Structural Design Pattern

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Outline

1. Structural Pattern Overview

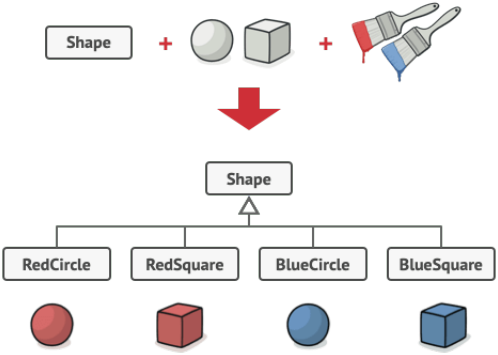
2. Bridge design pattern

Structural Pattern Overview

How classes and objects are composed to form larger structure.

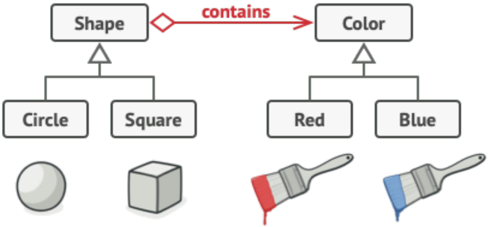
- **Adapter**: Convert the interface of a class into another interface.
- **Bridge**: Decouple an abstraction from its implementation.
- **Composite**: Compose objects into tree structure.
- **Decorator**: Attach additional responsibilities to an object dynamically.
- **Facade**: Provide a unified interface to a set of interfaces.
- **Flyweight**: Use sharing to support large numbers of fine-grained objects efficiently.
- **Proxy**: Provide a surrogate or placeholder for another object to control access to it.

Problem Statement



- You have a geometric Shape class with a pair of subclasses: Circle and Square.
- You want to extend this class hierarchy to incorporate colors.
- Adding new shape types and colors to the hierarchy will grow it exponentially.
- The total classes by combination?

Problem Statement

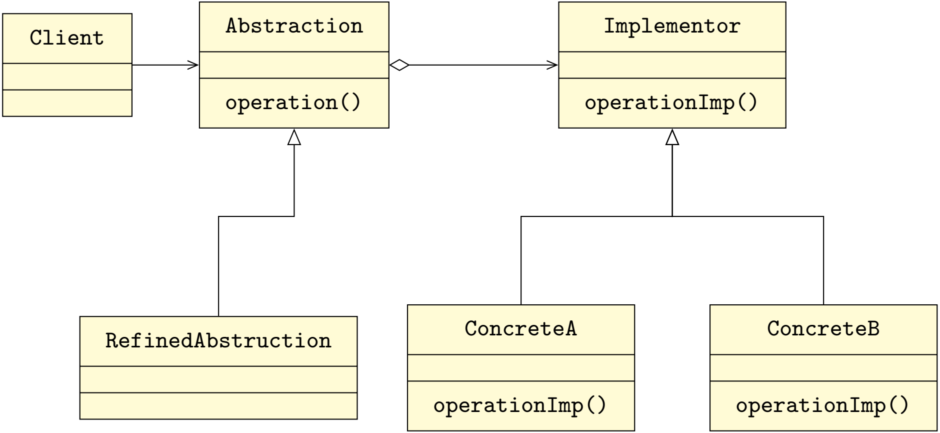


- The Bridge pattern attempts to solve this problem by switching from inheritance to the object composition.
- Adding new colors won't require changing the shape hierarchy, and vice versa.

The Intent of Decorator Design Pattern

Attach additional responsibilities to an object dynamically. Decorators provide a flexible alternative to subclassing for extending functionality.

Structure of Bridge Pattern: Object adapter



Pointer to Implementation (PIMPL)

- PIMPLE is the manifestation of the bridge design pattern albeit a slightly different one.
- PIMPL idiom is all about hiding the implementation details of a particular class by sticking it into separate implementation pointed by pointer just as the name suggests.

PIMPL implementation

person.h

```cpp
#ifndef _PERSON_H_
#define _PERSON_H_

#include <string>
#include <memory>

struct Person {
  class PersonImpl;
  unique_ptr<PersonImpl> m_imp; // Bridge not necessaruly inner class, can vary
  string m_name;

  Person();
  ~Person();

  void greet();

private:
  // secret data members or methods are in ‘PersonImpl‘ not here
  // as we are going to expose this class to client
}
#endif // _PERSON_H_
```

person.cpp

```cpp
#include "person.h"

/* PIMPL implementation*/

struct Person::PersonImpl {
  void greet(Person* p) {
    std::cout << "Helllo" << p->name.c_str() << std::endl;
  }
};

Person::Person() : m_impl(new PersonImpl){
}

Person::~Person() {
  delete m_impl;
}

void Person::greet() {
  m_impl->greet(this);
}
```

Why would you want to do this PIMPL?

- Security purpose: a data member which contains critical information.
- Compilation time

Disadvantages of PIMPL?

- Run-time overhead as we have to dereference the pointer every time for access.
- Construction & destruction overhead of unique_ptrbecause it creates a memory in a heap
- We also have to bear some indirection if we want to access the data member of Person in PersonImpl like passing this pointer or so

Advantages

- Bridge Design Pattern provides flexibility to develop abstraction(i.e. interface) and the implementation independently. And the client/API-user code can access only the abstraction part without being concerned about the Implementation part.
- It preserves the Open-Closed Principle, in other words, improves extensibility as client/API-user code relies on abstraction only so implementation can modify or augmented any time.
- By using the Bridge Design Pattern in the form of PIMPL. We can hide the implementation details from the client as we did in PIMPL idiom example above.
- The Bridge Design Pattern is an application of the old advice, "prefer composition over inheritance" but in a smarter way. It comes handy when you must subclass different times in ways that are orthogonal with one another(say 2×2 problem discuss earlier).
- A compile-time binding between an abstraction and its

Thank You!