SOLID Design Principles

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S.O.L.I.D.: First 5 Principles of OOD

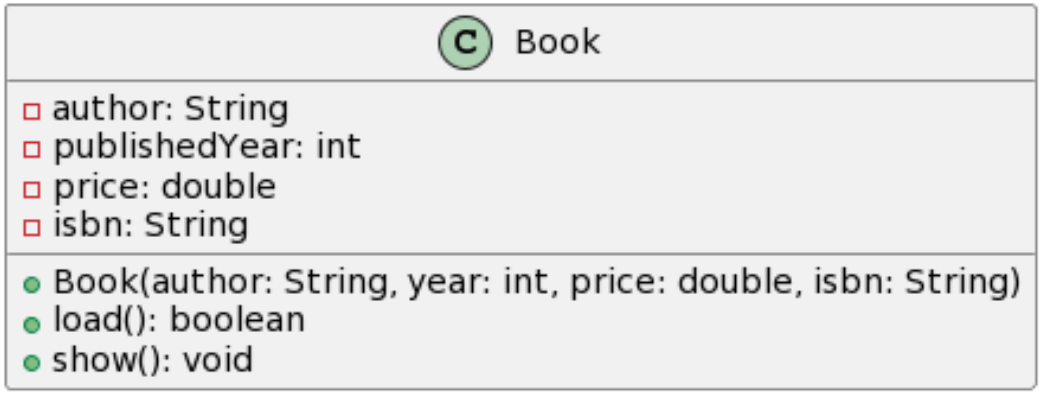
- Robert C. Martin collected 10 principles of Object Oriented Design (2000).
  - The first 5 principles - so called **SOLID** – deal with **the design of classes**. This principles is for easy-to-understand, flexible, and easy-to-maintain software development.

Acronym	Principle	한글 명칭
SRP	Single Responsibility	단일 책임 원칙
OCP	Open-Closed	개방-폐쇄 원칙
LSP	Liskov Substitution	리스코프 치환 원칙
ISP	Interface Segregation	인터페이스 분리 원칙
DIP	Dependency Inversion	의존 역전 원칙

Single Responsibility Principle

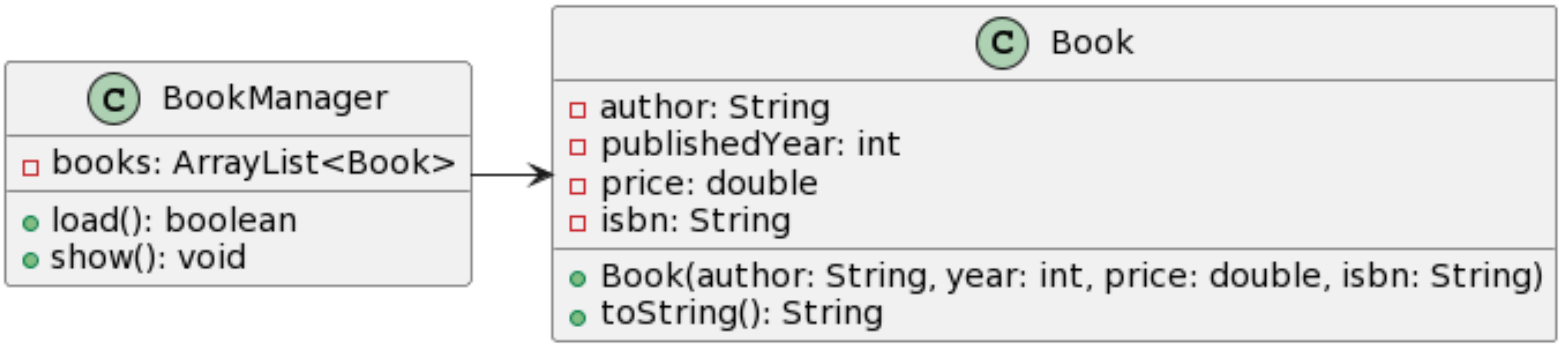
- A class should only have a **single responsibility**. In other words, it should have only **one reason to change**.
- *Responsibility as a 'reason to change'*
- ***Gather** together those things that change for the same reason, and **separate** those things that change for different reasons.*
- If there are too many features in a class, it makes difficult to maintain.

Single Responsibility Principle



- Book class example
  - load() reads the Book information and store it in member variables
  - show() displays the Book information on the console screen

