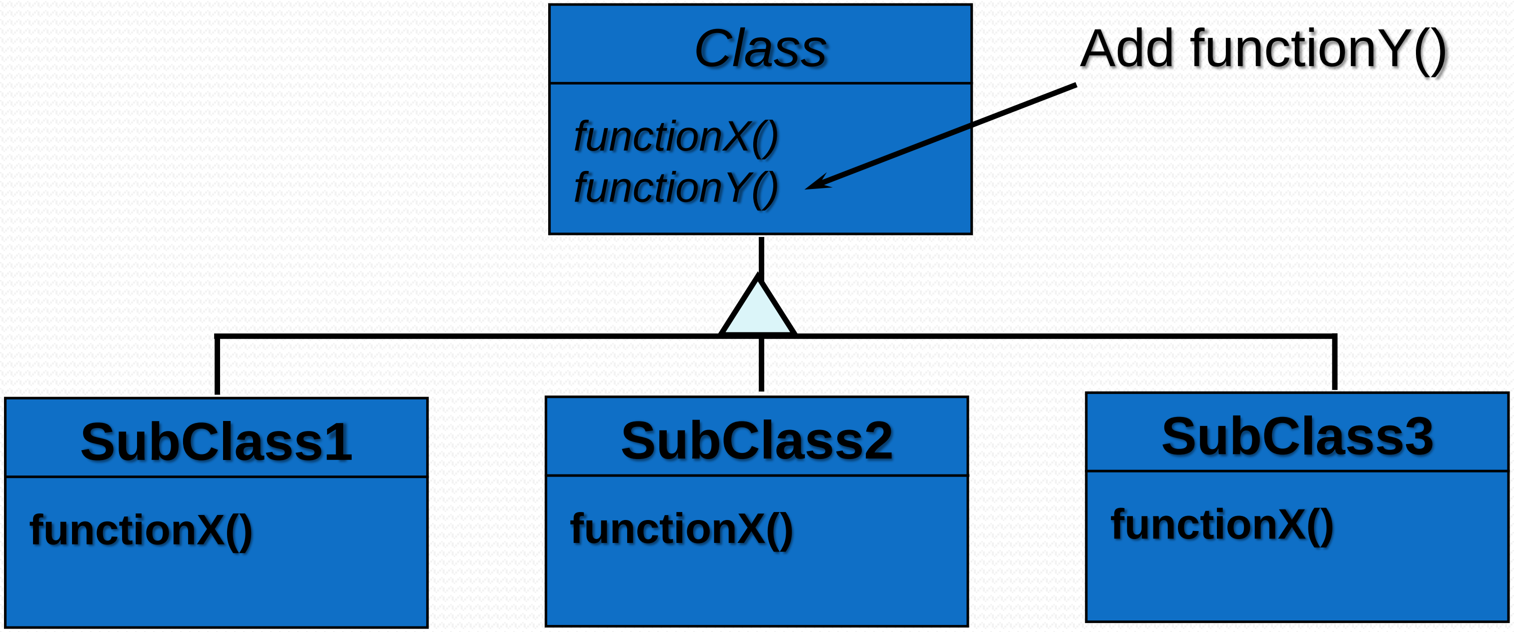
SubClass2

functionX()

SubClass3

functionX()

Add a function



Class

functionX()
functionY()

Add functionY()

SubClass1

functionX()

