Refactoring Exercise

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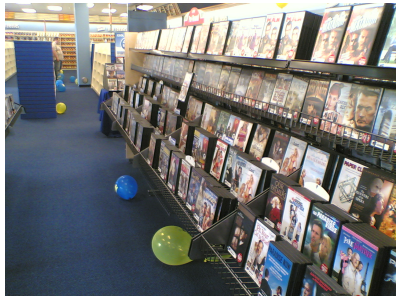
http://www.ge.infn.it/geant4/training/APC2025/

Exercise: The Video Store



Grab basic concepts

Get into the habit of refactoring

M. Fowler, Refactoring, Addison-Wesley, 1999, Chapter 1

(translated from Java into C++)

Setting up the computing environment

https://www.ge.infn.it/geant4/training/APC2025/environment.html

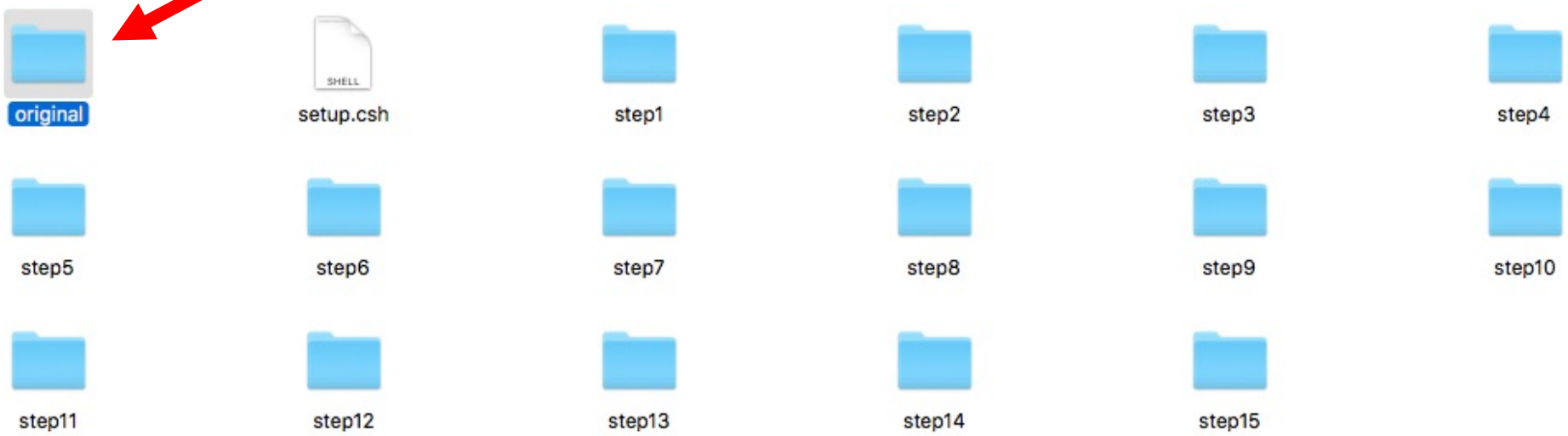
- The exercise has been tested on macOS 14 Sonoma and 15 Sequoia with Xcode 16.2 and 16.3, on various Linux platforms with gcc 9 or later, including the DESY NAF environment for the APC school
- The following tools should be installed
  - **cmake**, version 3.14 or later, *available at https://cmake.org/*
  - **googletest**, version 1.17.0, *available at https://github.com/google/googletest*
- Quick instructions for googletest installation at https://www.ge.infn.it/geant4/training/APC2025/gtest.html
- Define an environment variable corresponding to **your** googletest path setenv **GTESTPATH** */usr/local/* or export **GTESTPATH**=*"/usr/local/"*
- Follow the guidance for the exercise at https://www.ge.infn.it/geant4/training/APC2025/exercise.html

Download the source code for the exercise

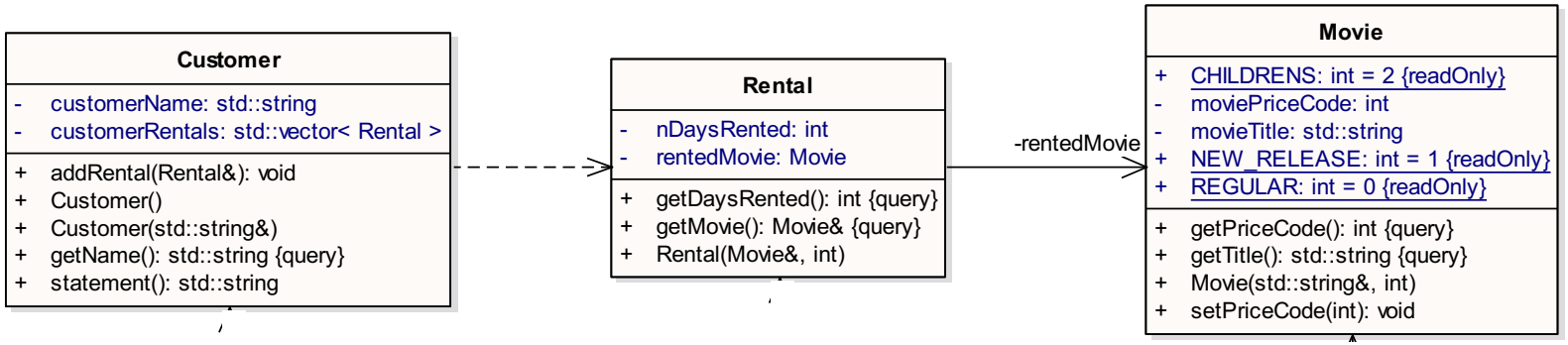
- Download a copy of the exercise source code from https://github.com/mariagraziapia/VideoStoreAPC/releases/tag/v3.0
- Unpack the source code and go into the source directory
  - `unzip VideoStoreAPC-v.3.0.zip`
  - `tar -xvf v3.0.tar`
  - `cd VideoStoreAPC-v.3.0`

15 steps of the refactoring process

Original code



Original code



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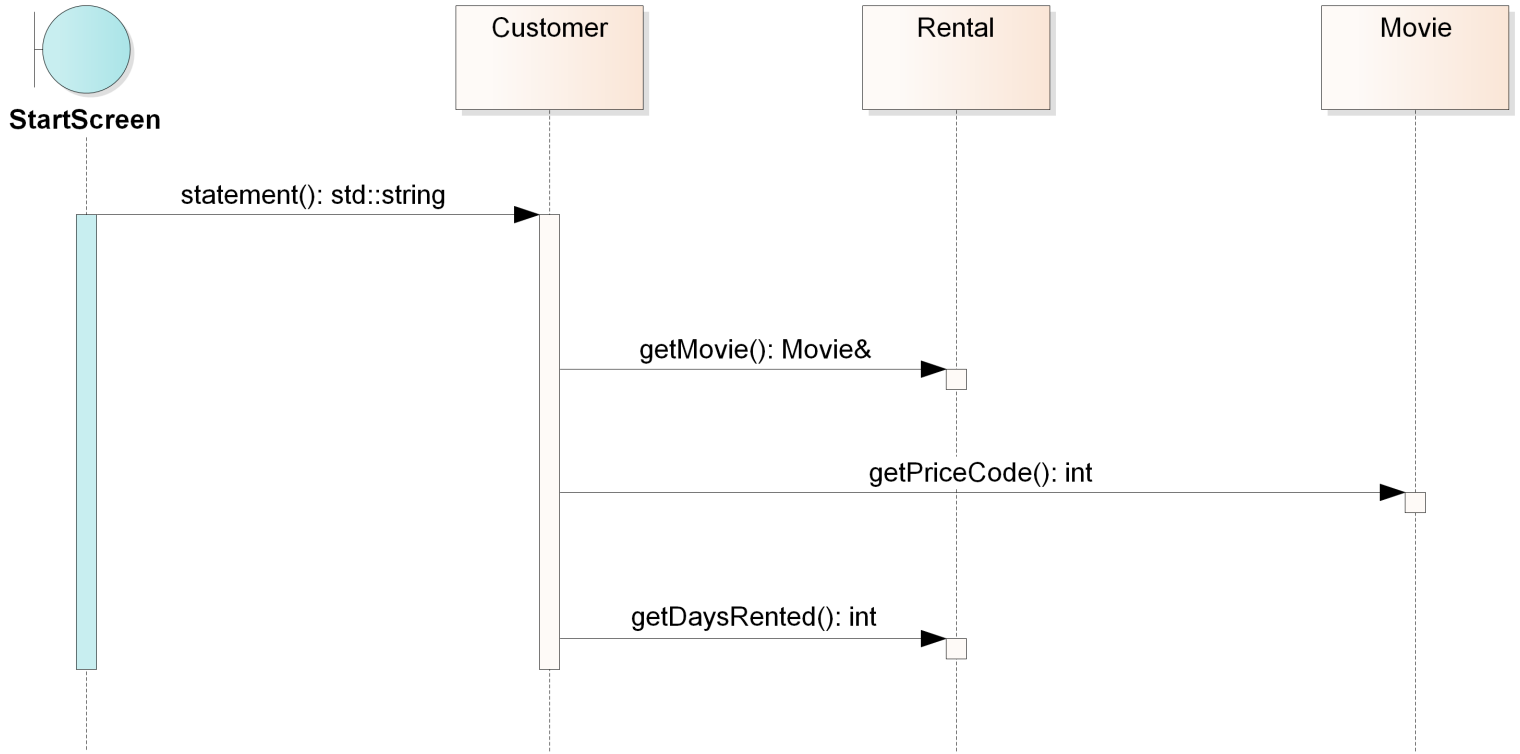


