SOLID PRINCIPLES ASSIGNMENT

In the rolex project I have chosen four classes for showing solid principles.

- Cart
- Bill
- Payment
- Product

- **Single Responsibility Principle (SRP):**
  - CartServices, BillCalculator, BillGenerator: These classes have a single responsibility each. For example, handling cart operations, calculating the bill total, and generating bill details.
  - OnlinePayment and OfflinePayment handle online and offline payments, respectively.

```
package com.ilp.service;
import com.ilp.entity.Bill;
public class BillCalculator {
  public double calculateTotal(Bill bill) {

      return bill.getSubtotal() + 1000.0;
  }
}
```

Here the BillCalculator has just a single responsibility to calculate the total.
For example if I want to generate the bill I need to create another class called BillGenerator to generate the bill.

```
package com.ilp.service;
import com.ilp.entity.Bill;
public class BillGenerator {
        public void generateBillDetails(Bill bill) {
      System.out.println("Bill generated");
   }
}
```

Therefore the BillCalculator just Calculates the subtotal and total whereas the BillGenerator generates the bill.

- **Open/Closed Principle (OCP):**
  - PaymentMethod Interface, OnlinePayment, CreditCardPayment, UpiPayment: These classes and interfaces adhere to the Open/Closed Principle.
  - New payment methods can be added without modifying existing code by creating classes that implement PaymentMethod interface.

```
package com.ilp.service;
import com.ilp.interfaces.PaymentMethod;
public class CreditCardPayment implements PaymentMethod {
  public void processPayment(double totalAmount) {
      System.out.println("Payment of $" + totalAmount + " made using Credit
Card");
   }
}
```

```
package com.ilp.service;
import com.ilp.interfaces.PaymentMethod;
public class NetBanking implements  PaymentMethod{
          public void processPayment(double totalAmount){
            System.out.println("Payment of $" + totalAmount + " made using Net Banking");
        }
}
```

Here CreditCardPayment and NetBanking Implements the interface PaymentMethod.

- **Liskov Substitution Principle (LSP):**
    - OnlinePayment and OfflinePayment are subclasses of Payment, and they are used interchangeably with the parent class Payment. Similarly, UpiPayment is another implementation of PaymentMethod, and it is used in the Payment class.
    - This usage adheres to the Liskov Substitution Principle because we can substitute instances of the derived classes (OnlinePayment, OfflinePayment, UpiPayment) for instances of the base class (Payment) without affecting the behavior of the program.

```
Payment onlinePayment = new OnlinePayment();
onlinePayment.makePayment(total, "Online");
Payment offlinePayment = new OfflinePayment();
offlinePayment.makePayment(total, "Cash");
```

Here OnlinePayment and OfflinePayment are child classes of the Payment Class.

- **Interface Segregation Principle (ISP):**
    - The interfaces (BillingOperations, CartOperations, PaymentMethod, PaymentOperations) are specific and not too broad. Each interface has methods related to its specific responsibility, adhering to the Interface Segregation Principle.

```
package com.ilp.interfaces;
public interface BillingOperations {
        double calculateSubtotal();
          double calculateTotal(double subtotal);
          void generateBillDetails();
}
```