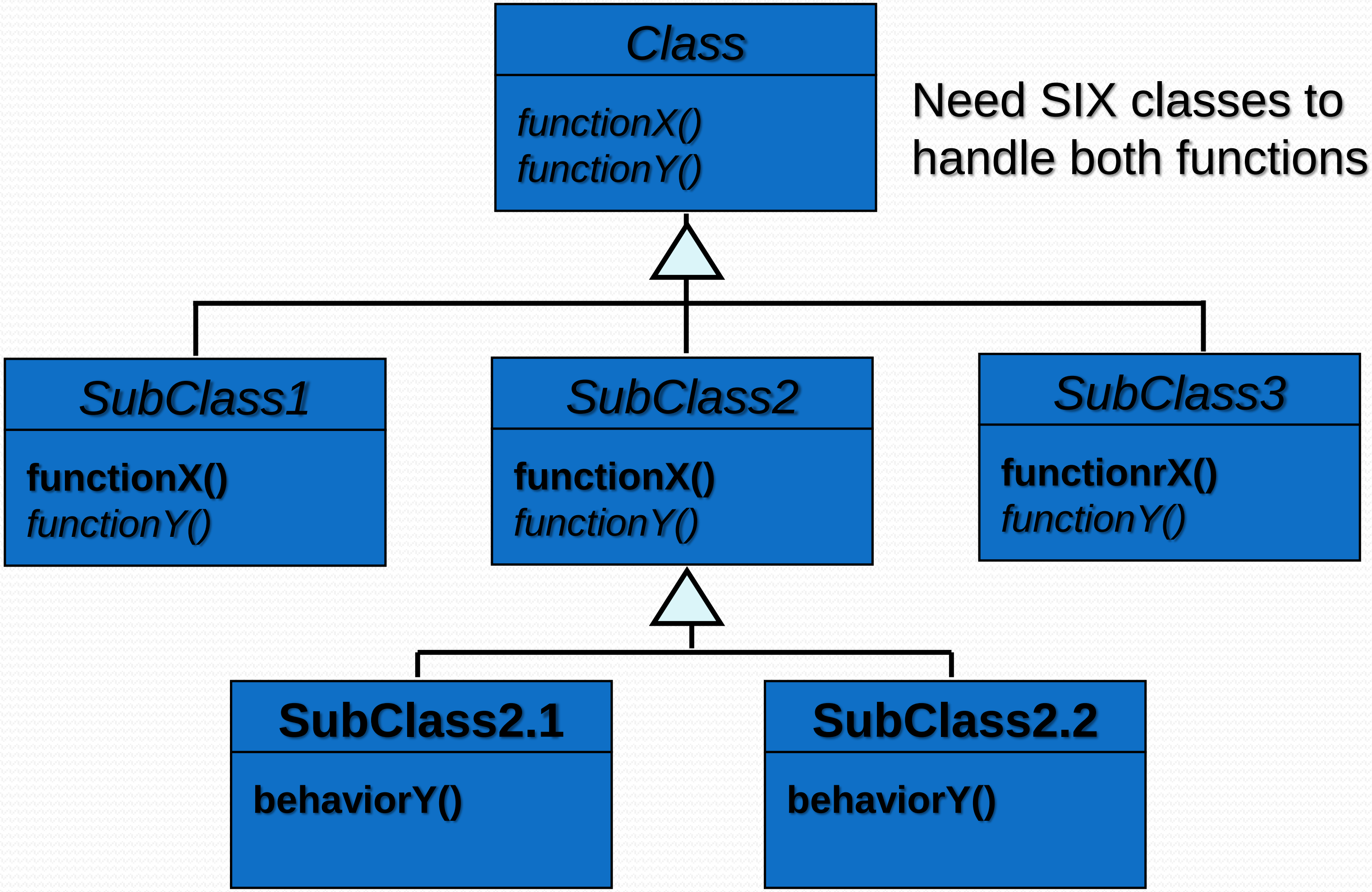
SubClass2

functionX()

