Exercise: Encapsulation and Polymorphism

This document defines an in-class exercise from the "OOP" Course @ Software University.

Problem 3. Cohesion and Coupling

Maintaining strong cohesion and keeping coupling between classes loose are two of the most important principles of high-quality code. You're given a program which needs refactoring to follow these principles. You'll be working with the **CohesionAndCoupling.sln** solution. The application contains an engine which executes commands and prints their result on the console. Follow the steps below to improve code quality.

Step 1. Get to Know the Application

Before applying any changes to the code, you need to **study** it and figure out how it works. The application models a book store with methods for **adding**, **selling** and **removing** books. Each command is executed and a result is returned as a string and printed on the console. Check out the provided classes.

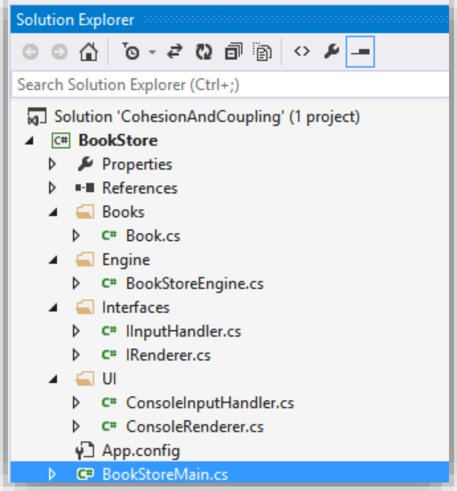
Step 2. Single Responsibility

Strong cohesion means that a class/method is responsible for one specific task. There is one class and a method in the engine which break this principle.

1. The **UserInterface** class does two different things – reads user input and prints output. What happens if we want output to be printed to a file? We'll need a new class that reads input from the console and writes to a file. For any combination of user input source and output there has to be a new class, which is cumbersome.

Following the principle of strong cohesion, extract **two interfaces** – **IRenderer** with method **WriteLine**, and **IInputHandler** with method **ReadLine**. Add two classes – **ConsoleRenderer** implementing IRenderer and **ConsoleInputHandler** implementing IInputHandler. Now, if we want the output to go to a file, we can just add a new class FileRenderer implementing the IRenderer interface.

Structure:



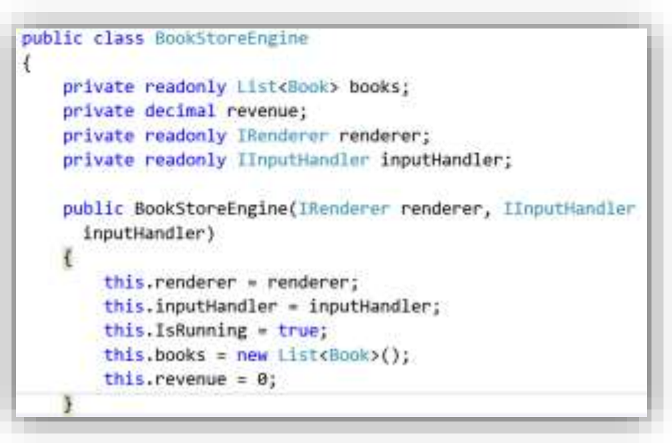
```
Solution 'CohesionAndCoupling' (1 project)
  BookStore
    Properties
    References
    Books
      Book.cs
    Engine
      BookStoreEngine.cs
    Interfaces
      IInputHandler.cs
      IRenderer.cs
    UI
      ConsoleInputHandler.cs
      ConsoleRenderer.cs
    App.config
    BookStoreMain.cs
```

2. In the engine, there is a method called **ExecuteRemoveSellBookCommand**, which does two different things. Separate it into two methods – **ExecuteRemoveBookCommand** and **ExecuteSellBookCommand**.

Step 3. Loose Coupling

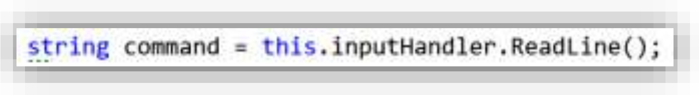
Currently, the engine is **coupled** with two concrete classes – **Console** and **Book**.

1. Decoupling the class from the console can be done through **dependency injection**. The engine needs a way to take user input and print stuff, in other words, it needs an **IRenderer** and an **IInputHandler** to perform these tasks. Create **two private fields** in the engine, one will hold an IRenderer and the other an IInputHander. In the Engine's constructor, add two parameters – renderer and inputHandler; when instantiating an engine the user will have to provide a renderer and input handler.

