Bruno Bossola

SOLID Design Principles

Design

- What's the meaning of design?
- What's the difference if compared to analysis?

Design is about **how**

Analysis is about **what**

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Design

- Why do we need (good) design?

to deliver faster

to deal with complexity

to manage change

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Design

- How do we know a design is bad?

„WTF?”

„WTF?”

„WTF??”

„WTF??”

„WTF?”

„WTF???”

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Design

- Ok, we probably need better criterias :)
- Are there any „symptoms" of bad design?

Rigidity

Immobility

Fragility

Viscosity

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Rigidity

- **the impact of a change is unpredictable**
- every change causes a cascade of changes in dependent modules
- a nice „two days” work become a kind of endless marathon
- costs become unpredictable

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Fragility

- **the software tends to break in many places on every change**
- the breakage occurs in areas with no conceptual relationship
- on every fix the software breaks in unexpected ways

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Immobility

- **it's almost impossible to reuse interesting parts of the software**
- the useful modules have too many dependencies
- the cost of rewriting is less compared to the risk faced to separate those parts

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Viscosity

- **a hack is cheaper to implement than the solution within the design**
- preserving-design moves are difficult to think and to implement
- it's much easier to do the wrong thing rather than the right one

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Design

- What's the reason why a design becomes rigid, fragile, immobile, and viscous?

improper dependencies between modules

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Good design

- So, what are the characteristics of a good design?

high coesion

low coupling

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Good design

- How can we achieve a good design?

SRP

OCP

LSP

ISP

DIP

Let's go **SOLID**!!!

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SOLID

Software Development is not a Jenga game

SOLID

- An acronym of acronyms!
- It recalls in a single word all the most important pricinple of design
  - **SRP** Single Responsabiity Principle
  - **OCP** Open Closed Principle
  - **LSP** Liskov Substitution Principle
  - **ISP** Interface Segregation Principle
  - **DIP** Dependency Inversion Principle

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BREAK!

- What is the best comment in source code you have ever encountered? (part 1)

```
/*
 * You may think you know what the following code does.
 * But you dont. Trust me.
 * Fiddle with it, and youll spend many a sleepless
 * night cursing the moment you thought youd be clever
 * enough to "optimize" the code below.
 * Now close this file and go play with something else.
 */
```

(source: stackoverflow.com)

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SINGLE RESPONSIBILITY PRINCIPLE

Just Because You Can, Doesn't Mean You Should

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Single Responsability Principle

- **A software module should have one and only one responsability**
- Easier: a software module should have one reason only to change
- It translates directly in high coesion
- It's usually hard to see different responsabilities

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SRP

- Is SRP violated here?

```
interface Modem
{
    public void dial(String pno);
    public void hangup();
    public void send(char c);
    public char recv();
}
```

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SRP

- Is SRP violated here?

```
interface Employee
{
    public Pay calculate();
    public void report(Writer w);
    public void save();
    public void reload();
}
```

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SRP

- identify things that are changing for different reasons
- group together things that change for the same reason
- note the bias compared to "classical" OO
- smells? *Manager, *Controller, *Handler
  - you really don't know how to name those
  - SRP requires very precise names, very focused classes