A first look at the code

- **Not well designed** and certainly **not object oriented**
  - The long routine in the Customer class does far too much
  - Many of the things that it does should really be done by the other classes
- **Difficult to change**
  - Suppose that they ***want a statement printed in HTML***
  - It is impossible to reuse any of the behavior of the current statement method for an HTML statement.
  - One would end up with writing a whole new method that duplicates much of the behavior of statement.
  - But what happens when the charging rules change? You have to fix both statement and htmlStatement and ensure the fixes are consistent.
  - The users want to make changes to the way they classify movies, but they haven't yet decided on the change they are going to make.
  - The statement method is where the changes have to be made to deal with changes in classification and charging rules

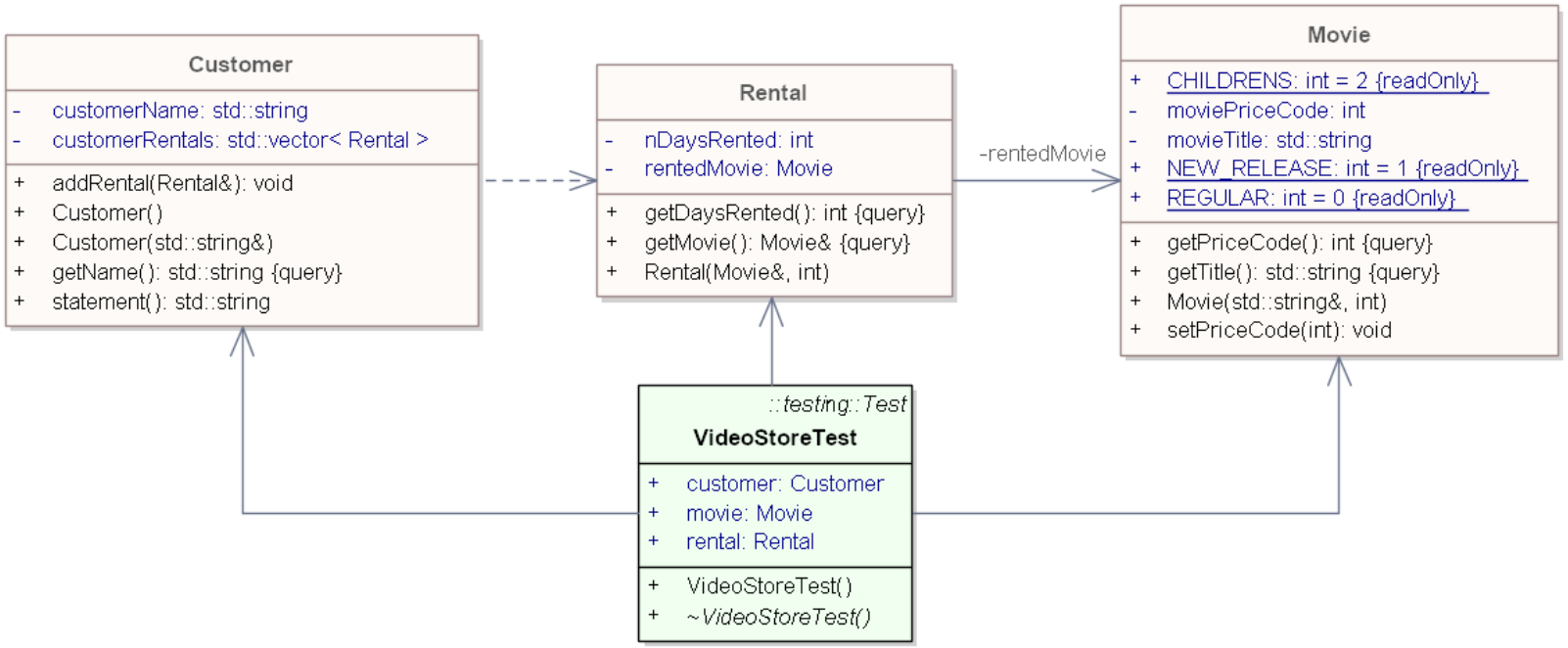
Step 0: Tests

- One needs a solid set of **tests** for that section of code
  - Risk of introducing bugs while modifying the code
- Tests must be **self-checking**
  - they either say "OK"

M. Fowler, Refactoring - Chapter 1: Refactoring, a First Example

UML diagrams produced with Enterprise Architect (Sparx Systems)

Original code



Running the unit tests

- Build testVideoStore.cc
- `cd original`
- `make` *the test is automatically run*

Build and run the tests in the same way at each step

`make clean`
to remove *.o and executable

To rerun the tests:
`./testVideoStore`

The output should look like

```
[==========] Running 7 tests from 1 test case.
[----------] Global test environment set-up.
[----------] 7 tests from VideoStoreTest
[ RUN      ] VideoStoreTest.testgetPriceCode
[       OK ] VideoStoreTest.testgetPriceCode (0 ms)
[ RUN      ] VideoStoreTest.testsetPriceCode
[       OK ] VideoStoreTest.testsetPriceCode (0 ms)
[ RUN      ] VideoStoreTest.testgetTitle
[       OK ] VideoStoreTest.testgetTitle (0 ms)
[ RUN      ] VideoStoreTest.testgetDaysRented
[       OK ] VideoStoreTest.testgetDaysRented (0 ms)
[ RUN      ] VideoStoreTest.testgetMovie
[       OK ] VideoStoreTest.testgetMovie (0 ms)
[ RUN      ] VideoStoreTest.testgetName
[       OK ] VideoStoreTest.testgetName (0 ms)
[ RUN      ] VideoStoreTest.teststatement
[       OK ] VideoStoreTest.teststatement (0 ms)
[----------] 7 tests from VideoStoreTest (0 ms total)

[----------] Global test environment tear-down
[==========] 7 tests from 1 test case ran. (0 ms total)
[  PASSED  ] 7 tests.
```

Refactoring in 15 steps

For each step N:

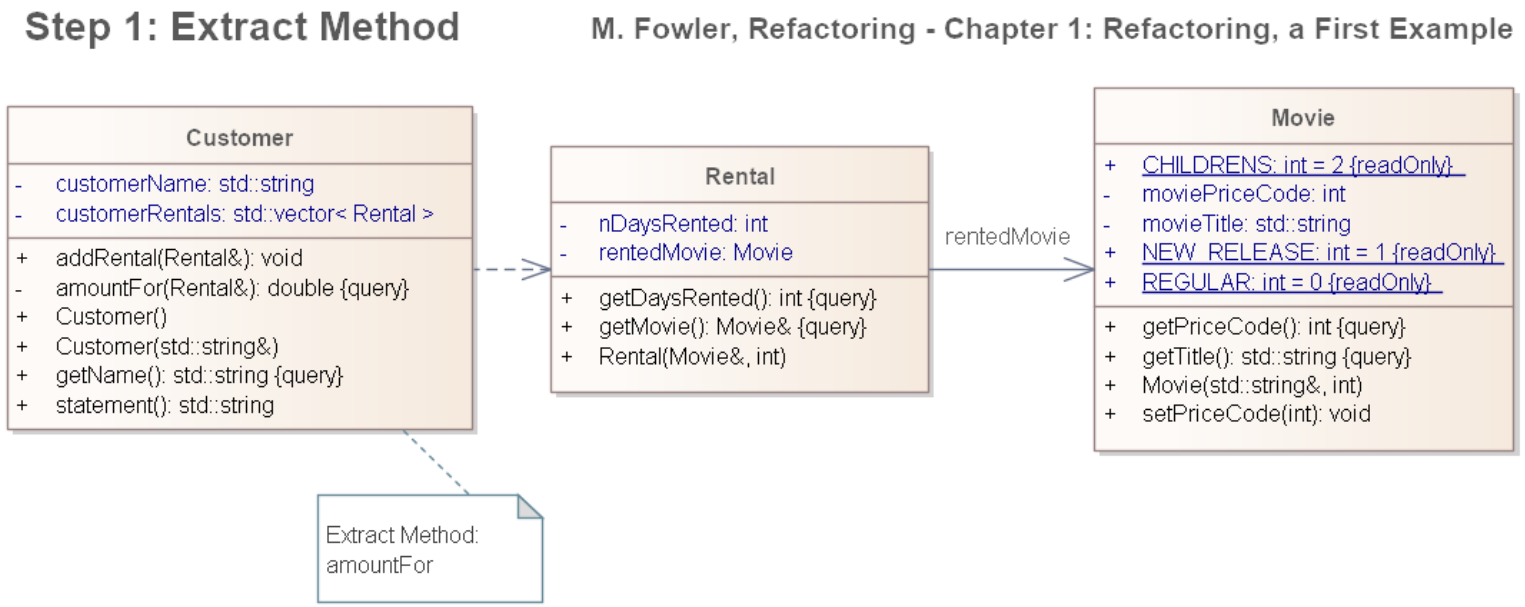
- Refactor the code in VideoStoreAPC-v.3.0/stepN-1/
- The solution is in VideoStoreAPC-v.3.0/stepN/

