Proxy Design Pattern

Linda Marshall

Department of Computer Science
University of Pretoria

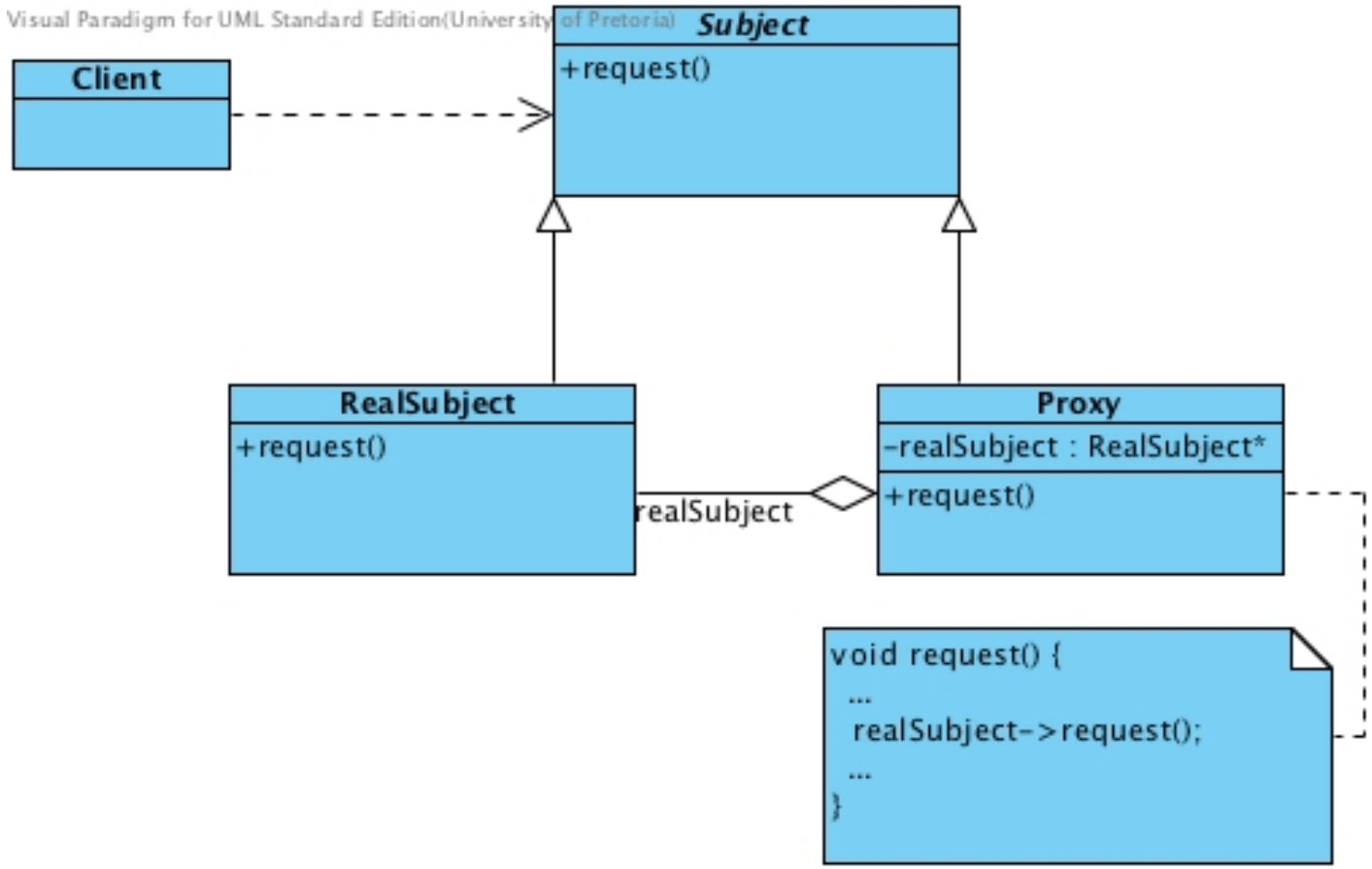
29 October 2021

Name and Classification: Proxy (Object Structural)

Intent: "Provide a surrogate or placeholder for another object to control access to it." GoF(207)

"Provide a surrogate or placeholder for another object to control access to it."

