

# SOLID Principles

## The Benefits and Potential of Using SOLID Principles

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**#python-advanced**



**Single Responsibility**

# What is Single Responsibility?

- Each class is responsible for **only one thing** and should have only one reason to change
- A class that has many responsibilities is **coupling** these responsibilities together, which leads to **complexity and fragility**



- SRP states that classes should have one responsibility. Here we have **two**:
  - student properties management
  - student database management

```
class Student:  
    def __init__(self, name):  
        self.name = name  
  
    def get_name(self):  
        return self.name  
  
    def register(self, student):  
        pass
```

- We can avoid the domino effect if the application changes by **splitting the class**:
  - create another class that will handle the responsibility of storing a student in a database

```
class Student:  
    def __init__(self, name):  
        self.name = name  
  
    def get_name(self):  
        return self.name
```

```
class StudentRecords:  
    def get_student(self, id):  
        pass  
  
    def register(self, student):  
        pass
```



**Open/Closed**



# What is the Open/Closed Principle?

- Software entities like **classes**, **modules**, and **functions** should be **open** for **extension** but **closed** for **modifications**
- This can be achieved through:
  - Abstraction
  - Mix-ins
  - Monkey-Patching
  - Generic functions (using overloading)

- Let's imagine that we want to make a 40% **discount** of the semester taxes to all students with **grades above 5**

```
class StudentTaxes:
    def __init__(self, name, semester_tax, average_grade):
        self.name = name
        self.semester_tax = semester_tax
        self.average_grade = average_grade

    def get_discount(self):
        if self.average_grade > 5:
            return self.semester_tax * 0.4
```

- Later we decide that we want to give a 20% **discount** to students with **grades above 4**

```
class StudentTaxes:
    def __init__(self, name, semester_tax, average_grade):
        self.name = name
        self.semester_tax = semester_tax
        self.average_grade = average_grade

    def get_discount(self):
        if self.average_grade > 5:
            return self.semester_tax * 0.4
        elif self.average_grade > 4:
            return self.semester_tax * 0.2
```

```
class StudentTaxes:
    def __init__(self, name, semester_tax, avg_grade):
        self.name = name
        self.semester_tax = semester_tax
        self.average_grade = average_grade

    def get_discount(self):
        if self.average_grade > 5:
            return self.semester_tax * 0.4

class AdditionalDiscount(StudentTaxes):
    def get_discount(self):
        result = super().get_discount()
        if result:
            return result
        if 4 < self.average_grade <= 5:
            return self.semester_tax * 0.2
```

Keep the class unchanged

Extend the base class functionality by adding new class



**Liskov Substitution**

# LSP – Substitutability

- Derived types must be completely **substitutable** for their base types
- Derived classes
  - only **extend** functionalities of the base class
  - must **not** remove **base** class **behavior**

Student **IS-SUBSTITUTED-FOR** Person

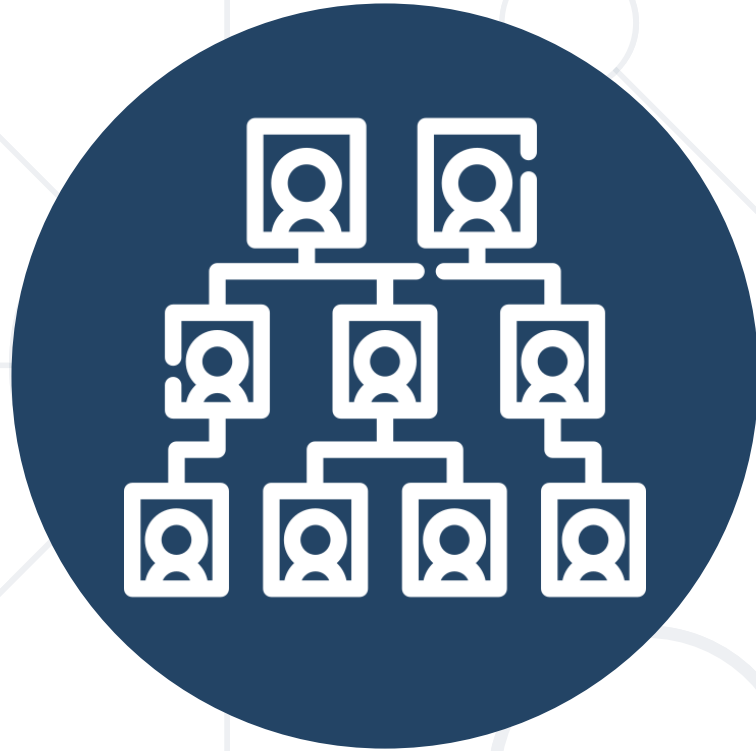


- LSP is fundamental to a good object-oriented software design because it emphasizes one of its core traits – **polymorphism**
  - It is about creating **correct hierarchies** so that classes derived from a base one are polymorphic along the parent one
  - Carefully thinking about new classes in the way that LSP suggests helps us to **extend the hierarchy correctly**
  - We could say that **LSP** contributes to the **OCP**