- **Try to do the suggested refactoring yourself** following the guidance in http://www.ge.infn.it/geant4/training/APC2025/exercise.html

- Whenever you modify the code, run the tests

Step 1: Extract Method

Bad smell:
the long metod in Customer
Decompose it in small pieces



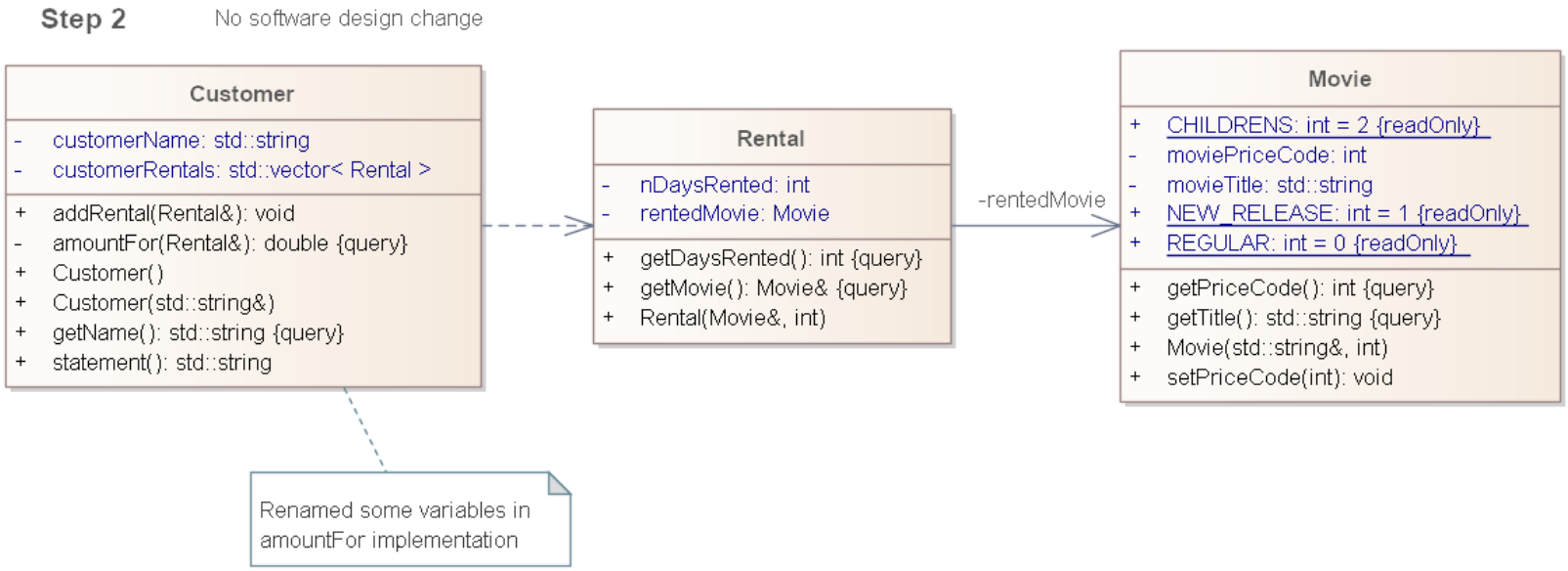
The first phase of refactorings in this exercise shows how to split up a long method and move the pieces to better classes

Find a logical clump of code and use **Extract Method**

Candidate: **switch** statement to extract into its own method

Solution in step2/

Step 2: Renaming Variables



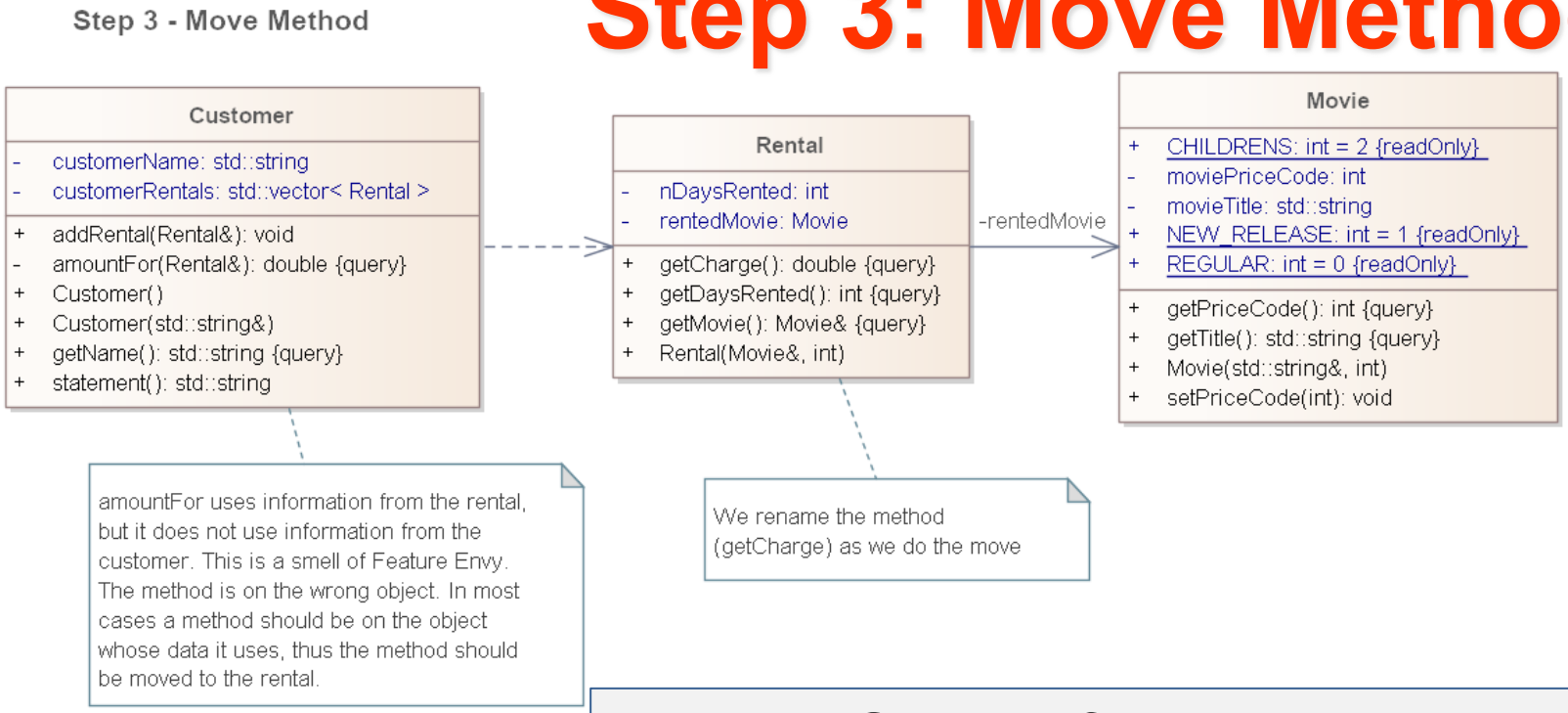
No design change

Some of the variable names in amountFor could be better renamed

Is renaming worth the effort? Absolutely. Good code should communicate what it is doing clearly, and variable names are a key to clear code.