GoF(207)


Visual Paradigm for UML Standard Edition(University of Pretoria)
Client
Subject
+request()
RealSubject
+request()
realSubject
Proxy
-realSubject : RealSubject*
+request()
void request() {
...
realSubject->request();
...
}

Subject

- Defines the common interface for RealSubject and Proxy so that a Proxy can be used anywhere a RealSubject is expected.

RealSubject

- Defines the real object that is represented by the proxy.

Proxy

- serves as substitute for the real subject.
- maintains a reference to the real subject.
- controls access to the real subject.
- may be responsible for creating and deleting the real subject.
- more responsibilities specific to its kind.

There are at least 4 kinds of proxy

- Remote proxy
- Virtual proxy
- Protection proxy
- Smart reference

- provides a local representative for an object in a different address space
- can hide the fact that an object resides in a different address space

Responsible for

- encoding a request and its arguments
- sending the encoded request to the real subject in a different address space

- provides a representative for an expensive object
- can postpone access to an object until it is really needed

Responsible for

- creating expensive objects on demand
- caching information about the real subject so that access to it can be avoided if possible

- controls access to the real object
- useful when objects/users have different access rights

- check that the caller has the access permissions required to perform a request
- may perform additional housekeeping tasks when an object is accessed

A replacement for a bare pointer that performs additional actions when an object is accessed. Typical uses

- **Memory management** - count the number of references to the real object
- **Load on demand** - load a persistent object into memory on first reference
- **Safe updating** - lock the real object before it is accessed

Smart Pointers: They're Smart, but They're not Pointers

author: Daniel R. Edelson

Prceedings: Usenix C++ Conference

year: 1992

An abstract data type that simulates a pointer while providing additional features intended to reduce bugs caused by the misuse of pointers while retaining efficiency.

Keep track of the objects they point to for the purpose of memory management

- bounds checking
- automatic garbage collection

STL C++ (11) smart pointers

- **unique_ptr** - unique ownership, move constructible and move assignable
- **shared_ptr** - counted pointer, object is deleted when the use count goes to zero
- **weak_ptr** - robust unowned pointer.

Adapter and **Proxy** both provide an interface to access another object. However, the reasons for doing this are different.

Adapter

Provides a different interface to the object it adapts

Proxy

Provides the same (or diminished) interface as its subject

Decorator and **Proxy** both describe how to provide a level of indirection to an object and forward requests to it. However, they have a different purpose

Decorator

1) dynamic attach or detach

2) recursive composition

The component provides only part of the functionality, and one or more decorators furnish the rest.

Proxy

Provide a stand-in when it is inconvenient or undesirable to access the subject directly

Subject defines the key functionality, and the proxy provides (or refuses) access to it

Prototype and **Proxy** both offer a solution to a problem related to an object that is expensive to create. However, the solutions are different.

Prototype

Keep a copy of the object handy and clone it on demand

Proxy

Create a stub for the object and create the object on demand

Flyweight and **Proxy** both apply a smart reference to manage access to an object. However, the purpose of the reference is quite different.