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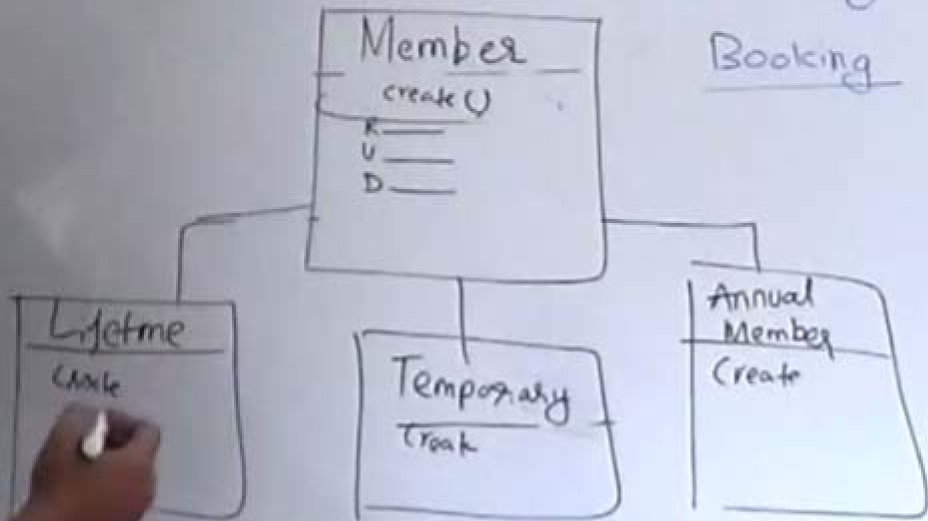
Single Responsibility Principle
Member
create()
R
U
D
Booking
Lifetime
Temporary
Annual Member
Create

OPEN CLOSED PRINCIPLE

Open Chest Surgery Is Not Needed When Putting On A Coat

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Open Closed Principle

- **Modules should be open for extension but closed to modification**
- theorized in 1998 by Bertrand Meyer in a classical OO book
- you should be able to extend the behavior of a module without changing it!

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OCP?

```
void DrawAllShapes(ShapePointer list[], int n)
{
  for (int i=0; i<n; i++)
  {
    struct Shape* s = list[i];
    switch (s->type)
    {
      case square: DrawSquare((struct Square*)s);
                   break;
      case circle: DrawCircle((struct Circle*)s);
                   break;
    }
}
```

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OCP?

```
public void draw(Shape[] shapes) {
    for( Shape shape : shapes ) {
        switch (shape.getType()) {
            case Shape.SQUARE:
                draw((Square)shape);
                break;
            case Shape.CIRCLE:
                draw((Circle)shape);
                break;
            }
        }
    }
```

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OCP!

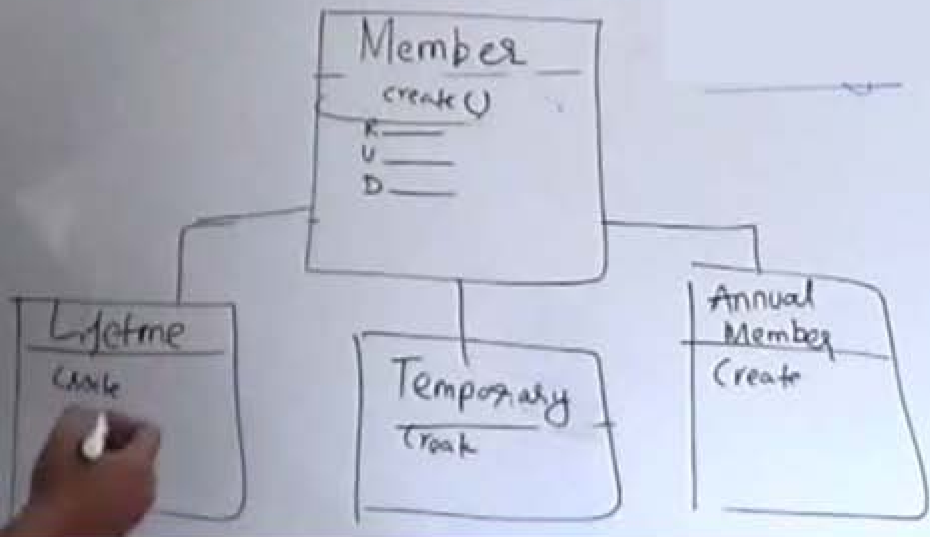
```
public void draw(Shape[] shapes) {
    for( Shape shape : shapes ) {
        shape.draw();
    }
}
```

OCP

- Abstraction is the key!