- If the code is checking the type of class
- Overridden methods change their behavior
- Override a method of the superclass by an empty method
- Base class depends on its subtypes







# Interface Segregation

# What is Interface Segregation?

- A client **should not depend** on methods it **does not use**
  - A good way of ensuring this is by **separation** through multiple **inheritance**
  - This is precisely the purpose of the **mix-ins** - to provide multiple clients with **specific behaviours**
- ISP is intended to keep a system **decoupled** and thus easier to refactor, change, and redeploy



- Python **doesn't have** interfaces
- Languages that do have interfaces:
  - Breaking them up too much ends up with **interfaces implementing interfaces**



**COMPLEX**

- Class **Shape** draws rectangle and circle
- Class Circle or Rectangle implementing the Shape class must define the methods **draw\_rectangle()** and **draw\_circle()**

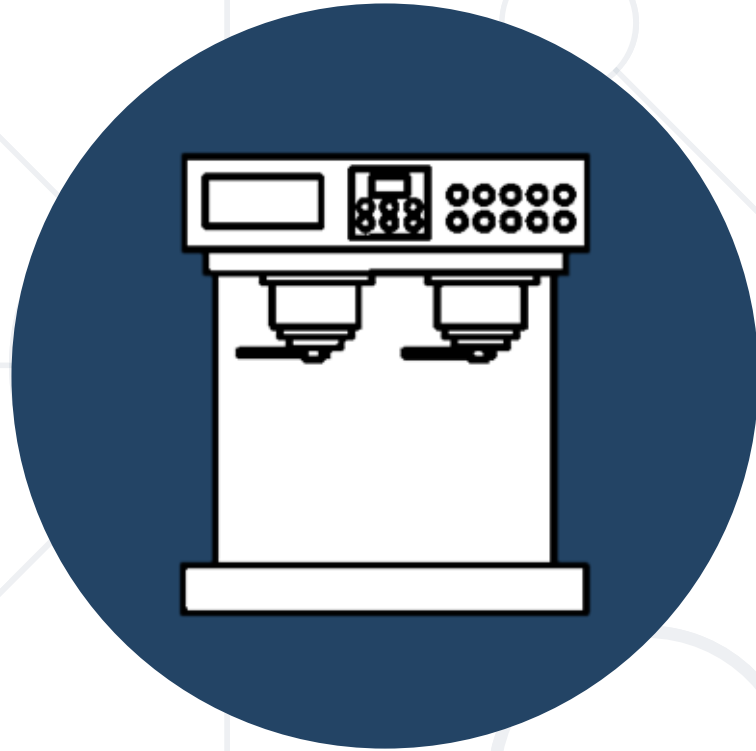
```
class Shape:  
    def draw_rectangle(self):  
        raise NotImplementedError  
  
    def draw_circle(self):  
        raise NotImplementedError
```

- Class Rectangle implements the method draw\_circle it has no use of
- Class Circle implements method draw\_rectangle

```
class Rectangle(Shape):  
    def draw_rectangle(self):  
        pass  
    def draw_circle(self):  
        pass  
class Circle(Shape):  
    def draw_rectangle(self):  
        pass  
    def draw_circle(self):  
        pass
```

- To make Shape conform to the ISP principle, we segregate the actions into **different classes**
  - Classes Circle and Rectangle can inherit from class Shape and implement **their own draw behaviour**

```
class Shape:
    def draw(self):
        raise NotImplementedError
class Rectangle(Shape):
    def draw(self):
        pass
class Circle(Shape):
    def draw(self):
        pass
```



# Dependency Inversion

# Dependency Inversion

- Interesting design principle by which we protect our code by making it **independent** of things that are fragile, volatile, or out of our control
- Depend on **abstractions**, not on **concretions**
  - High-level modules should not depend on low-level modules. **Both** should depend on **abstractions**
  - Abstractions should not depend on details. **Details** should depend on **abstractions**





# Dependency Injection

- Software engineering technique for defining the **dependencies** among objects
- Why use Dependency Injection?
  - **Decreases coupling** between a class and its dependency
  - Can be applied to legacy code as a **refactoring** because it doesn't require any change in code behaviour
  - Allows a client to **remove** all knowledge of a **concrete implementation** that it needs to use



```
class Email:  
    def send_email(self):  
        pass
```

```
class Notification:  
    def __init__(self):  
        self._email = Email()
```

```
    def promotional_notification(self):  
        self._email.send_email()
```