SubClass3

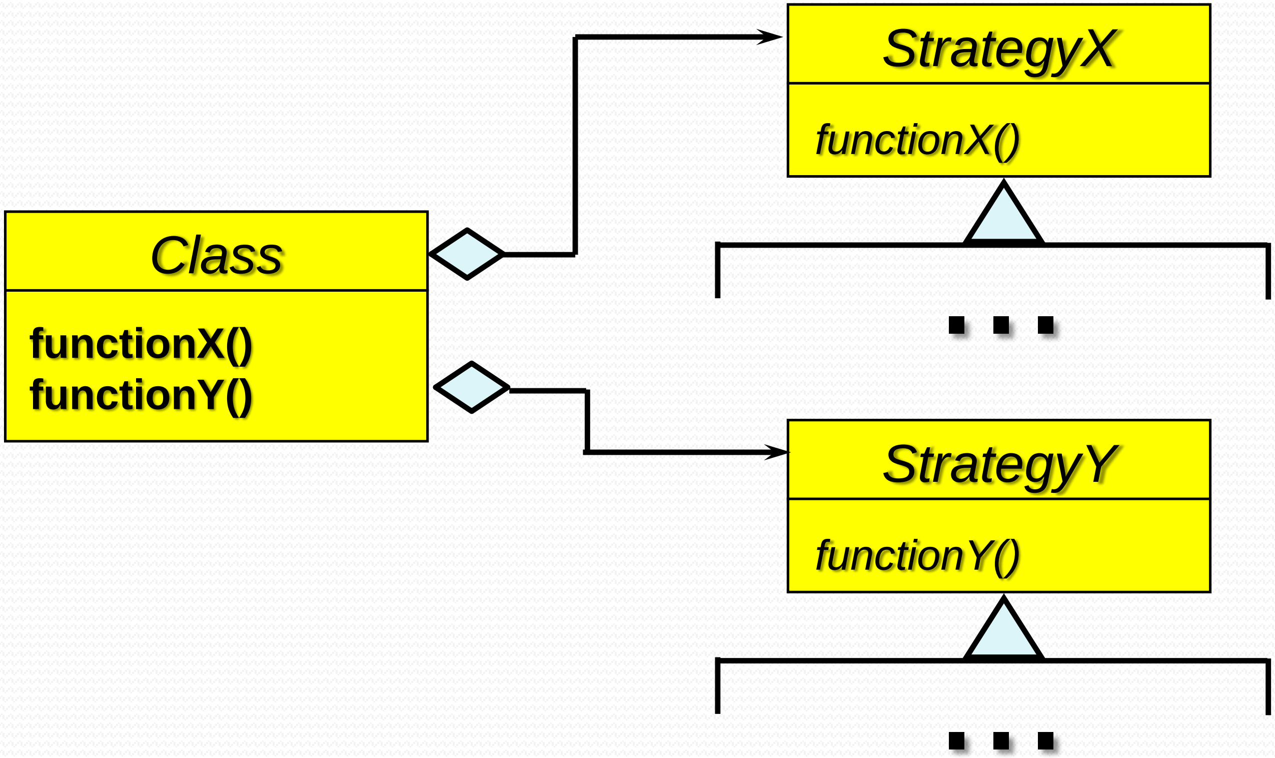
functionX()

What happens?



Need SIX classes to handle both functions!!!

Strategy makes this easy!

