SOLID: Liskov Substitution Principle

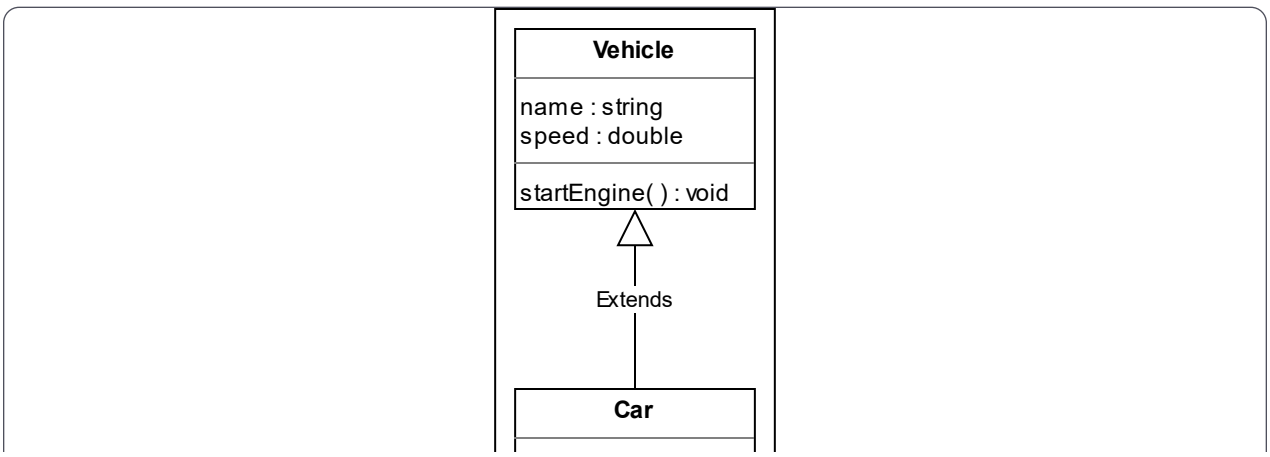
Explore the Liskov Substitution Principle and how it guides the use of inheritance.

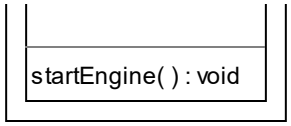
Introduction

The **Liskov Substitution Principle (LSP)** is one of the fundamental design principles of object-oriented design. The LSP helps guide the use of inheritance in design so that the application does not break. It states that the objects of a subclass should behave the same way as the objects of the superclass, such that they are replaceable. This rule generally applies to abstraction concepts like inheritance and polymorphism.

The Vehicle class

Let's construct a simple class called `Vehicle` that has some attributes and methods and a subclass `Car` that extends it as shown below:



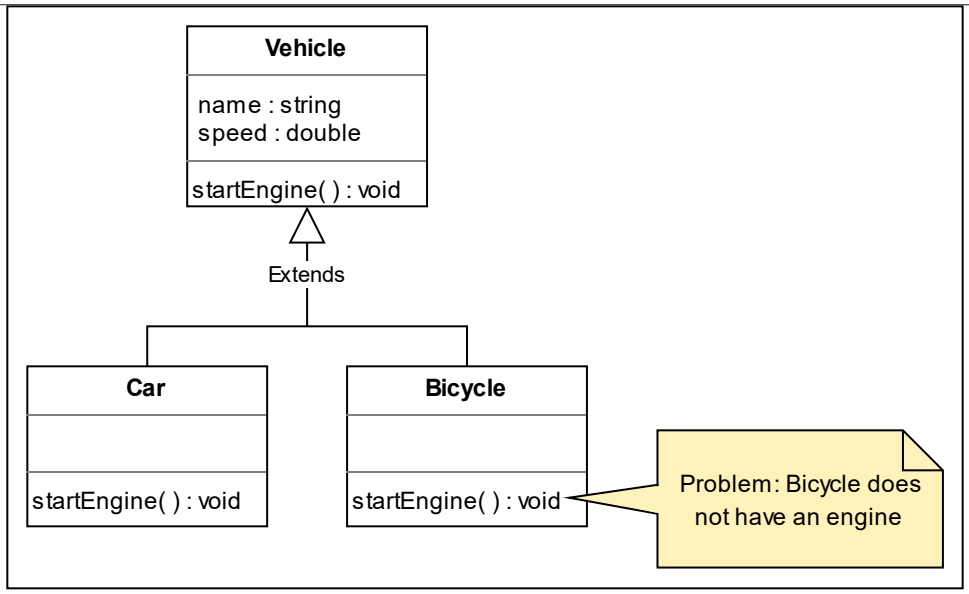


The vehicle superclass

So far, this implementation seems right since a car IS A vehicle, and the `startEngine()` method will override the superclass method. However, it's not as simple as it looks.

Violation

Let's add a `Bicycle` subclass in this system and see what happens:

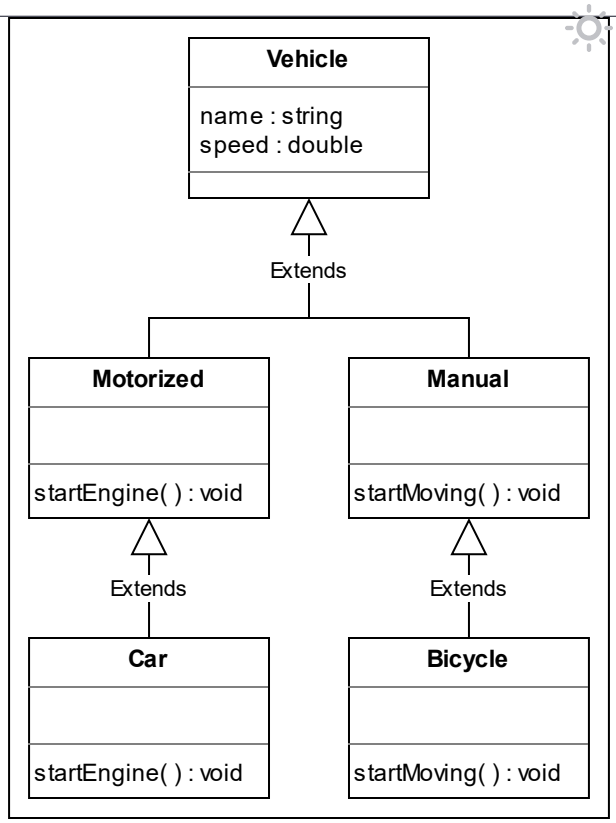


Violation of the LSP

This results in a problem. A bicycle is a vehicle, but it does not have an engine. Therefore, the `Bicycle` class should not be allowed to override the `startEngine()` method.

Solution

A possible fix to this issue would be to add two subclasses of `Vehicle` that classify the vehicles as motorized vehicles and manual vehicles as follows:



An example of the LSP implementation

With this implementation, we have satisfied the LSP.

- `Car` is substitutable with its superclass, `Motorized`, and `Bicycle` is substitutable with its superclass, `Manual`, without breaking the functionality.
- Their methods can also override the methods of the superclass.

Conclusion

The LSP is an important principle that should be extended to the level of system architecture. A small violation of the substitutability of classes can cause the system to break down, which is why we should always be on the lookout for violations. A few benefits of the LSP are provided below:

- It avoids the generalization of concepts that may not be needed in the future.
- It makes the code maintainable and easier to upgrade.

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Now that we have learned about the Liskov Substitution Principle, let's look at the Interface Segregation Principle in the next lesson.

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