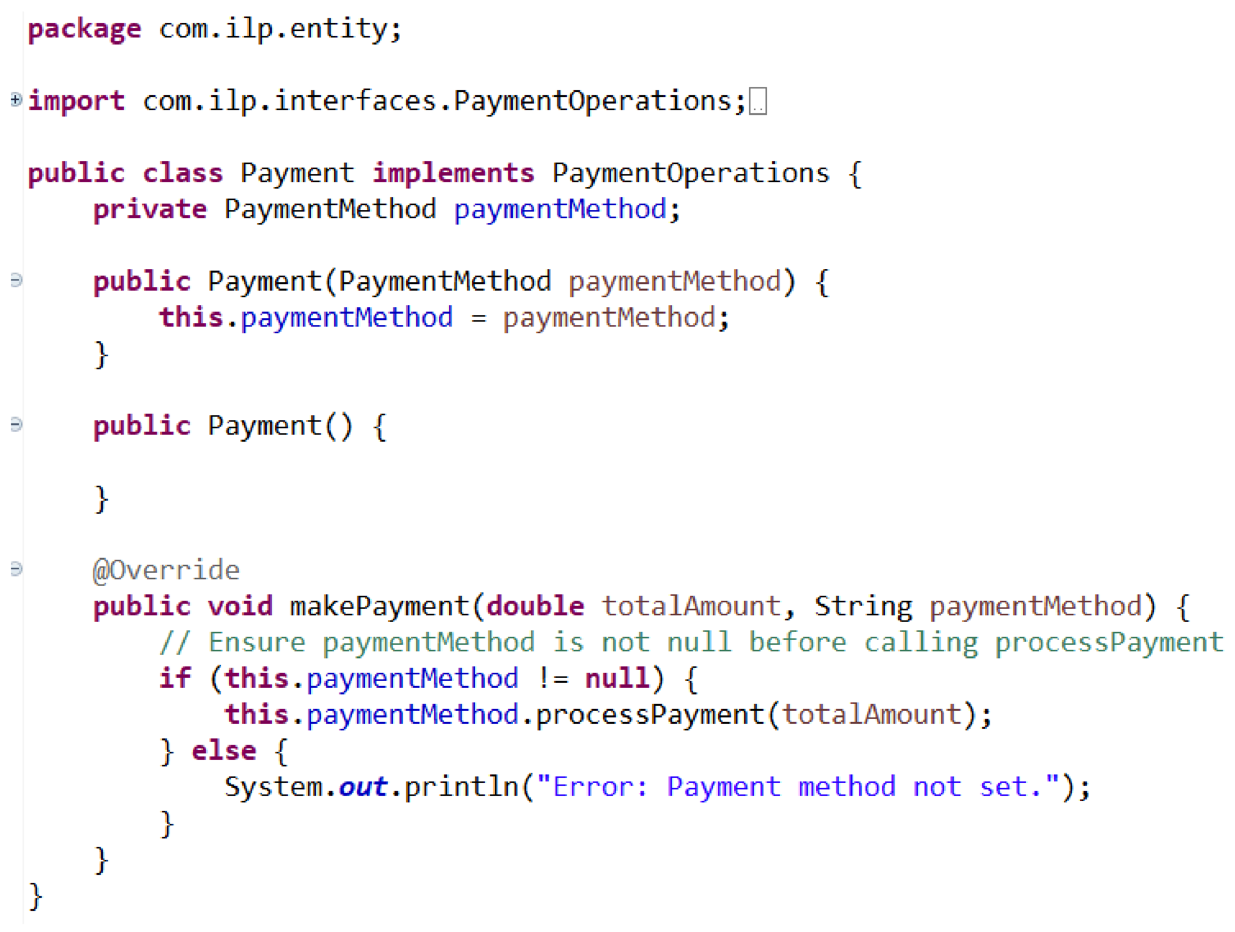
```
package com.ilp.interfaces;
import com.ilp.entity.Product;
public interface CartOperations {
                void addToCart(Product product);
                void removeFromCart(Product product);
                void viewCart();
}
```

These interfaces are focused and specific in terms of the operations they declare. A class that needs billing-related operations can implement the BillingOperations interface, and a class that needs cart-related operations can implement the CartOperations interface.

- **Dependency Inversion Principle (DIP):**
  - The code here depends on abstractions (interfaces) rather than concrete implementations. For example, the Payment class depends on the PaymentOperations interface. This follows the Dependency Inversion Principle.

```
package com.ilp.interfaces;

public interface PaymentOperations {
        void makePayment(double totalAmount, String paymentMethod);
}
```



```java
package com.ilp.entity;

import com.ilp.interfaces.PaymentOperations;

public class Payment implements PaymentOperations {
    private PaymentMethod paymentMethod;

    public Payment(PaymentMethod paymentMethod) {
        this.paymentMethod = paymentMethod;
    }

    public Payment() {

    }

    @Override
    public void makePayment(double totalAmount, String paymentMethod) {
        // Ensure paymentMethod is not null before calling processPayment
        if (this.paymentMethod != null) {
            this.paymentMethod.processPayment(totalAmount);
        } else {
            System.out.println("Error: Payment method not set.");
        }
    }
}
```

Situations where this code can violate the solid principles:

Single Responsibility Principle (SRP);

- Suppose the CartServices class not only handles cart operations but also contains methods for calculating the bill total and generating bill details. In this case, it would violate SRP, as the class is responsible for more than one thing.

```java
package com.ilp.service;
import com.ilp.entity.Bill;
public class BillCalculator {
  public double calculateTotal(Bill bill) {

     return bill.getSubtotal() + 1000.0;
```

```
    }
    public void addTocart() {
        System.out.println("Product added to the cart");
    }
    public void removeFromCart() {
        System.out.println("Product removed from the cart");
    }
}
```