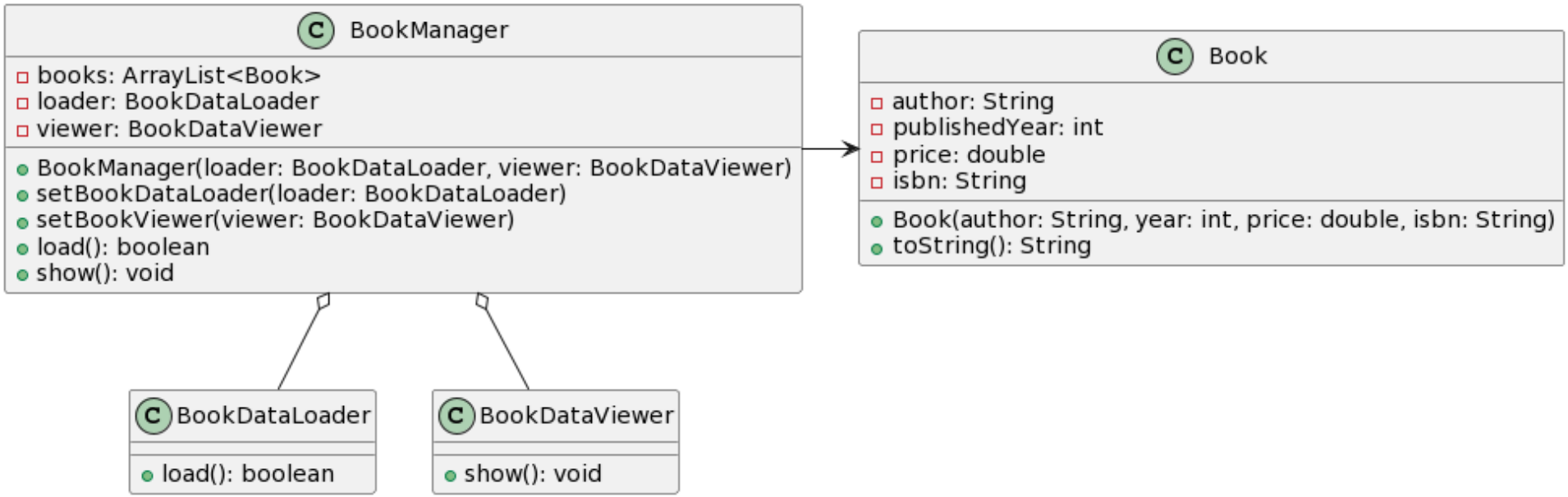
Single Responsibility Principle



- Book & BookManager class example
  - Book remove load() and show()
  - BookManager add load() & show()
    - load() reads the Book information from a file and store it in member variables
    - show() displays the books on the console screen
  - If the program is no longer modified, this design keeps SRP.

Single Responsibility Principle

- However, if you add features or new behavior, you must reconsider SRP.
  - What if you create load() that reads and stores book data from a database rather than a file?
  - What if you create show() that displays the contents of a book on the GUI(Graphical User Interface) screen instead of the console screen?



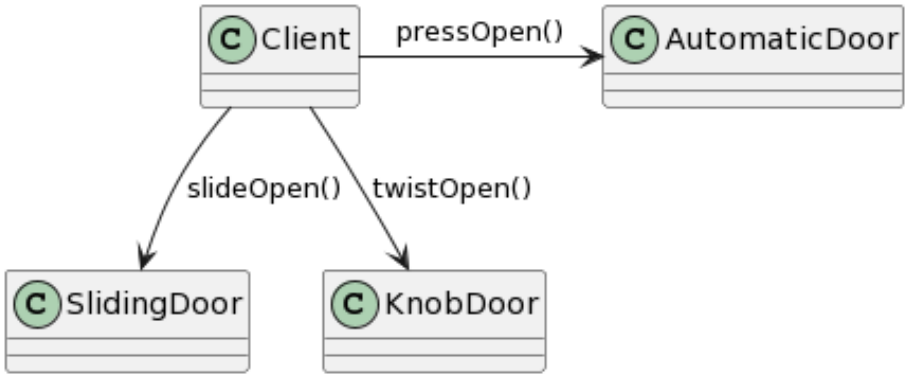
Open-Closed Principle

- "Software entities (class, module, etc) should be **open for extension, but closed for modification**."
- You should be able to **extend a class behavior, without modifying it.**
- Example: Assume a program that opens a door
  - There are three types of doors
    - Sliding door – door that slide
    - Knob door – door with a handle
    - Automatic door – button type automatic door

Open-Closed Principle

- Version 1
  - Using the if-statement depending on the type of door
  - However, if a new door is added, the code modification is inevitable.

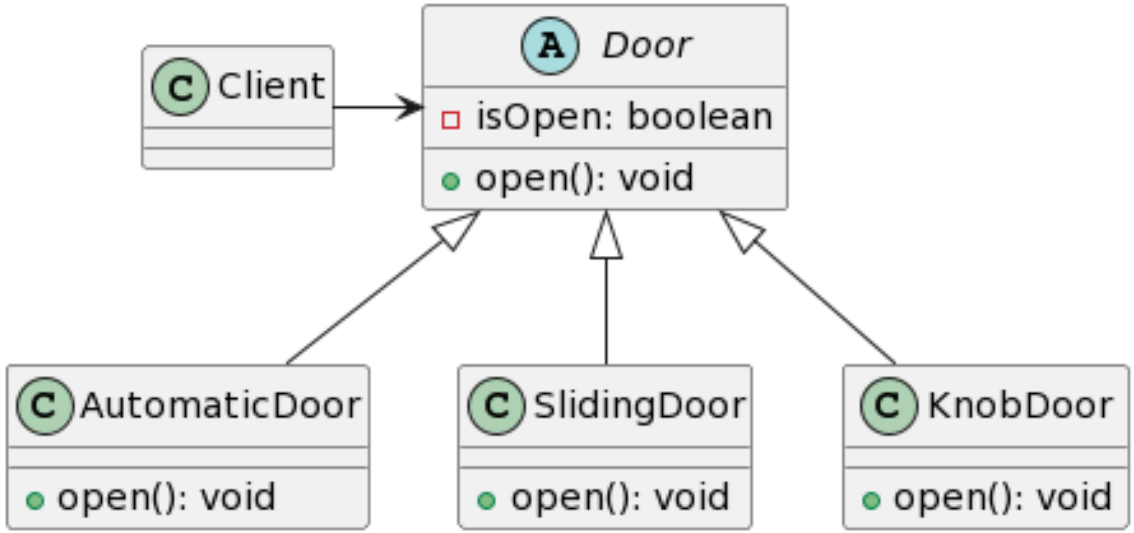
```
if (door instanceof AutomaticDoor)
    client.pressOpen(door);
else if (door instanceof KnobDoor)
    client.twistOpen(door);
else if (door instanceof SlidingDoor)
    client.slideOpen(door);
```