Uncle Bob's recipe

- keep the things that change frequently away from things that don't change
- if they depend on each other, things that change frequently should depend upon things don't change


Member
create()
R
U
D
Lifetme
Temporary
Annual
Member
Create

Open for Extension/Closed for
Modification
Booking
Member
Create()
R
U
D
Lifetime
Create()
Temporary
Annual
Member
Create
Quarterly
Create()

BREAK!

- What is the best comment in source code you have ever encountered? (part 2)

```
// I dedicate all this code, all my work, to my wife,
// Darlene, who will have to support me and our three
// children and the dog once it gets released into
// the public.
```

(source: stackoverflow.com)

LISKOV SUBSTITUTION PRINCIPLE

If It Looks Like A Duck, Quacks Like A Duck, But Needs Batteries - You Probably Have The Wrong Abstraction

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Liskov Substitution Principle

- **If for each object o1 of type S there is an object o2 of type T such that for all programs P defined in terms of T, the behavior of P is unchanged when o1 is substituted for o2, then S is a subtype of T.**

Ability to replace any instance of a parent class with an instance of one of its child classes without negative side effects.

- uh?

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LSP

- Try #2:
- **Function that use pointers or references to base classes must be able to use objects of derived classes without knowing it**

LSP

- Try #3:
- **Given an entity with a behavior and some possible sub-entities that could implement the original behavior, the caller should not be surprised by anything if one of the sub entities are substituted to the original entity**

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LSP (by example)

- How would you model the relationship between a square and a rectangle?
- Should the square class extends rectangle?

LSP (by example)

- Of course, isn't the Square a kind of Rectangle, after all?
- It seems an obvious ISA

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LSP (by example)

- But... what about:
  - rectangle has two attributes, width and height: how can we deal with that?
  - how do we deal with setWidth() and setHeight() ?

- Is it safe?

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LSP (by example)

- No, behavior is different
- If I pass a Square to a Rectangle aware function, then this may fail as it may assume that width and heigth are managed separately

- Geometry != Code

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INTERFACE SEGREGATION PRINCIPLE

You Want Me To Plug This In, Where?

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Interface Segregation Principle

Separation

- fat classes may happen :(
- usually there are many clients each using a subset of the methods of such classes
- such client classes depend upon things they don't use
  - what happens when the big class changes? all depending modules must also change

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ISP

- ISP states that clients should not know about fat classes
- instead they should rely on clean cohesive interfaces
- you don't want to depend upon something you don't use

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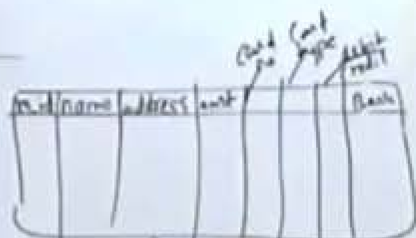
Object Oriented Programming

Concepts / Design / Practices

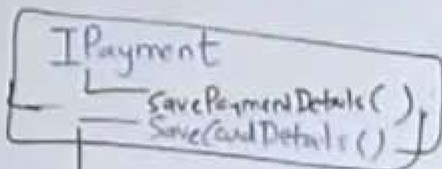
SOLID

I — Interface Segragation Principle



Booking

bookingDetails(mybm m)
PaymentDetails( )



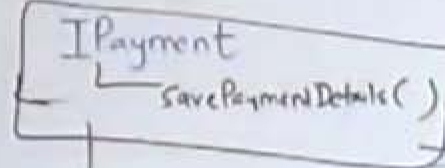

```
CardPayment : IPayment
{
  SavePaymentDetails()
  {
    Nid, amt
  }
  Save CardDetails()
  {
    cno, ct, bank
  }
}

Cash Payment : IPayment
  SavePaymentDetails()
  {
  }

OnlineCardPayment : IPayment
{
  SavePaymentDetails()
  {
  }
  Save CardDetails()
  {
  }
}
```