Solution in step3/

Step 3: Move Method



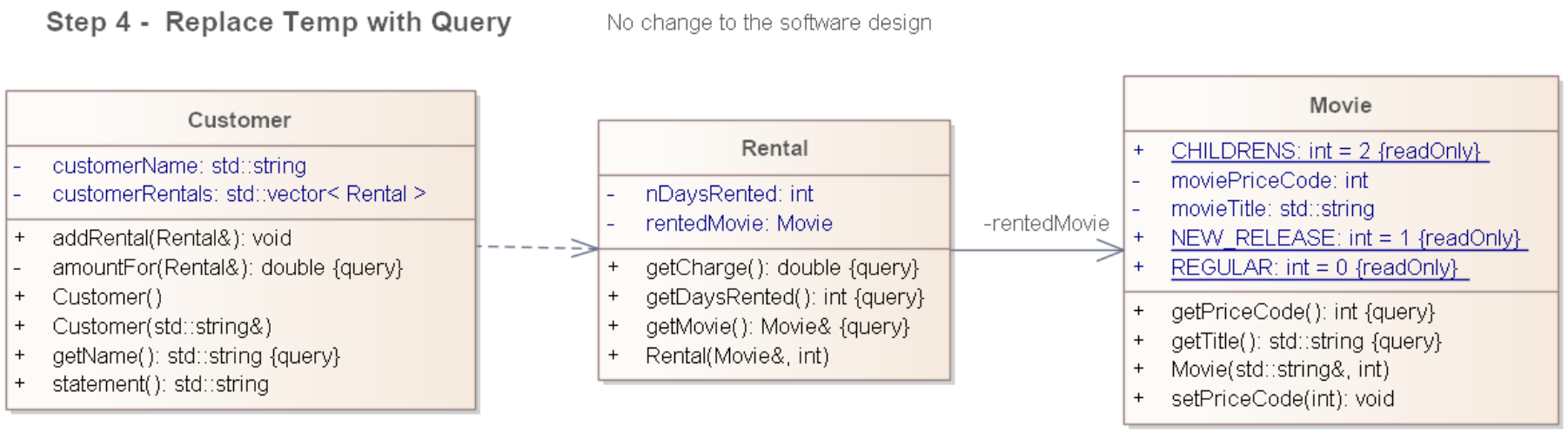
Smell of Feature Envy

amountFor uses information from the rental,
but it does not use information from the customer

In most cases a method should be on the object whose data it uses:
the method should be moved to the rental

- Use **Move Method**
- Rename the method (*getCharge*) as we do the move
- Replace the body of *Customer::amountFor* to delegate to the new method

Step 4: Replace Temp with Query



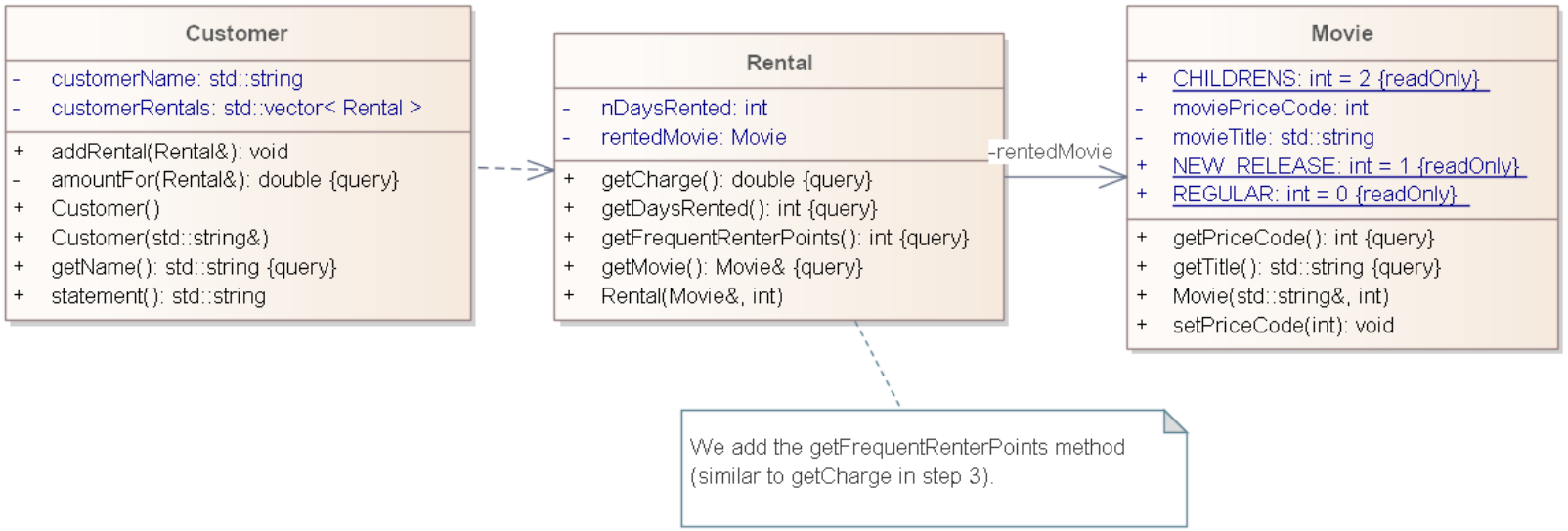
thisAmount is now redundant.