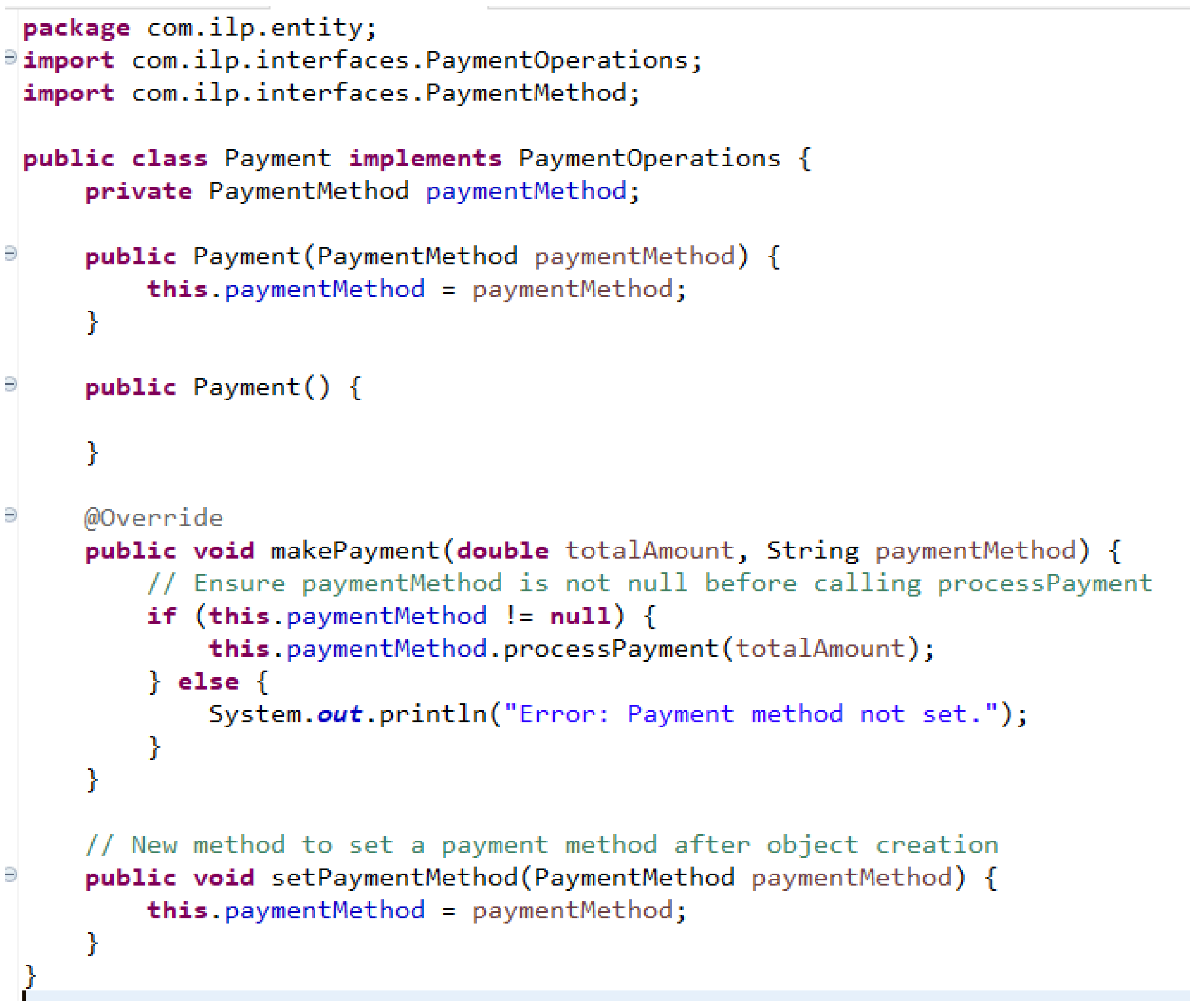
This is violating the SRP principle as the BillCalculator is responsible for both calculating the bill total,adding and removing products from the cart.

According to SRP a class should have only a single responsibility.

Open/Closed Principle (OCP):

- If adding a new payment method involves modifying existing code in the Payment class instead of extending it, the Open/Closed Principle is violated. This may occur if the existing code has conditional statements for each payment method.

  If I want to add a new payment method called WalletPayment. To do this, you would need to modify the Payment class to include that method , and this violates the OCP.



```java
package com.ilp.entity;
import com.ilp.interfaces.PaymentOperations;
import com.ilp.interfaces.PaymentMethod;

public class Payment implements PaymentOperations {
    private PaymentMethod paymentMethod;

    public Payment(PaymentMethod paymentMethod) {
        this.paymentMethod = paymentMethod;
    }

    public Payment() {

    }

    @Override
    public void makePayment(double totalAmount, String paymentMethod) {
        // Ensure paymentMethod is not null before calling processPayment
        if (this.paymentMethod != null) {
            this.paymentMethod.processPayment(totalAmount);
        } else {
            System.out.println("Error: Payment method not set.");
        }
    }

    // New method to set a payment method after object creation
    public void setPaymentMethod(PaymentMethod paymentMethod) {
        this.paymentMethod = paymentMethod;
    }
}
```

This modification of the Payment class to accommodate a new payment method is a violation of the Open-Closed Principle. To conform to the OCP, you should be able to add new payment methods without modifying the existing code.

Liskov Substitution Principle (LSP):

- LSP may be violated if a subclass fails to provide the expected behavior of the base class. For example, if OnlinePayment or OfflinePayment introduces behavior that is not consistent with the Payment class, substituting instances might lead to unexpected results.

Interface Segregation Principle (ISP):

- Suppose the BillingOperations interface includes methods not relevant to all implementing classes. For instance, if BillingOperations forces a class to implement a method related to cart operations, it violates ISP.

Dependency Inversion Principle (DIP):

- The Payment class directly instantiates the OnlinePayment class, forming a tight coupling between the high-level module (Payment) and the low-level module (OnlinePayment)If the high-level module directly depends on a low-level module rather than abstractions, DIP is violated.