Flyweight	**Proxy**
Control multiple pointers to a shared instance	Control single access to a specific real object
shared_ptr	**unique_ptr**

An example of a *protection proxy*

- Subject - `OnlineBankAccount`
- Proxy - `ProxyOnlineBankAccount`
- RealSubject - `RealOnlineBankAccount`

```
class ProxyOnlineBankAccount : public OnlineBankAccount {
  public :
    ProxyOnlineBankAccount();
    virtual ~ProxyOnlineBankAccount();
    virtual bool login( string name, string pass );
    virtual bool pay( string to , string from , int amount );
  private :
    RealOnlineBankAccount* realSubject ;
    long maxTime;
    long startTime ;
    bool loggedIn ;
};
```

```
ProxyOnlineBankAccount::ProxyOnlineBankAccount() {
        // initialization of maxTime = 10000, loggedIn = false , et
}
ProxyOnlineBankAccount::~ProxyOnlineBankAccount() {
        //deletions
}
```

```
bool ProxyOnlineBankAccount::login( string name, string pass ) {
    //Already logged in
    if (loggedIn) {
      delete realSubject ;
    }
    //get start time of session
    startTime = clock () ; bool valid = false ;
    //validates password with database.
    //Create real bank account
    if (valid) {
      realSubject = new RealOnlineBankAccount () ;
      loggedIn = realSubject->login ( name, pass ) ;
    } else { cout << "Invalid login details" << endl;  }
    return loggedIn ;
  }
```

```
bool ProxyOnlineBankAccount::pay(string to, string from,
                                 int amount ) {
    long duration = clock () - startTime ;
    if ( duration < maxTime && loggedIn ) {
      return realSubject->pay(to, from, amount );
    } else {
      cout << "Your session has expired" << endl ;
      loggedIn = false ;
      delete realSubject ;
      return false ;
  } }
```

Smart references act as proxies to the actual reference. In this way memory is managed. The most prominent aspect of memory management by smart references is the release of the memory when the smart reference goes out of scope.

```
class MyClass {
public:
        MyClass();
        MyClass(string);
        void doSomething();
protected:
        string str;
};
```

```
void foo() {
        cout << "In foo() ";
        MyClass* p(new MyClass);
        MyClass* q = p;
        p->doSomething();
        q->doSomething();
        delete p;
        cout << "... leaving foo() " << endl;
}
```

```
void foo_unique() {
        cout << "In foo_unique() ";
        unique_ptr<MyClass> p (new MyClass);
        p->doSomething();
        cout << "... leaving foo_unique() " << endl;
}
```