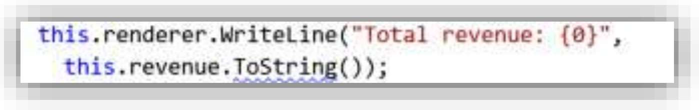


```
public class BookStoreEngine
{
    private readonly List<Book> books;
    private decimal revenue;
    private readonly IRenderer renderer;
    private readonly IInputHandler inputHandler;

    public BookStoreEngine(IRenderer renderer, IInputHandler
      inputHandler)
    {
        this.renderer = renderer;
        this.inputHandler = inputHandler;
        this.IsRunning = true;
        this.books = new List<Book>();
        this.revenue = 0;
    }
```

Create a console renderer and console input handler in the main program and pass them to the engine's constructor. Anywhere in the code where you see **Console.ReadLine** replace it with **this.inputHandler.ReadLine**, and anywhere you see **Console.WriteLine** exchange it with **this.renderer.WriteLine**. Now, if we want to print to a file, we have to create a class FileRenderer, instantiate it in the main program (with a file path) and pass it to the engine's constructor; no other modifications will be necessary.



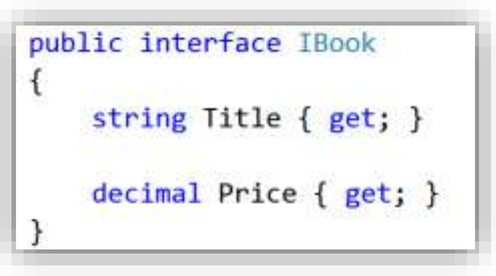
```
string command = this.inputHandler.ReadLine();
```



```
this.renderer.WriteLine("Total revenue: {0}",
  this.revenue.ToString());
```

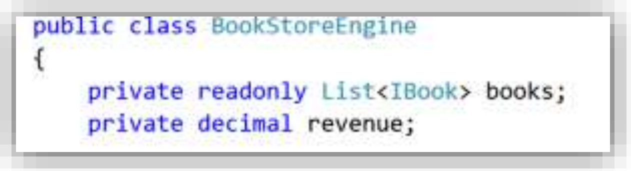
2. What happens if we want to add different types of books? To make the application more flexible, we can extract an interface **IBook**. Let's say that whatever is being sold at the bookstore needs to have at least a **title** and **price**. Create the interface; the Book class should implement it. Now any method or list accepting Book objects should be modified to accept **IBook** instead.

Interface:



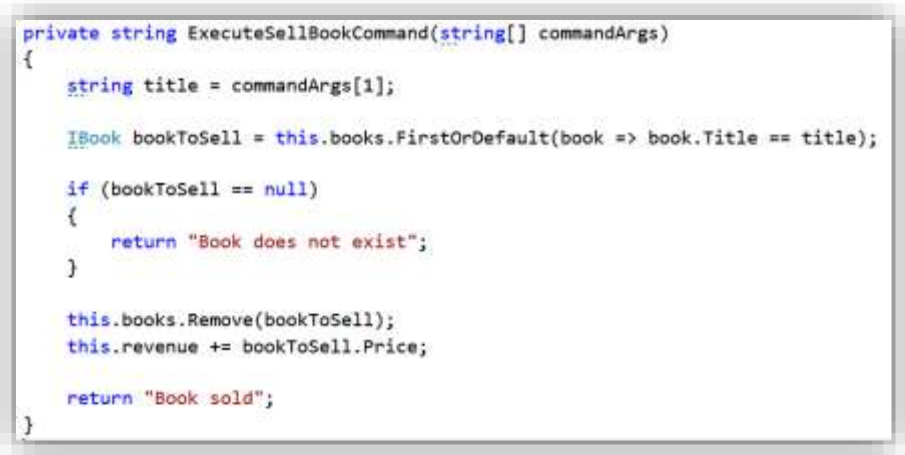
```
public interface IBook
{
    string Title { get; }

    decimal Price { get; }
}
```

Engine fields:



```
public class BookStoreEngine
{
    private readonly List<IBook> books;
    private decimal revenue;
```

