Formal Methods - Spring 2025 Section - C

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Prior To Training
Quiz - 4

You are given 7 constraints written in OCL. Each contains a specific code smell. Your task is to identify the bad smell and give a solution for it.

1) If an order exists, and its price is above 1000, and it's pending, then the customer must have logged in within the last 24 hours.

Implies Chain

```
context Order
inv:
 self.price > 1000 implies
 self.status = 'Pending' implies
 self.customer.lastLogin >= Date.now() - 1
```

```
context Order
inv: (self.price > 1000 and self.status = "Pending")
     implies self.custom.lastLogin ≥ Date.now() - 1
```

4

2) Each customer's orders must all have valid details and those details must have a non-empty shipping address.

For All Chain

```
context Customer
inv:
 self.orders->forAll(o | o.details->forAll(d |
   d.shippingAddress <> '' ) )
```

3

```
context Customers
self.orders.allInstances() -> details -> forAll(d | d.shippingAddress <>
```

3) If a cart has products, the user must not be a guest.

Verbose Expression

```
context ShoppingCart
inv:
 if self.productId->size() > 0 then
   self.customer.user.email <> 'guest@example.com'
 else true endif
```

```
context ShoppingCart
inv:
  self.productId->size() > 0
  implies self.customer.user.email <> "guest@example
```

4

1

4) All orders must have a status and a price defined, and no order should be in 'Canceled' state.

```
context Order
inv:
 self.status <> '' and self.price > 0 and self.status <> 'Canceled'
```

Duplication

context Order
inv: self.price > 0 and self.status <> "Cancelled".

3

5) If a user is a customer, they must have a billing address.

```
context User
inv:
 self.oclIsTypeOf(Customer) implies  self.oclAsType(Customer).billingAddress <>""
```

DownCasting

context Customer
inv:
self.billingAddress <> ""

4

6) If the shipping type is 'Express', then shipping cost should be over 20.

```
context OrderDetails
inv:
 if self.shippingType = 'Express' then  self.shippingCost > 20
 else  true endif
```

Verbose Expression

context OrderDetails
inv: self.shippingType = "Express" implies self.shippingCost > 20.

4

7) Every Order's customer's default shipping address must be in Pakistan.

```
context Order
inv:
   self.customer.defaultShipping.region.country.code = 'PK'
```

Long Journey

3

context Customer
self.defaultShipping.region.country.code = 'PK'

There is no need to check order, because all customers have a default shipping address

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Post Training
Quiz - 4

You are given 7 constraints written in OCL. Each contains a specific code smell. Your task is to identify the bad smell and give a solution for it.

1) If an order exists, and its price is above 1000, and it's pending, then the customer must have logged in within the last 24 hours.

```
context Order
inv:
  self.price > 1000 implies
  self.status = 'Pending' implies
  self.customer.lastLogin >= Date.now() - 1
```

Chain Implies

context Order
inv:
(self.price > 1000 and self.status = "pendy") implies self.customer.lastLogin ≥ Date.now() -1

2) Each customer's orders must all have valid details and those details must have a non-empty shipping address.

```
context Customer
inv:
  self.orders->forAll(o | o.details->forAll(d |
    d.shippingAddress <> '' ))
```

Chain For All

context Customer
inv: self.orders.details → forAll(d | d.shippingAddress <> "")

3) If a cart has products, the user must not be a guest.

```
context ShoppingCart
inv:
  if self.productId->size() > 0 then
    self.customer.user.email <> 'guest@example.com'
  else true endif
```

Verbose Expression & Long Journey

context ShoppingCart
inv: self.productId → size() > 0 implies self.customer.CustData <> "guest@example.com"

context Customer
let CustData = self.user.email

context Customer
def CustData = self.user.email

4) All orders must have a status and a price defined, and no order should be in 'Canceled' state.

```
context Order
inv:
 self.status <> '' and self.price > 0 and self.status <> 'Canceled'
```

Duplication

4

context Order
inv: let s = self.status
s <> "" and s > 0 and s <> "Cancelled"

5) If a user is a customer, they must have a billing address.

```
context User
inv:
 self.oclIsTypeOf(Customer) implies self.oclAsType(Customer).billingAddress
<>""
```

Downcasting

context Customer
inv: self.billingAddress <> ""

Because Customer is the only possible User type in Diagram

4

6) If the shipping type is 'Express', then shipping cost should be over 20.

```
context OrderDetails
inv:
 if self.shippingType = 'Express' then self.shippingCost > 20
 else true endif
```

Verbose Expression

Type Based cond

context OrderDetails
inv: self.shippingType = "Express" implies self.shippingCost > 20

4

7) Every Order's customer's default shipping address must be in Pakistan.

```
context Order
inv:
 self.customer.defaultShipping.region.country.code = 'PK'
```

Long Journey

context Customer
self.defaultShipping.region.country.code

let Shipping = context Order
inv: self.customer.Shipping = "PK"

4