It is set to the result of *each.getCharge* and not changed afterward

Thus we can eliminate *thisAmount* by using

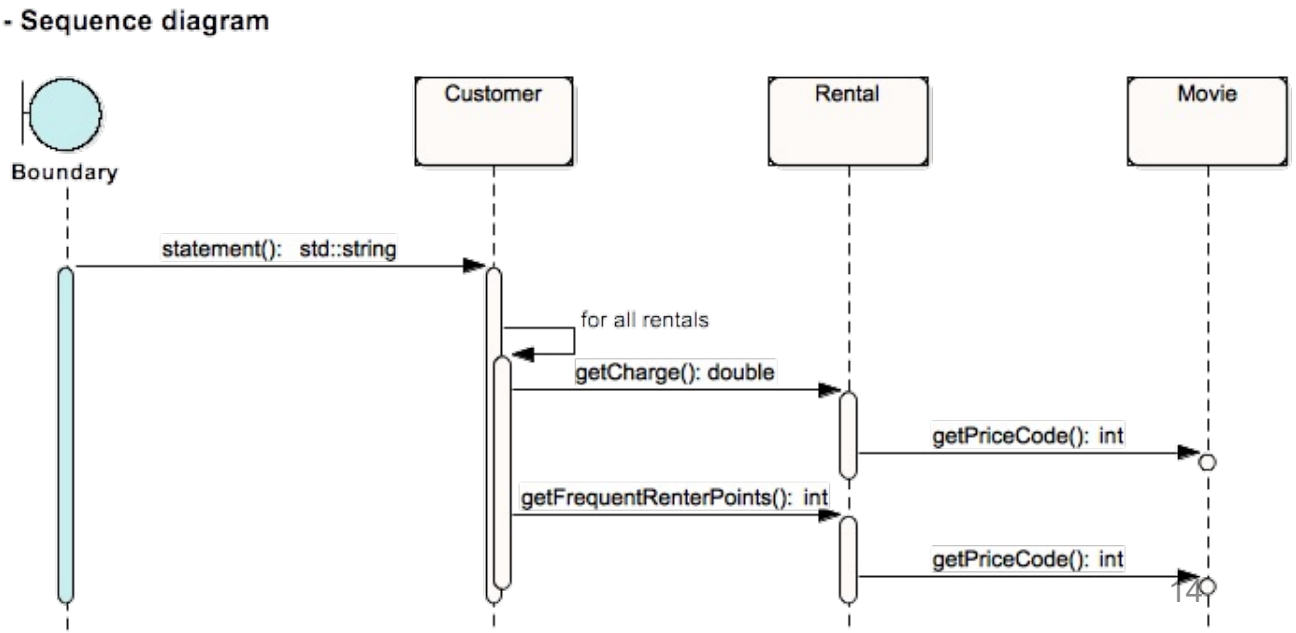
Replace Temp with Query

Step 5: Extracting Frequent Renter Points

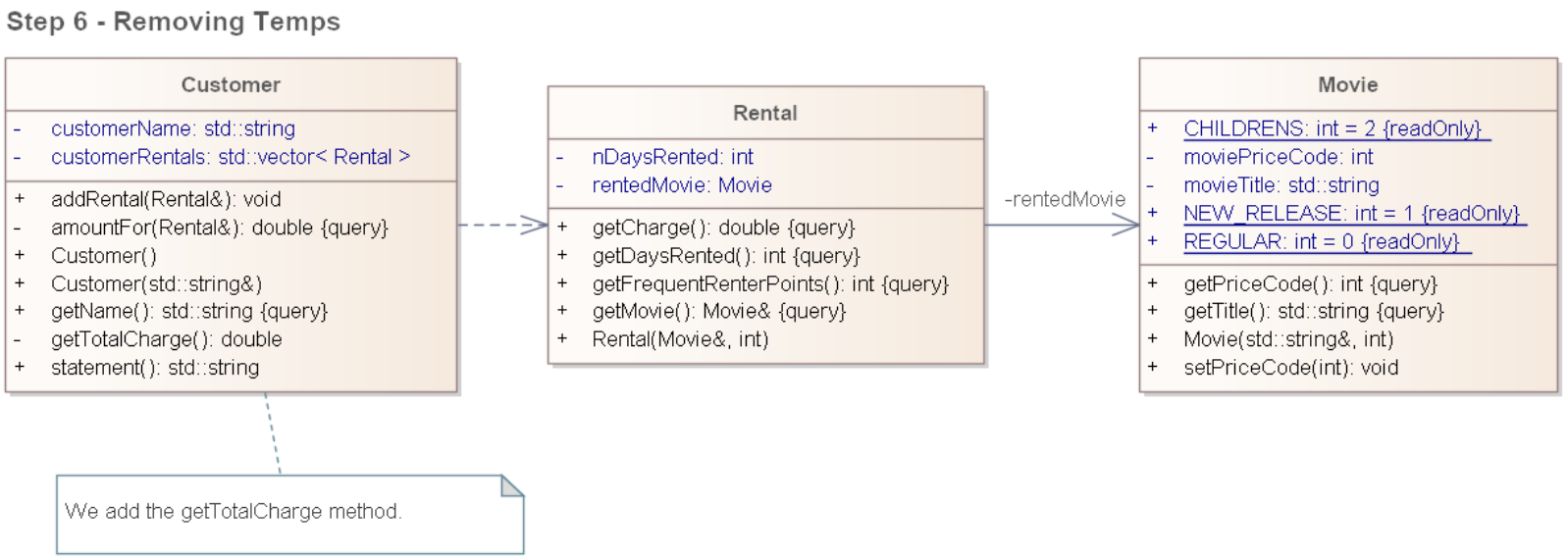


We do a similar thing for the frequent renter points

Extract Method on the frequent renter points part of the code



Step 6: Removing Temps



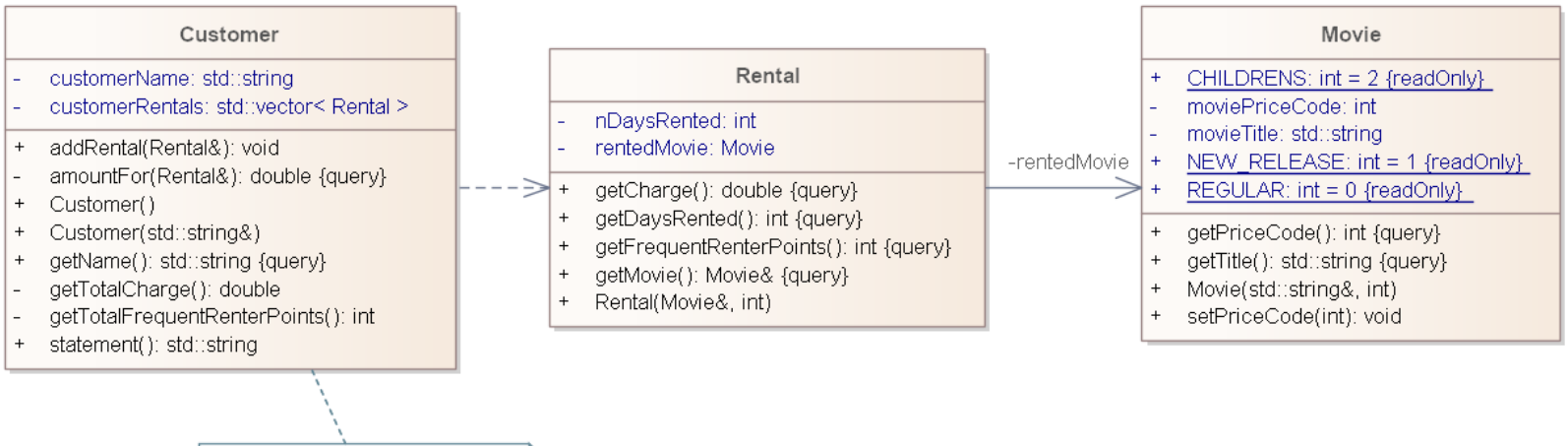
In this case we have two temporary variables, both of which are being used to get a total from the rentals attached to the customer. Both the ASCII and HTML versions require these totals.

Use **Replace Temp with Query** to replace *totalAmount* and *frequentRenterPoints* with query methods

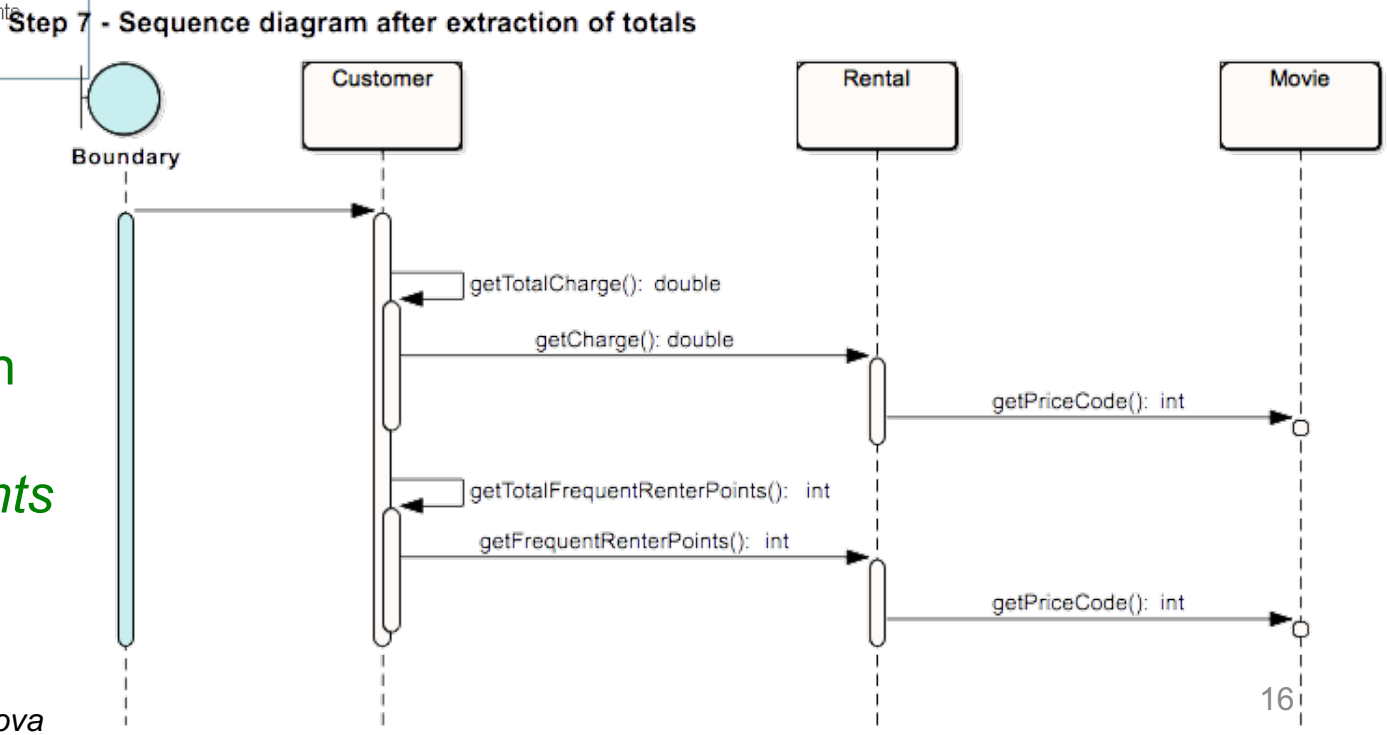
Queries are accessible to any method in the class, thus encourage a cleaner design

We begin by replacing *totalAmount* with a *charge* method on *customer*

Step 7: Still about removing temps

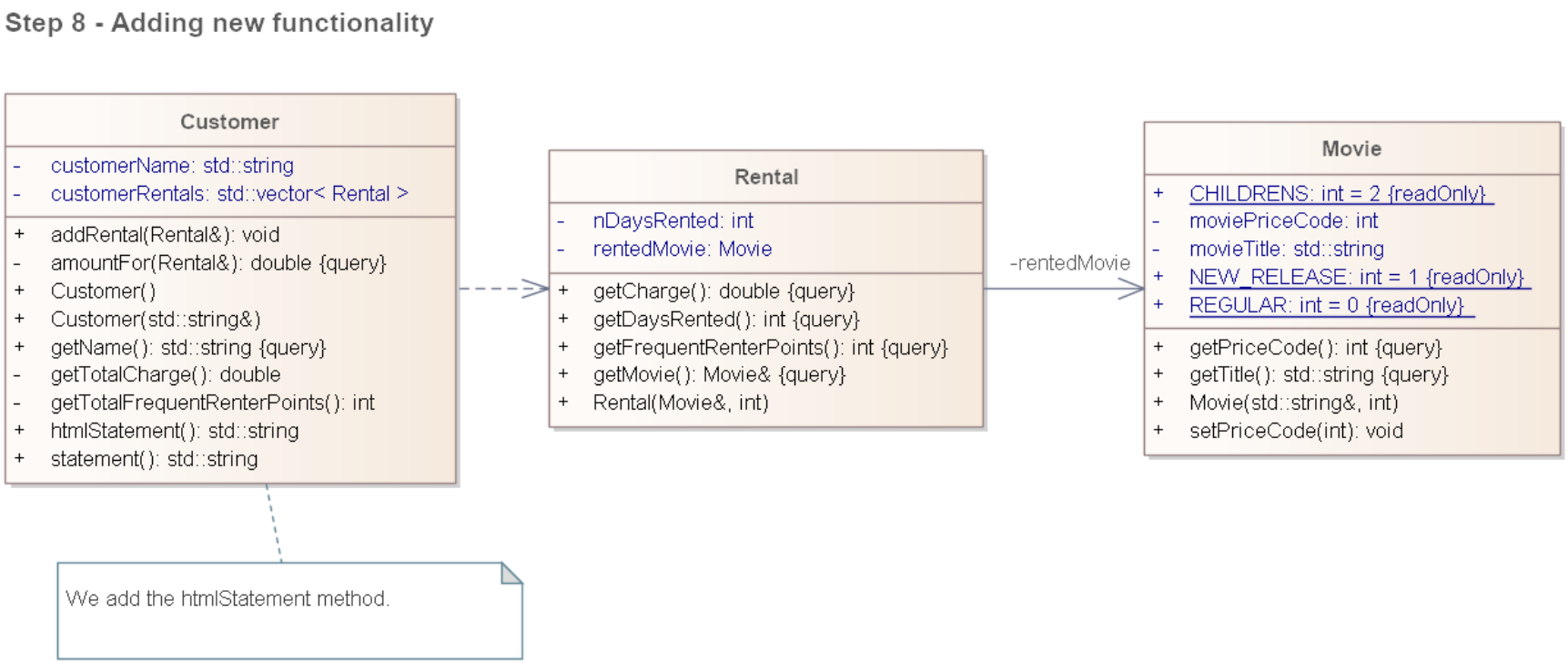


We add the getTotalFrequentRenterPoints method.