Open-Closed Principle

- Version 2
  - Using polymorphism
  - If a new door is added, you just add a new door class and override the open() method.

```
door.open();
```



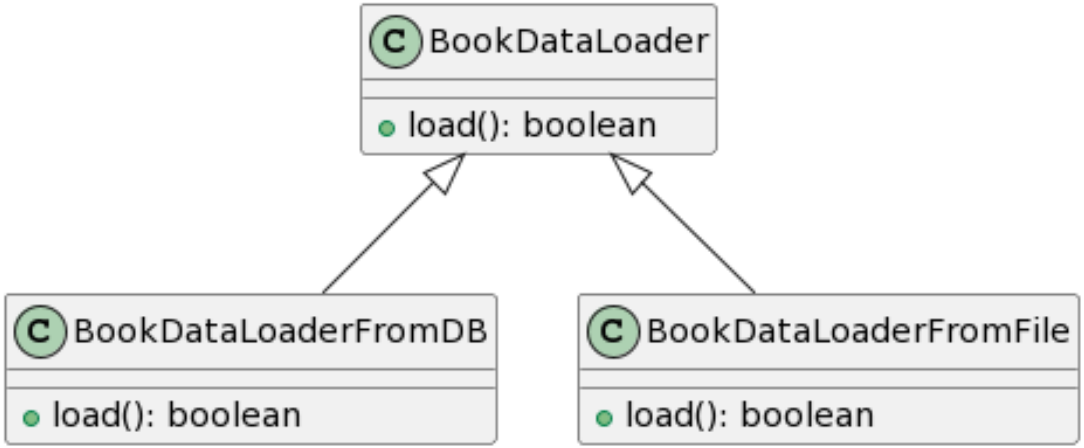
Open-Closed Principle

- Another example
  - BookManager.load() method
  - BookDataLoader class reads the data from the file.
  - BookDataLoaderFromDB class reads the data from the database.

Open-Closed Principle

- Version 1
  - Using the if-statement depending on the type of loader
  - if a new loader is added, the code modification is inevitable.

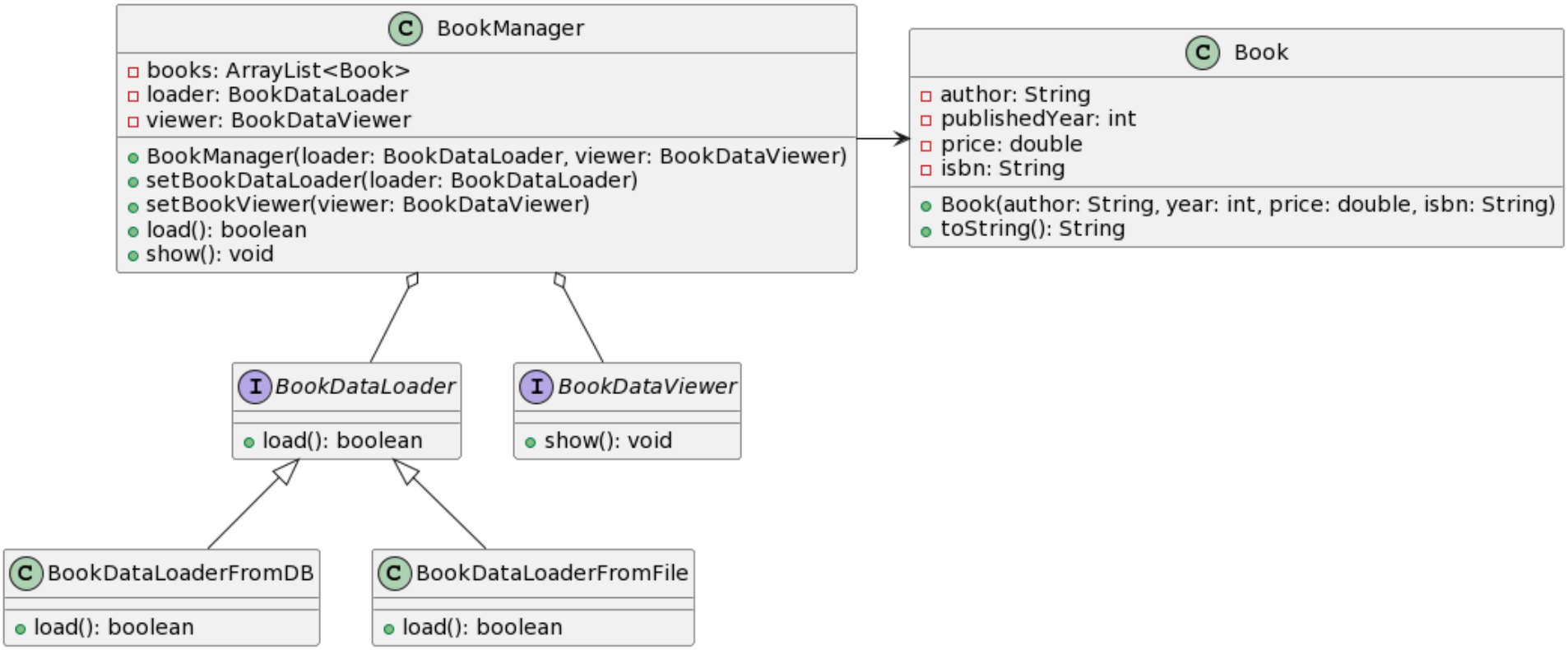
```
if (loader instanceof BookDataLoaderFromFile)
    manager.loadFromFile(loader);
else if (loader instanceof BookDataLoaderFromDB)
    manager.loadFromDB(loader);
```



