17.3.2 Representing the observer pattern as aspects

Description

The example in the previous section is meant for illustrating the observer pattern, but from a modeling point-of-view, it does not make sense that `fireAlarm` is a subclass of `Subject` and that `FireDepartment`, etc. are subclasses of `Observer`.

In this section, we will show how the observer pattern may be represented as aspects. For this purpose, we will use the bank system. A scenario that calls for adding subject/observer aspects to the bank system is the following: Every day the bank checks if there has been some suspicious transactions on accounts, and in case, both a special alarm part of the bank *and* the actual customer are notified of the event. This is done by giving each account a subject aspect and both alarm and each customer an observer aspect.

`Account` objects have a subject aspect represented by the object `asSubject`, and `Customer` objects and the `alarm` object have an observer aspect represented by an object `asObserver`:

```
BankSysEx: obj
   class Account(owner: ref Customer):
      -"-
      asSubject: obj Subject

   class Customer(id: var Integer):
      -"-
      asObserver: obj Observer

   alarm: obj
      asObserver: obj Observer
   ...
```

The subject and observer aspects are now represented as properties of part-objects of `Account` objects, `Customer` objects, and the `alarm` object. This is illustrated in the following figure, in the first round with the types of the part objects being `Subject` and `Observer`:

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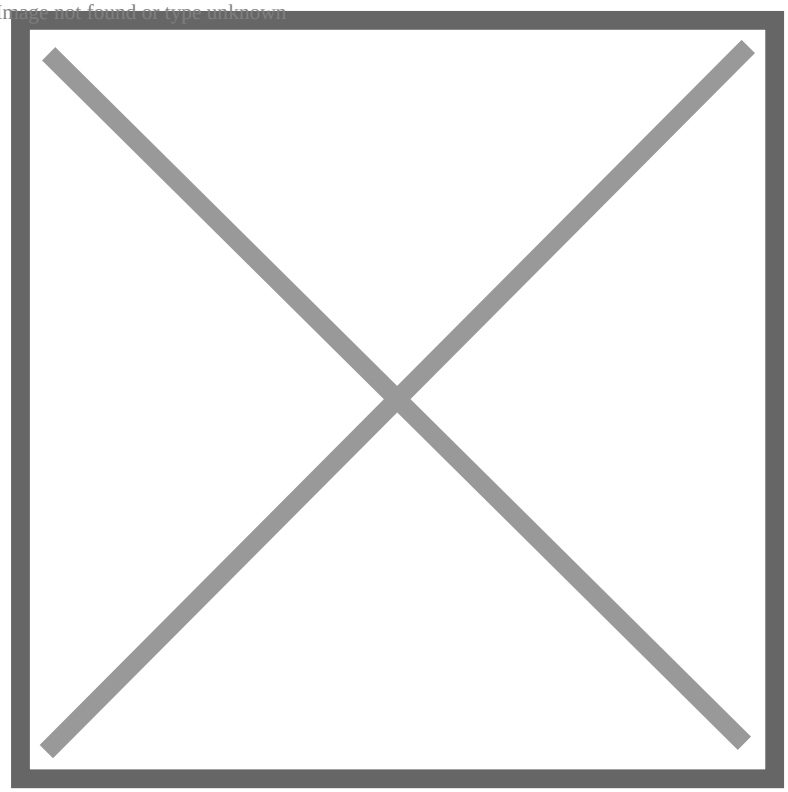


Recall that an object defined by **obj** is generated and executed as part of the generation of the object in which the object is. So, each time an `Account` object is generated, the `asSubject` object is generated and executed, with the implication that the `alarm` and the `owner` are subscribed as observers of this account. Note that the parameters to the invocation of `subscribe` are not references to `alarm` or `owner`, but rather to their `asObserver` aspect objects.