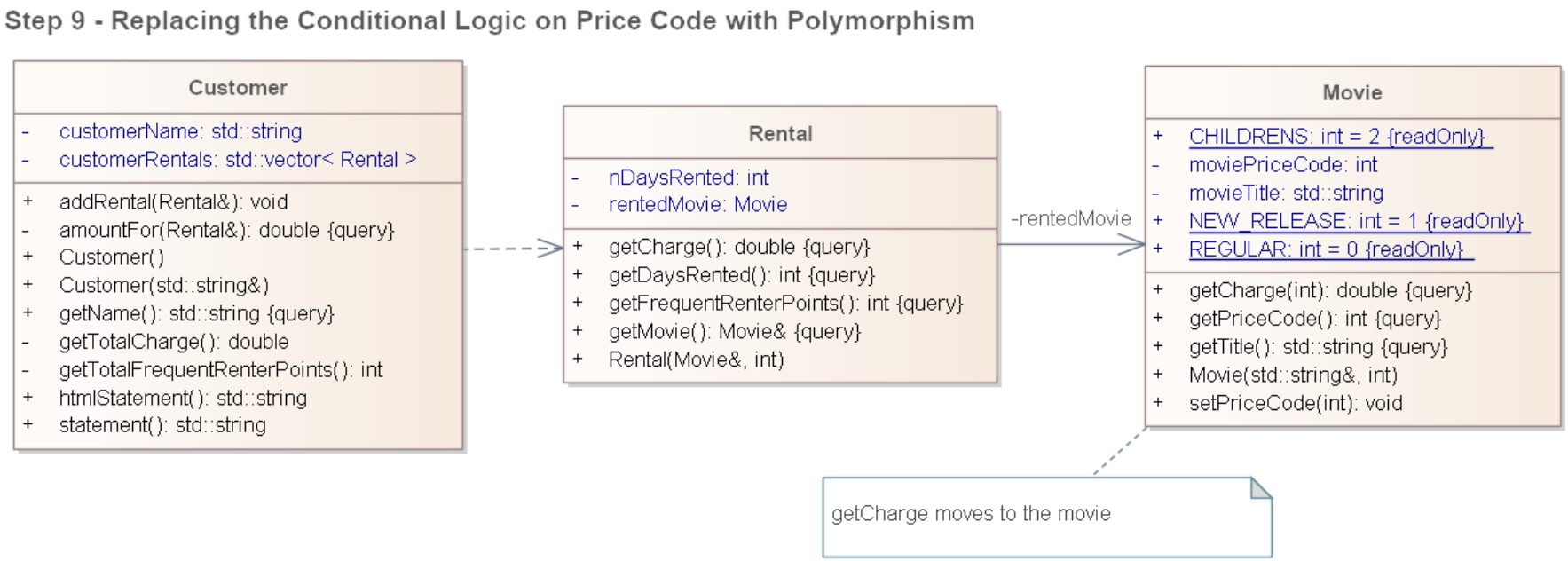
Do the same as in step 6 for *frequentRenterPoints*

Step 8: Adding new functionality



Add htmlStatement() to Customer

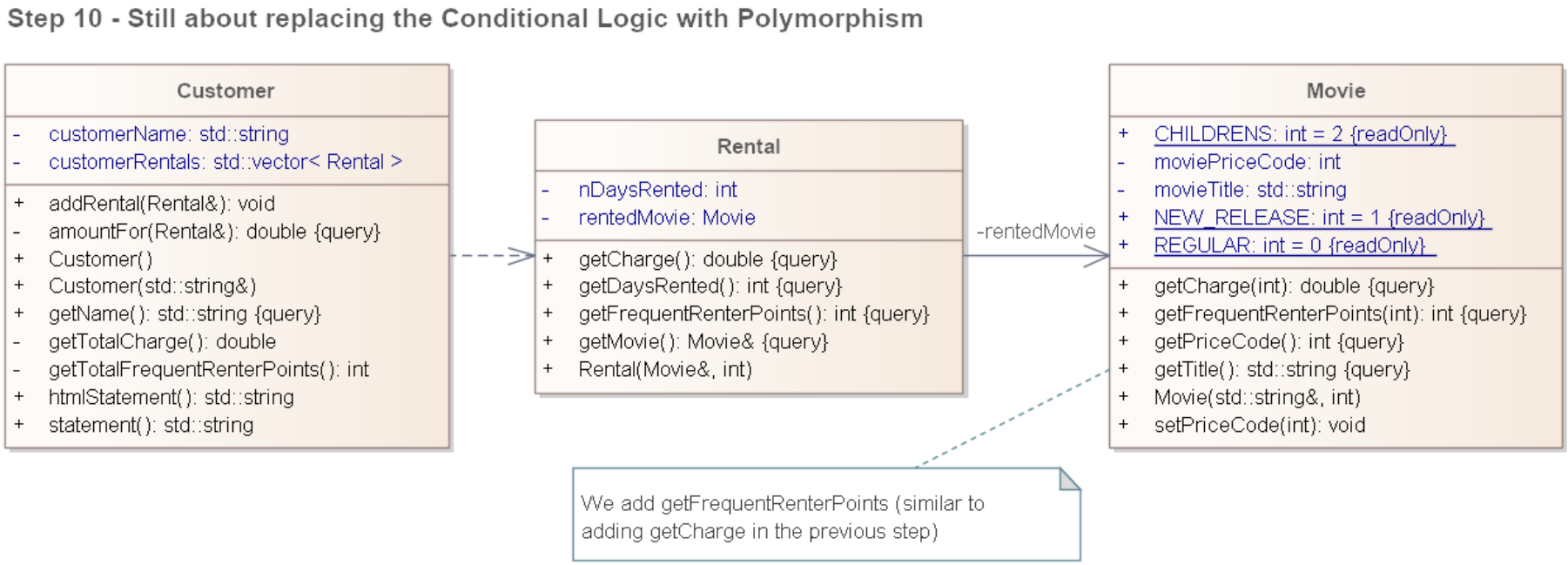
Step 9: Replacing the Conditional Logic on Price Code with Polymorphism



The first part of this problem is that *switch* statement.
It is a bad idea to do a switch based on an attribute of another object.
If you must use a *switch* statement, it should be on your own data, not on someone else's