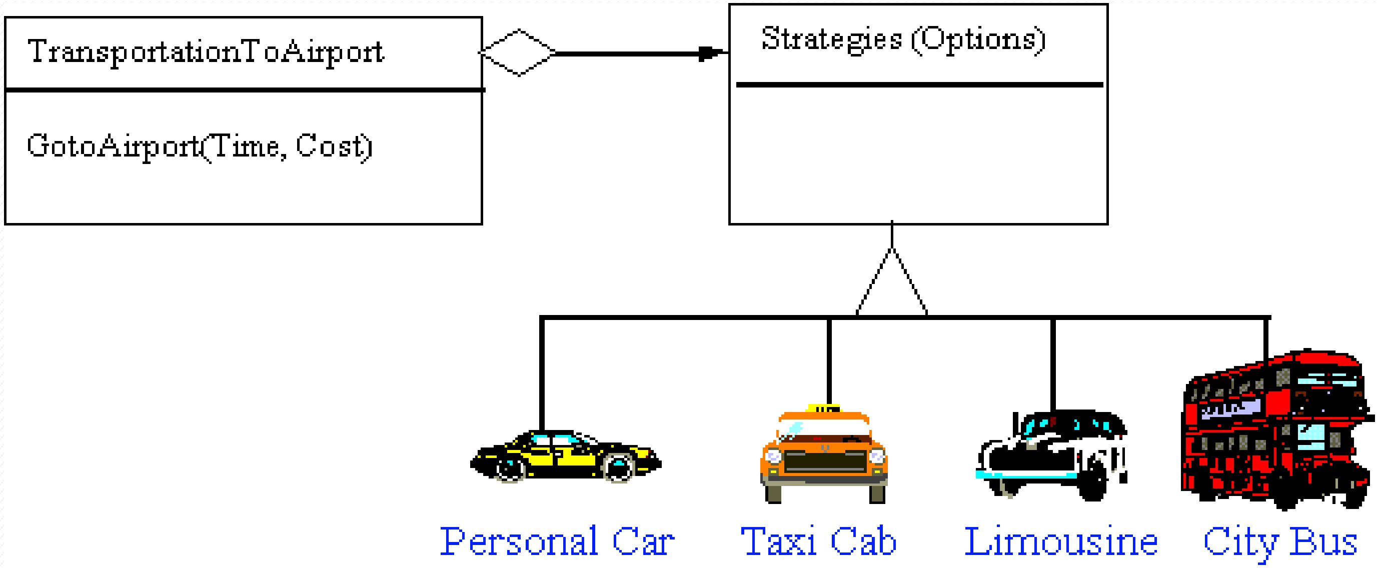


Applicability

- Many related classes differ only in their behavior.
- You need different variants of an algorithm. Strategy can be used as a class hierarchy of algorithms.
- An algorithm use data structures that clients shouldn’t know about.
- A class defines many behaviors, and these appear as multiple conditionals in its operation.

Example

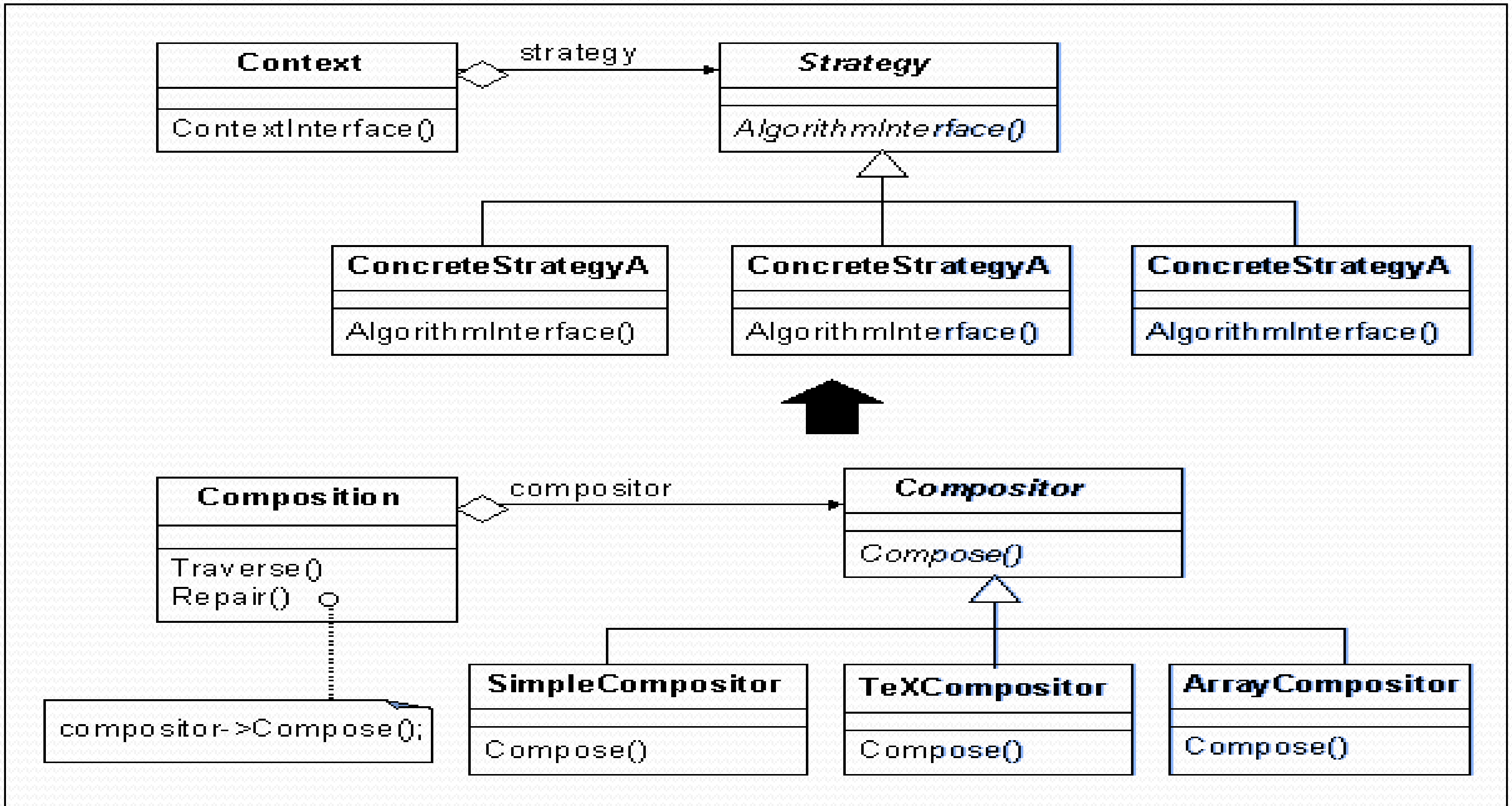
Modes of transportation to an airport is an example of a Strategy. Several options exist, such as driving one's own car, taking a taxi, an airport shuttle, a city bus, or a limousine service. Any of these modes of transportation will get a traveler to the airport, and they can be used interchangeably. The traveler must chose the Strategy based on tradeoffs between cost, convenience, and time.