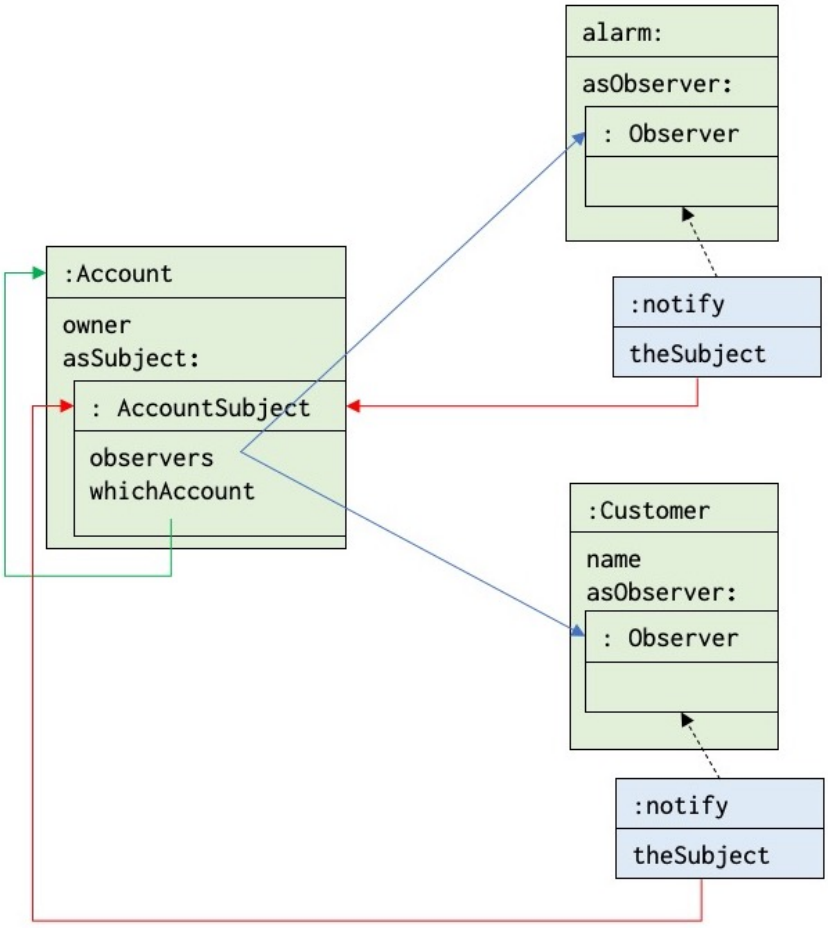
As for the `Firealarm` example, we also have to extend `ObservedSubject` to include information about the accounts. The type of `asSubject` object cannot just be `Subject`, as it has to report events that has to do with `Account`-objects. Since we have two types of observers, `Customer` objects and the `alarm`, we introduce a class `AccountSubject` being a subclass of `Subject`, and we use the class as the type of `asSubject`:

```
class AccountSubject(whichAccount: ref Account): Subject
   issueWithTransactions:
      "There is an issue with the account of: ".print
      whichAccount.owner.print
   inner(AccountSubject)

class Account(owner: ref Customer):
   -"-
   asSubject: obj AccountSubject(this(Account))
```

In a similar way, the `asObserver` objects of `Customer` and `alarm` are defined as subclasses of `Observer`:

```
class Customer(name: var String):
   asObserver: obj Observer
      class ObservedSubject:: AccountSubject
      notify::
         theSubject.issueWithTransactions
...
alarm: obj
   asObserver: obj Observer
      class ObservedSubject:: AccountSubject
      notify::
         theSubject.issueWithTransactions
```



Next we show how `Customer` objects and `alarm` may subscribe to events in `Account` objects. This is done in a method `newAccount` in `BankSysEx`:

```
newAccount(owner: ref Customer):
   acc: ref Account
   acc := Account(owner)
   theAccountsFile.insert(acc)
   acc.asSubject.subscribe(owner.asObserver)
   acc.asSubject.subscribe(alarm)
```

The method `newAccount` creates a new `Account` for the `Customer` referred to by `owner`.

- First a new `Account` object is generated and a reference to it is assigned to `acc`.
- Next this reference is inserted in the `theAccountsFile`, which is the set of accounts of `BankSysEx`.
- Then the `owner` aspect (`owner.asObserver`) of the new `Account` is subscribed to the subject aspect of `acc` (`acc.asSubject`).
- Finally the `alarm` subscribes to the subject aspect of `acc`.

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To sum up, the overall structure of `BankSysEx` is:

```
BankSysEx: obj
   class AccountSubject(whichAccount: ref Account): Subject
      -"-
   class Account(owner: ref Customer):
      -"-
      asSubject: obj AccountSubject

   class Customer(id: var Integer):
```

```
   -"-
   asObserver: obj Observer
      ObservedSubject:: AccountSubject
      -"-

alarm: obj
   asObserver: obj Observer
      ObservedSubject:: AccountSubject
      -"-
newAccount(owner: ref Customer):
   -"-
accountsFile: obj OrderedList(Account)
...
```