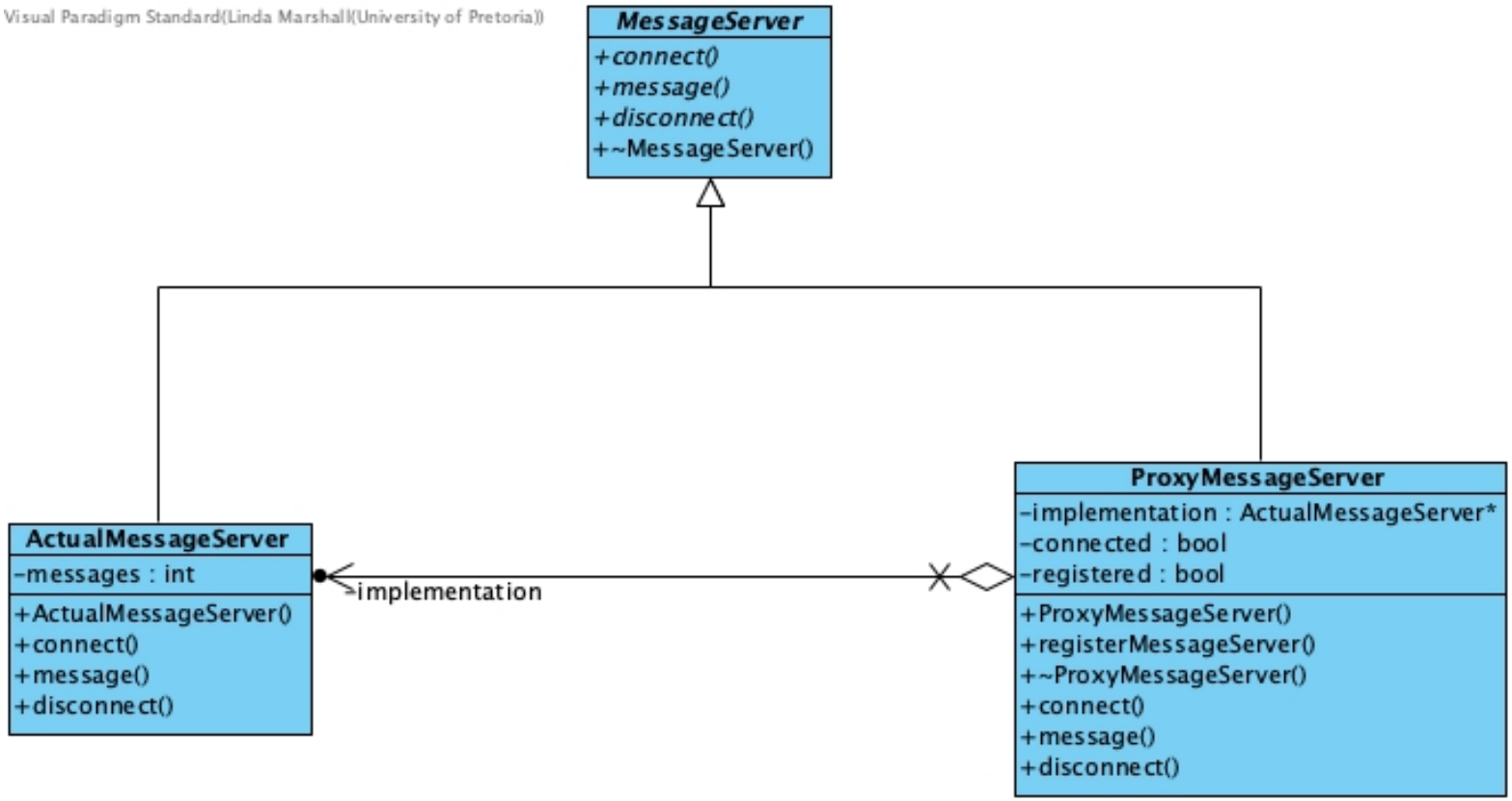
```
void foo_dangle() {
        cout << "In foo_dangle() ";
        MyClass* p(new MyClass);
        MyClass* q = p;
        delete p;
        p->doSomething();
        p = NULL;
        q->doSomething();
        cout << "... leaving foo_dangle() " << endl;
}
```

```
void foo_dangle_shared() {
    cout << "In foo_dangle_shared() ";

    shared_ptr<MyClass> s1(new MyClass("s1"));
    shared_ptr<MyClass> s2 = make_shared<MyClass>("s2");
    shared_ptr<MyClass> s3 = s1;
    weak_ptr<MyClass>   w(s1);

    cout << "Use counts: " << endl    <<  "  s1 " << s1.use_count(
                 "  s2 " << s2.use_count() << "  s3 " << s3.use_co
                 "  w " << w.use_count() << endl;
    s1->doSomething();
    s2->doSomething();
    s3->doSomething();
    if (!w.expired()) {
        w.lock()->doSomething();
    } else {
        cout << "w has expired" << endl;
    }
    cout << "... leaving foo_dangle_shared() " << endl;
}
```

- shared_ptr<MyClass> s1(new MyClass("s1")) - more overhead - creates 2 pointers
- shared_ptr<MyClass> s2 = make_shared<MyClass>("s2") - less overhead
- shared_ptr<MyClass> s3 = s1 - or shared_ptr<MyClass> s3(s1)


Visual Paradigm Standard(Linda Marshall(University of Pretoria))
MessageServer
+connect()
+message()
+disconnect()
+~MessageServer()
ActualMessageServer
-messages : int
+ActualMessageServer()
+connect()
+message()
+disconnect()
implementation
ProxyMessageServer
-implementation : ActualMessageServer*
-connected : bool
-registered : bool
+ProxyMessageServer()
+registerMessageServer()
+~ProxyMessageServer()
+connect()
+message()
+disconnect()