Open-Closed Principle

- Version 2
  - Using polymorphism

```
loader.load();
```

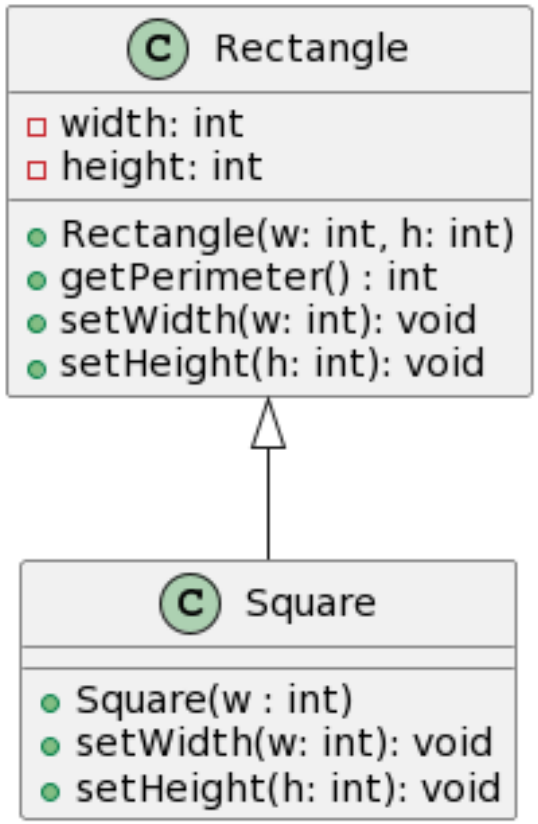


Liskov Substitution Principle

- "Objects in a program should be **replaceable with instances of their subtypes without altering the correctness of that program**."
- ***Subtypes should be substitutable for their base types***.
- *Child classes should never break the parent class' type definitions.*
- *In other words, even if you do upcasting, there should be no problem.*
- "a violation of LSP is a latent violation of OCP"

Liskov Substitution Principle

- Example: Rectangle and Square class
  - Square is a special kinds of rectangle.
  - Is the Square class really the subclass of the Rectangle class in programming?



Liskov Substitution Principle

```
class Rectangle {
    private int width;
    private int height;
    public Rectangle(int w, int h) {
        width = w;
        height = h;
    }
    public int getPerimeter() {
        return 2 * (width + height);
    }
    public void setWidth(int w) { width = w; }
    public void setHeight(int h) { height = h; }
}
```

Liskov Substitution Principle

```
class Square extends Rectangle {
    public Square(int w) {
        super(w, w);
    }
    @Override
    public void setWidth(int w) {
        super.setWidth(w);
        super.setHeight(w);
    }
   @Override
    public void setHeight(int h) {
        super.setWidth(h);
        super.setHeight(h);
    }
}
```

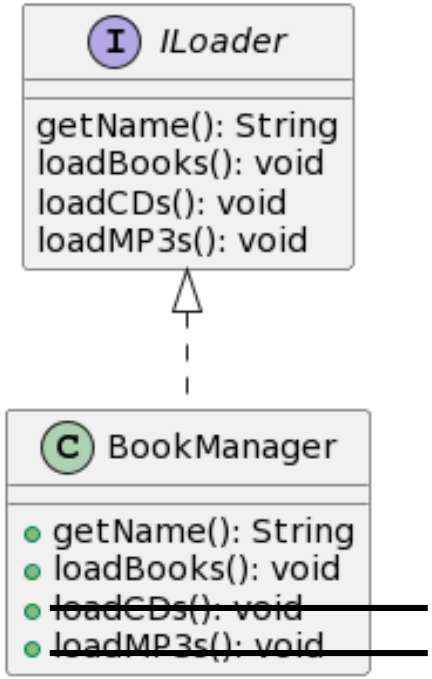
Liskov Substitution Principle

```
class Main {
    public static void main(String[] args) {
        Rectangle r = new Rectangle(3, 5);
        System.out.println(r.getPerimeter()); // 16 (2*8)
        Square s = new Square(3);
        System.out.println(s.getPerimeter()); // 12 (2*6)
        r = s;
        r.setWidth(3); // set w=3, h=3
        r.setHeight(5); // set w=5, h=5
        System.out.println(r.getPerimeter()); // 20 (2*10)
    }
}
```