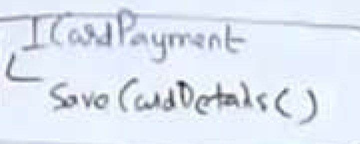
SOLID

I — Interface Segragation Principle

Booking

bookingDetails(mybm m)
PaymentDetails( )






```
CardPayment : IPayment, ICardPayment
{
  SaveCardDetails()
  {
    cno - ct - bank
  }
  SavePaymentDetails()
  {
    amt/address/name/mid
    SaveCardDetails()
  }
}

Cash Payment : IPayment
{
  SavePaymentDetails()
  {
    amt
    name
    address
  }
}

OnlineCardPayment : IPayment, ICardPayment
{
  SaveCardDetails()
  {
    cno, ctype, bank
  }
  Save PaymentDetails()
  {
    name/address/amt
    SaveCardDetails()
  }
```

12:22

BREAK!

- What is the best comment in source code you have ever encountered? (part 3)

```
// I'm sorry
```

(source: stackoverflow.com)

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DEPENDENCY INVERSION PRINCIPLE

Would You Solder A Lamp Directly To The Electrical Wiring In A Wall?

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Dependency Inversion Principle

- **High level modules should not depend upon low level modules, both should depend upon abstractions**
- **Abstractions should not depend upon details, details should depend upon abstractions**

DIP?

```
enum OutputDevice {printer, disk};

void copy(OutputDevice dev)
{
    int c;
    while((c=readKeyboard()) != EOF)
    {
        if (dev == printer)
            writePrinter(c);
        else
            writeDisk(c);
    }
}
```

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DIP!

```
void copy(Reader input, Writer output)
{
    int c;
    while((c=input.read()) != EOF) {
        output.write(c);
    }
}
```

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DIP

- don't depend on anything concrete, depend only upon abstraction
- high level modules should not be forced to change because of a change in low level / technology layers
- drives you towards low coupling

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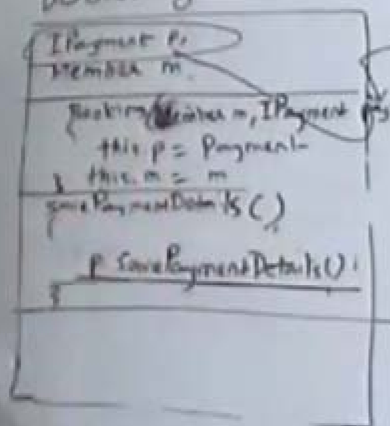


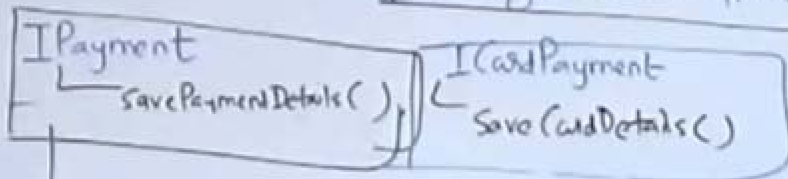
Booking b = new Booking(m, new CardPayment())

Booking b = new Booking(m, new CashPayment());

Booking b = new Booking(m, new OnlineCardPayment());

SOLID

Dependency Inversion Principle




```
CardPayment : IPayment, ICardPayment {
  {
  SaveCardDetails()
  {
  — cno – ct → bank
  }
  SavePaymentDetails()
  {
  amt/address/name/mid
  SaveCardDetails()
  }
}
```

```
Cash.Payment : IPayment
{
  SavePaymentDetails()
  {
  amt
  name
  address
  }
}
```

```
OnlineCardPayment : IPayment, ICardPayment
{
  SaveCardDetails()
  {
  cno, ctype, bank
  }
  SavePaymentDetails()
  {
  name/address/amt
  SaveCardDetails()
  }
```

Conclusion

- **good design** is needed to successfully deal with change
- the main forces driving your design should be **high cohesion** and **low coupling**
- **SOLID** principles put you on the right path

- warning: these principles cannot be applied blindly :)

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Q&A

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