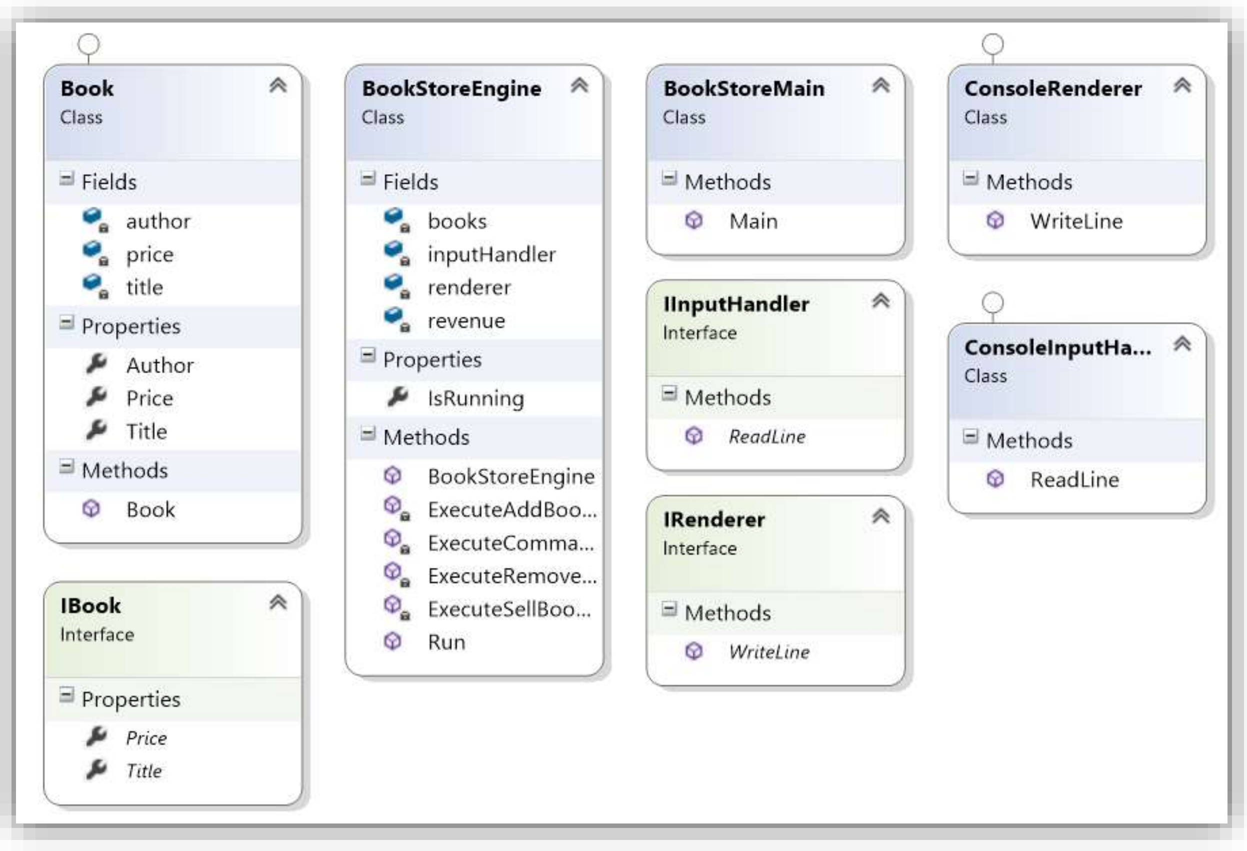
ExecuteSellBookCommand method:



```
private string ExecuteSellBookCommand(string[] commandArgs)
{
    string title = commandArgs[1];

    IBook bookToSell = this.books.FirstOrDefault(book => book.Title == title);

    if (bookToSell == null)
    {
        return "Book does not exist";
    }

    this.books.Remove(bookToSell);
    this.revenue += bookToSell.Price;

    return "Book sold";
}
```

Step 4. View Hierarchy and Test

This is how the class diagram should look like:



You can use the following commands to test the program:

Input	Output
add Game_Of_Thrones GRR_Martin 12.90 add Pod_Igoto Ivan_Vazov 4.45 remove Clash_Of_Kings sell Pod_Igoto remove Pod_Igoto remove Game_Of_Thrones sell Game_Of_Thrones stop	Book added Book added Book does not exist Book sold Book does not exist Book removed Book does not exist Goodbye! Total revenue: 4.45