Example

Many algorithms exists for breaking a string into lines.

- Simple Compositor is a simple **line breaking** method.
- TeX Compositor uses the TeX linebreaking strategy that tries to optimize linebreaking by breaking one **paragraph** at a time.
- Array Compositor breaks a **fixed** number of items into each row.



Participants

- *Strategy*

  declares an interface common to all supported algorithms. Context uses its interface to call the algorithm defined by a ConcreteStrategy.
- *ConcreteStrategy*

  implements a specific algorithm using the Strategy interface.
- *Context*
  - is configured with a ConcreteStrategy object.
  - maintains a reference to a Strategy object.
  - may define an interface for Strategy to use to access its

Consequences

- ***Families of related algorithms***
  - Hierarchies of Strategy factor out common functionality of a family of algorithms for contexts to reuse.
- ***An alternative to subclassing***
  - Subclassing a Context class directly hard-wires the behavior into Context, making Context harder to understand, maintain, and extend.
  - Encapsulating the behavior in separate Strategy classes lets you vary the behavior independently from its context, making it easier to understand, replace, and extend.
- ***Strategies eliminate conditional statements.***
  - Encapsulating the behavior into separate Strategy classes eliminates conditional statements for selecting desired behavior.
- ***A choice of implementations***
  - Strategies can provide different implementations of the same behavior with different time and space trade-offs.

Consequences (cont..)

- ***Clients must be aware of different strategies.***
  - A client must understand how Strategies differ before it can select the appropriate one.
  - You should use the Strategy pattern only when the variation in behavior is relevant to clients.
- ***Communication overhead between Strategy and Context.***
  - The Strategy interface is shared by all ConcreteStrategy classes.
  - It's likely that some ConcreteStrategies will not use all the information passed to them through this common interface.
  - To avoid passing data that get never used, you'll need tighter coupling between Strategy and Context.