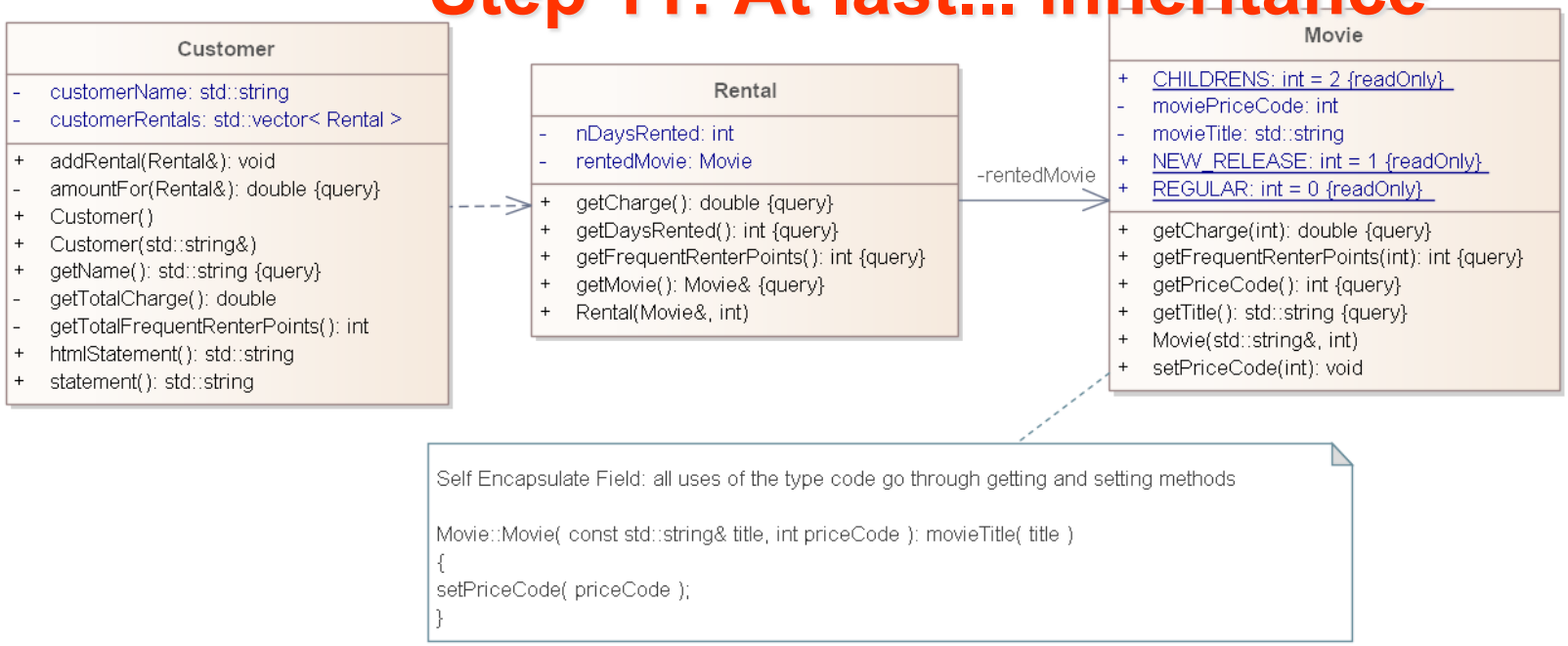
This implies that getCharge should move onto movie

10: Still about replacing the Conditional Logic with Polymorphism



Do the same as in step 9
with the frequent renter point calculation

Step 11: At last... inheritance



Replace the *switch* statement by using **polymorphism**

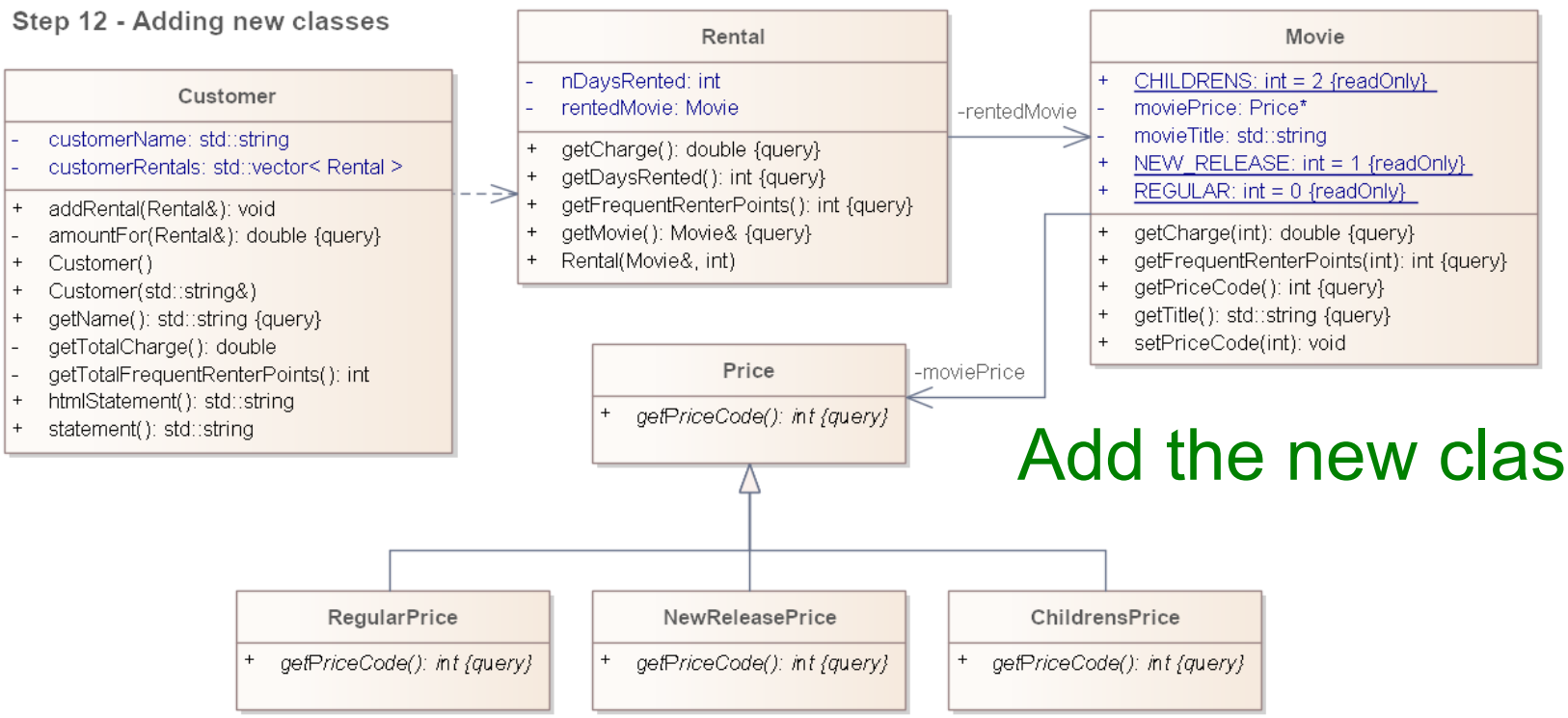
We have several types of movie that have different ways of answering the same question

This sounds like a job for **subclasses**

A movie can change its classification during its lifetime
An object cannot change its class during its lifetime
Solution: **use the State pattern**

1. **Replace Type Code** with **State/Strategy**: **Self Encapsulate Field** on the type code
2. Move Method to move the switch statement into the price class
3. Replace Conditional with Polymorphism to eliminate the switch statement