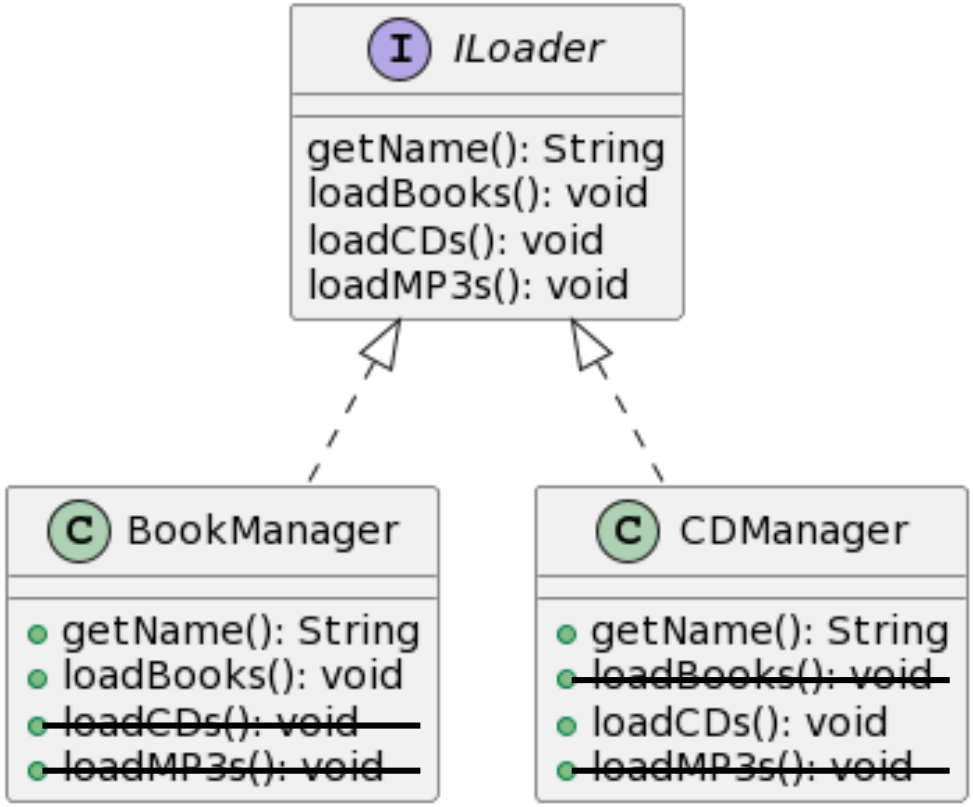
- Square cannot completely substitute Rectangle. The correct design should be both Rectangle and Square derive from a common Shape class.

Interface Segregation Principle

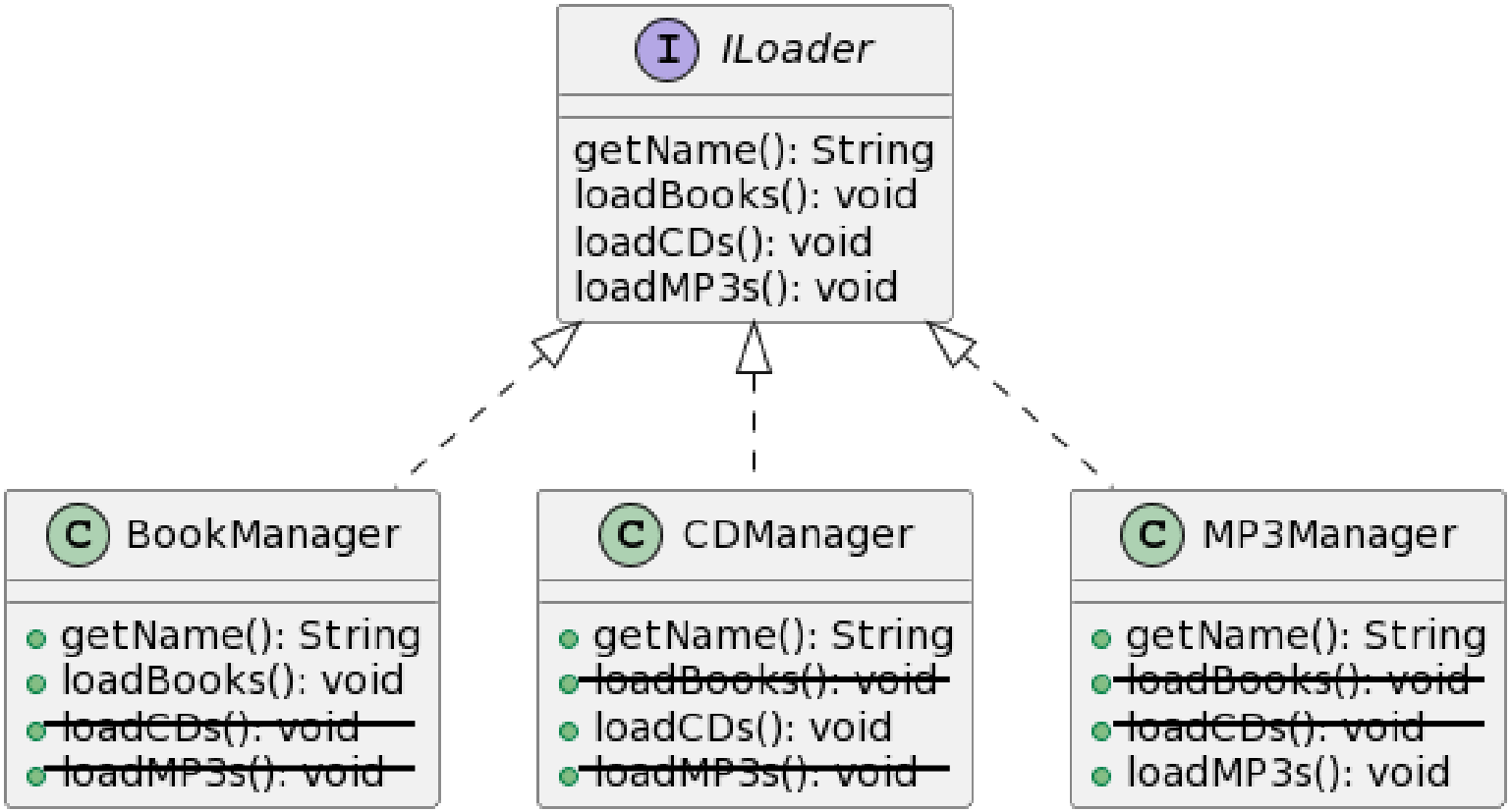
- "**Many client-specific interfaces** are better than one general-purpose interface."
- "*do not force any client to implement an interface which is irrelevant to them*"
- Each interface should have a specific responsibility.