**Notification  
depends on Email**

# Example: Constructor Injection

```
class MessageService:
    def send_message(self):
        pass

class Email(MessageService):
    def send_message(self):
        pass

class Notification:
    def __init__(self, service: MessageService):
        self._service = service

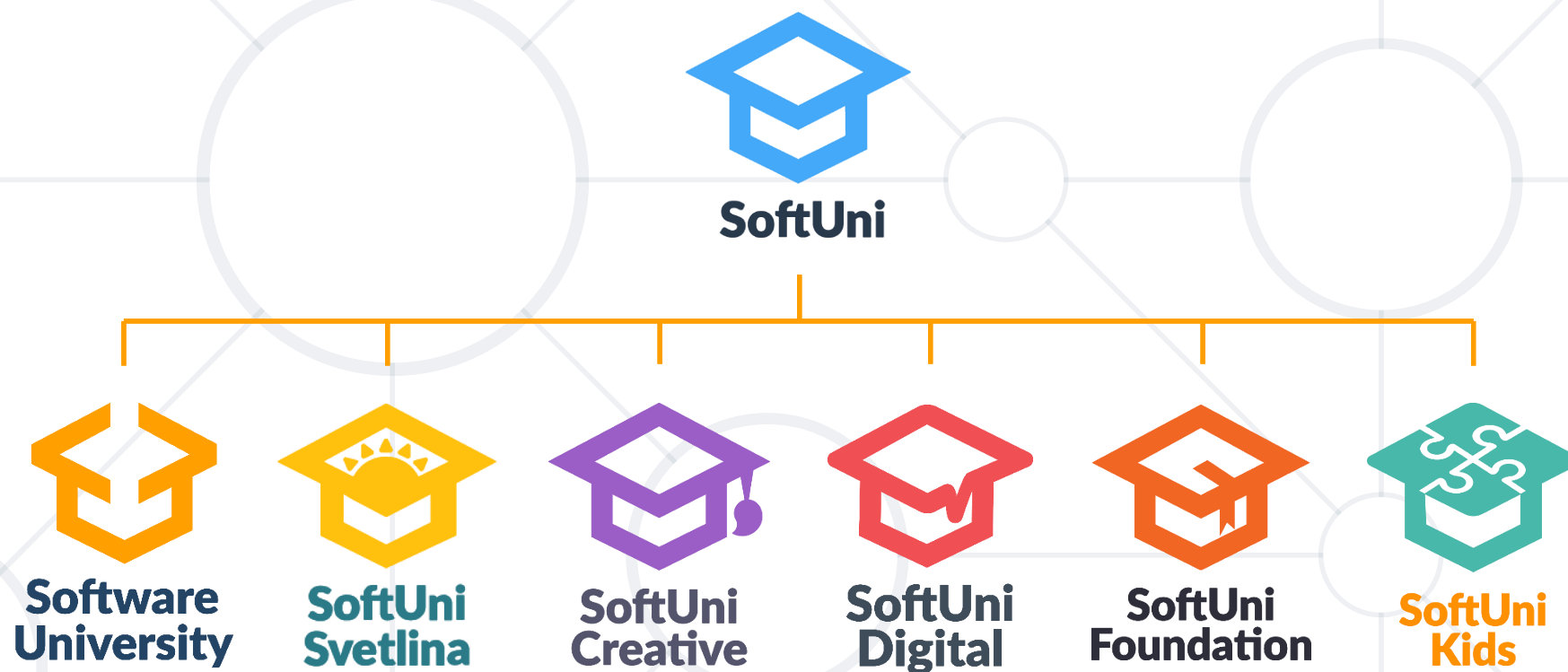
    def promotional_notification(self):
        self._service.send_message()
```

Using abstraction

- **SOLID** principles make your code more:
  - Extendable
  - Logical
  - Easier to read



# Questions?



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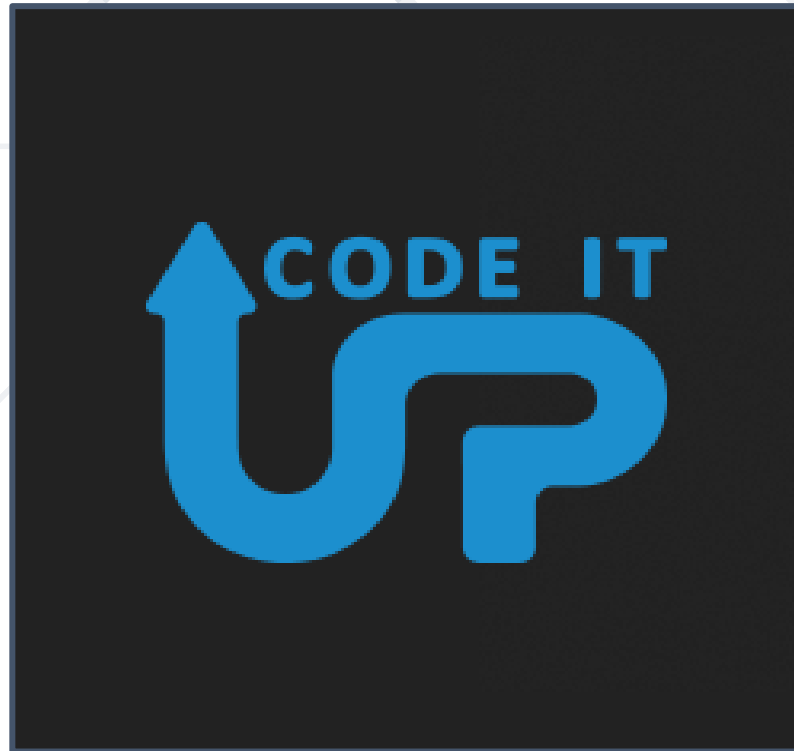
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