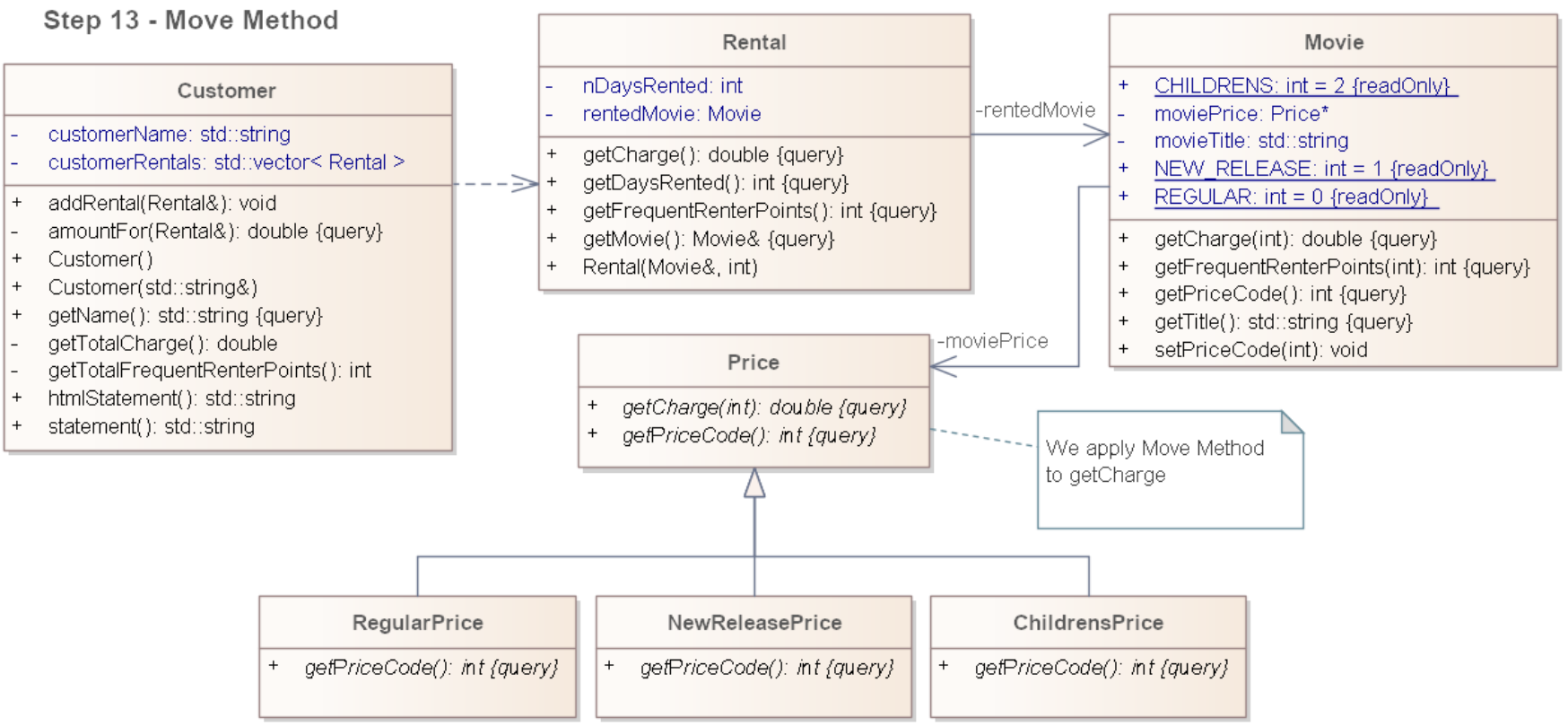
Step 12: Adding new classes



Add the new classes

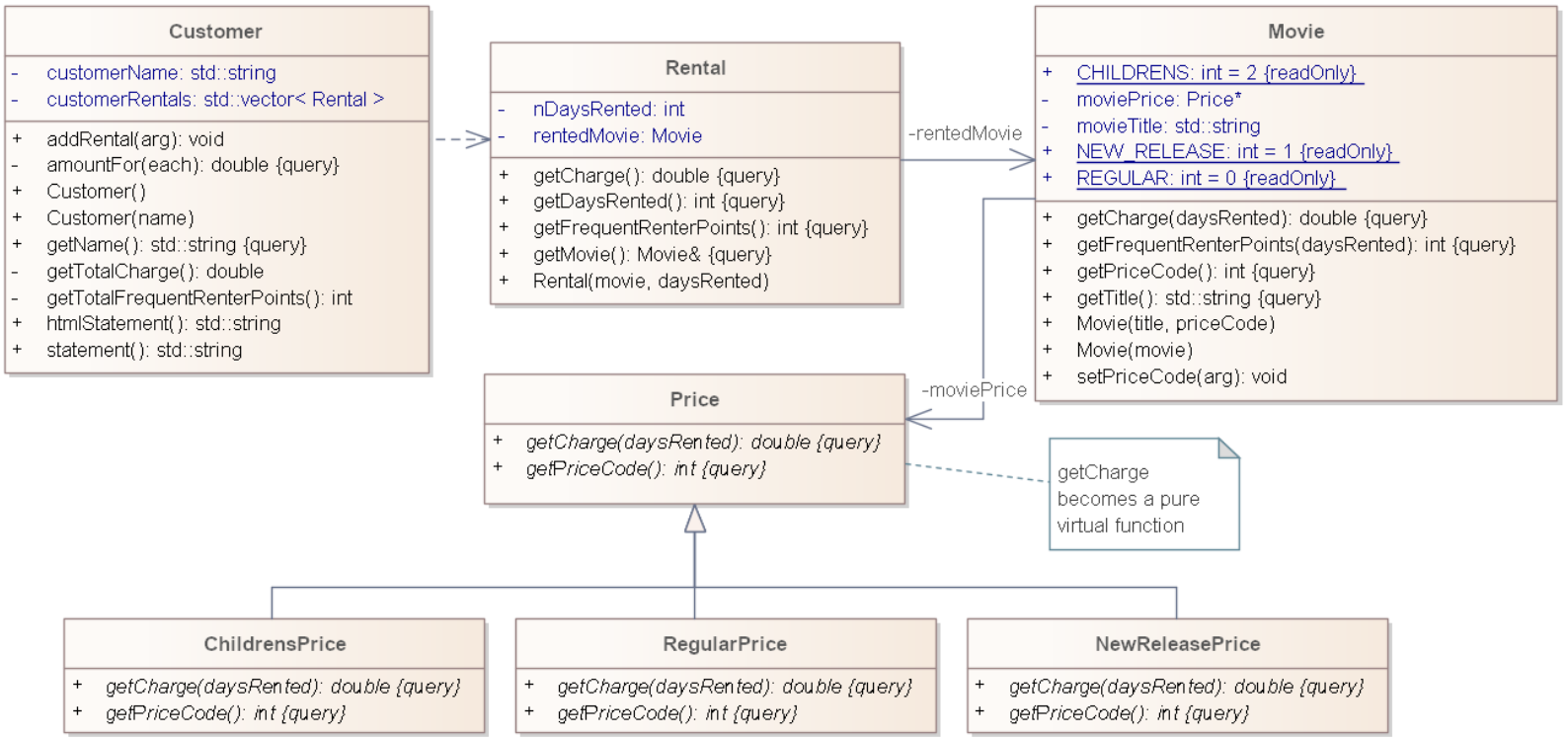
Provide the type code behavior in the price object
Do this with an
abstract method on price and **concrete methods** in the subclasses
Change the movie's accessors for the price code to use the new class

Step 13: Move Method



Apply Move Method to getCharge

Step 14: Replace Conditional with Polymorphism



Take one leg of the case statement at time and create an overriding method

Start with *RegularPrice*, override the parent case statement, which we just leave as it is

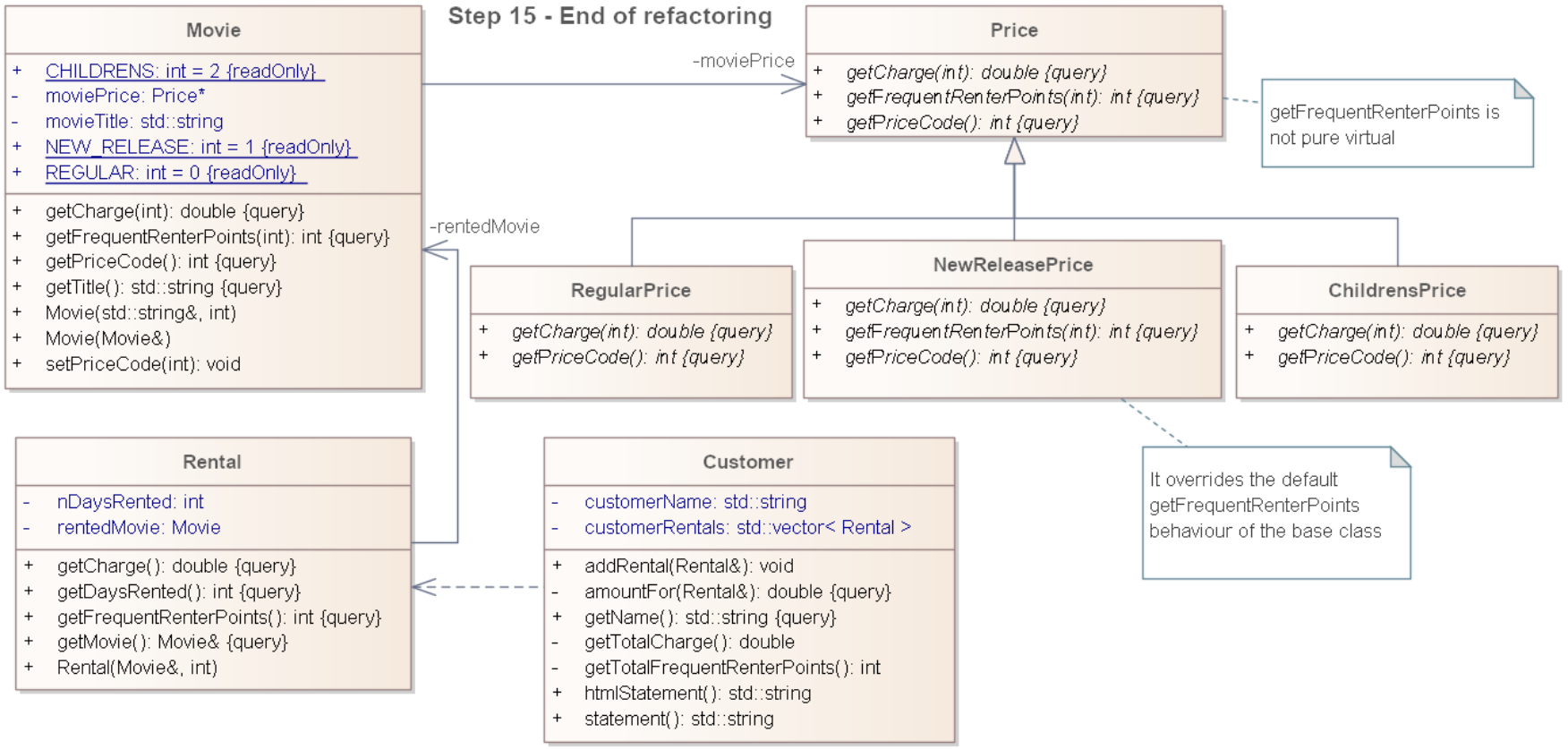
Compile and test, then take the next leg, compile and test

When done with all the legs, make *Price::getCharge* a pure virtual function

Step 15

Apply the same procedure to *getFrequentRenterPoints*

In this case do not make the superclass method pure virtual
Create an overriding method for the new releases and leave a defined method (as the default) on the superclass



Step 15: The End