Interface Segregation Principle

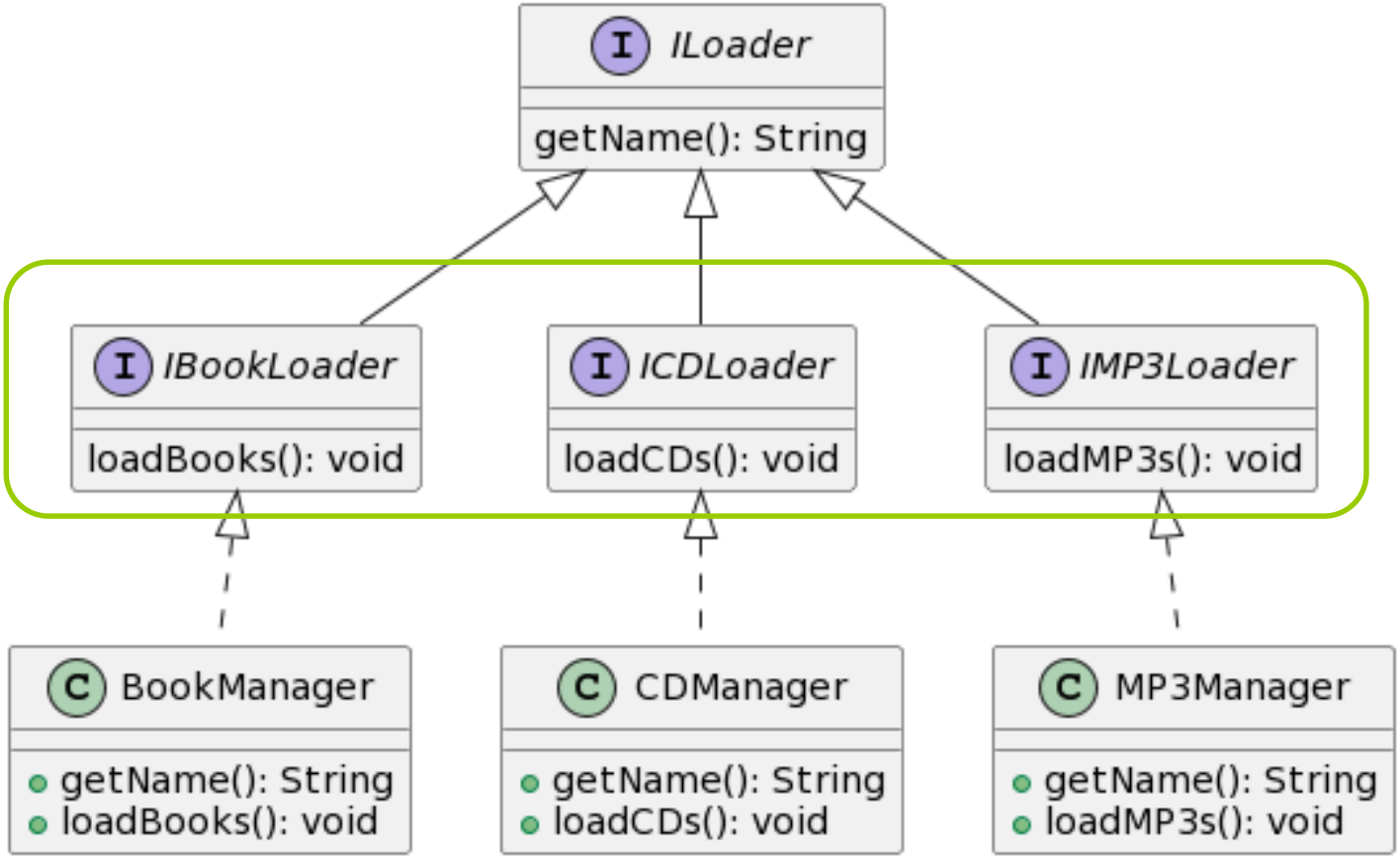


Interface Segregation Principle



Interface Segregation Principle

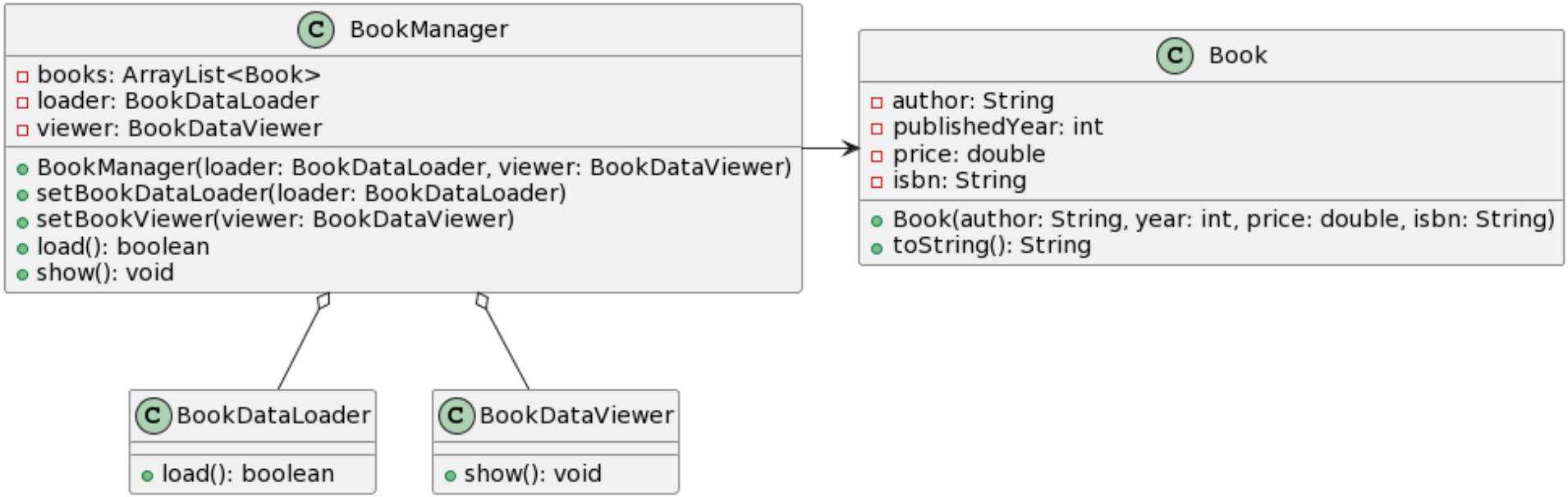
- Interface Segregation



Dependency Inversion Principle

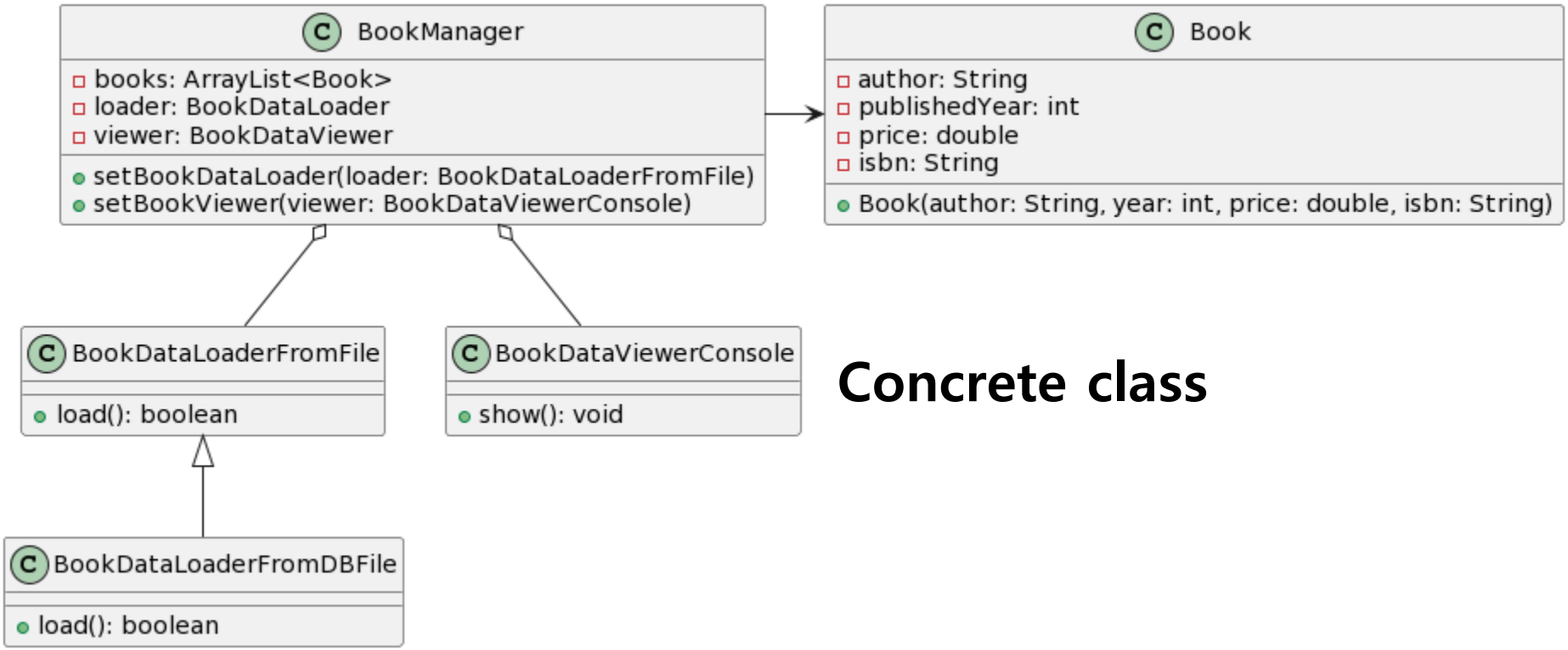
- "One should **depend upon abstractions, not concretions**."
- You should write a code that uses abstract classes or interfaces rather than concrete classes or methods that implement the functionality.
- What is a dependency between classes?
  - When one class performs a function, and needs a service of another class.
  - To become OCP, DIP must be satisfied basically.
- How do you distinguish between easy-to-change and hard-to-change?
  - Hard-to-change: "policy", "strategy"
  - Easy-to-change: "concrete way", "things"

Dependency Inversion Principle



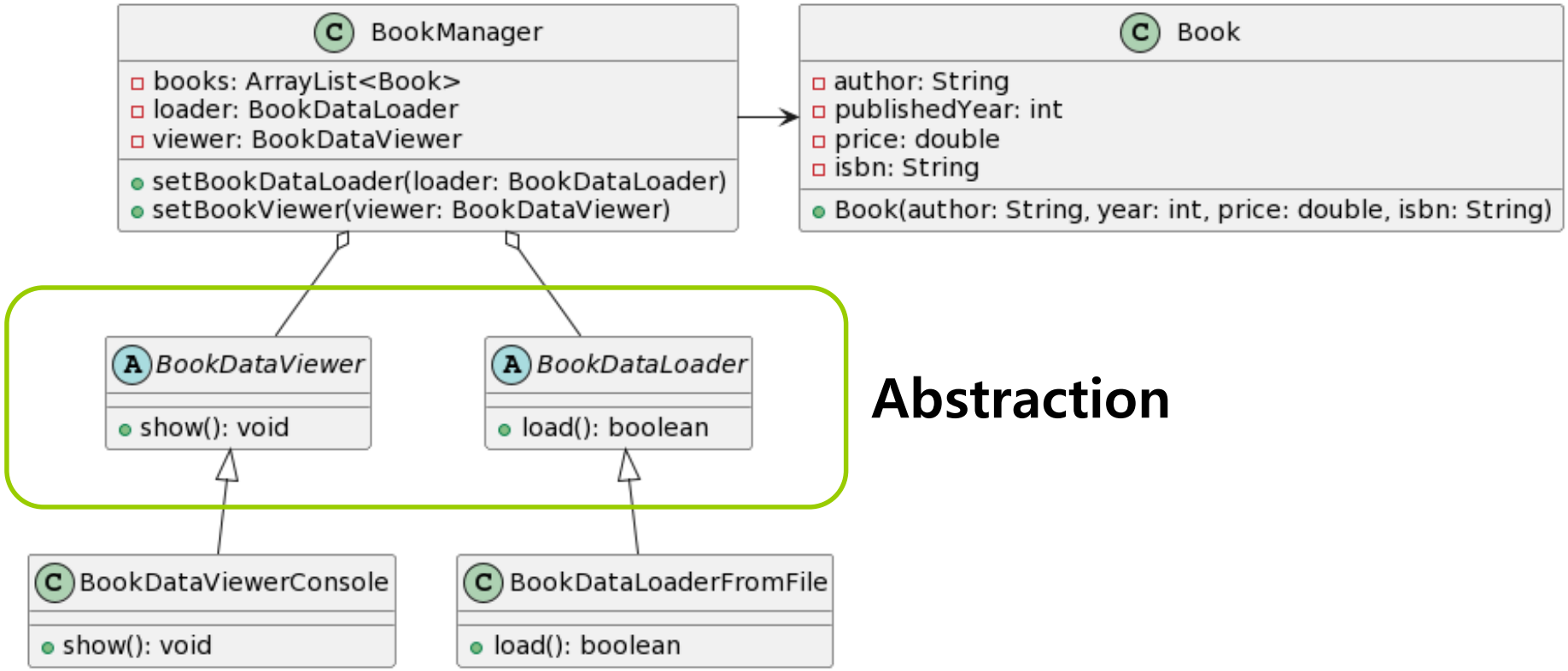
Dependency Inversion Principle

- Violation of DIP - High-level modules, which provide complex logic, should not import anything from low-level modules, which provide utility features.



Dependency Inversion Principle

- Apply DIP – Need to introduce an abstraction that decouples the high-level and low-level modules from each other



Dependency Inversion Principle