OOD Smells and Principles

C++ Object Oriented Programming

Pei-yih Ting
NTOUCS

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- Unplesant Code Smells vs. Refactoring

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- Bad Design Smells vs. Design Principles – **SOLID**

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https://sourcemaking.com/refactoring/bad-smells-in-code

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- **Opacity** – The design is hard to read and hard to understand. It does not express its intents well.

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- It is a mistake to unconditionally conform to a principle. Indeed, over-conformance to a principle leads to the design smell of Needless complexity.

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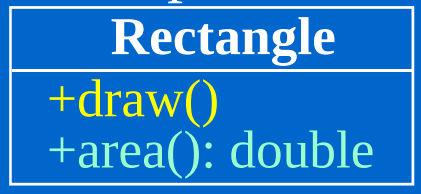

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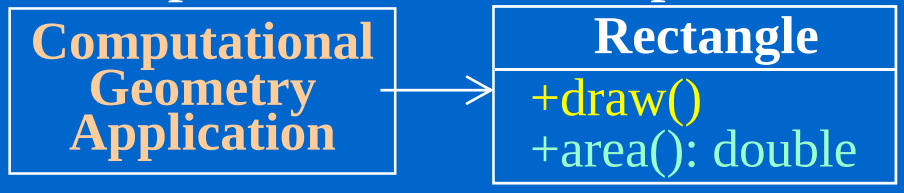

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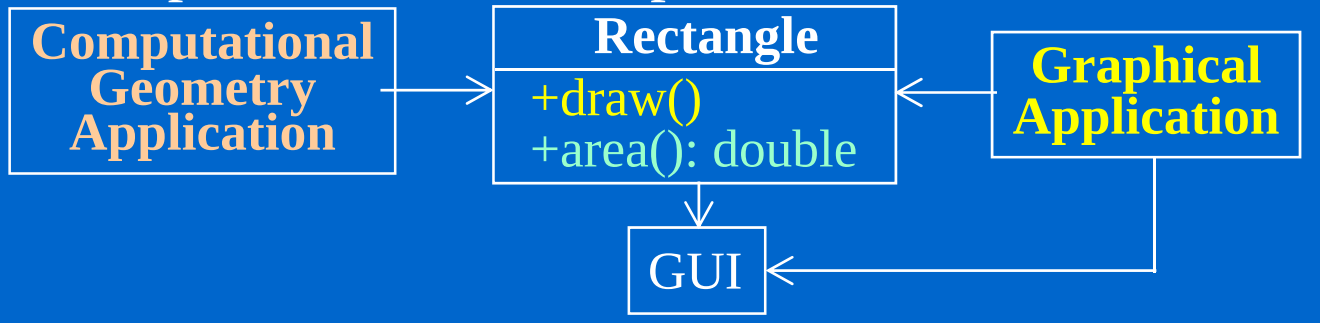

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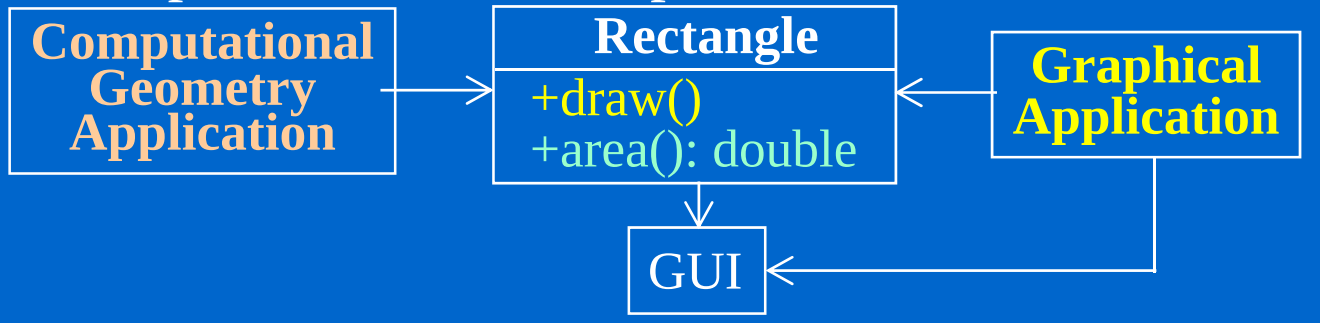

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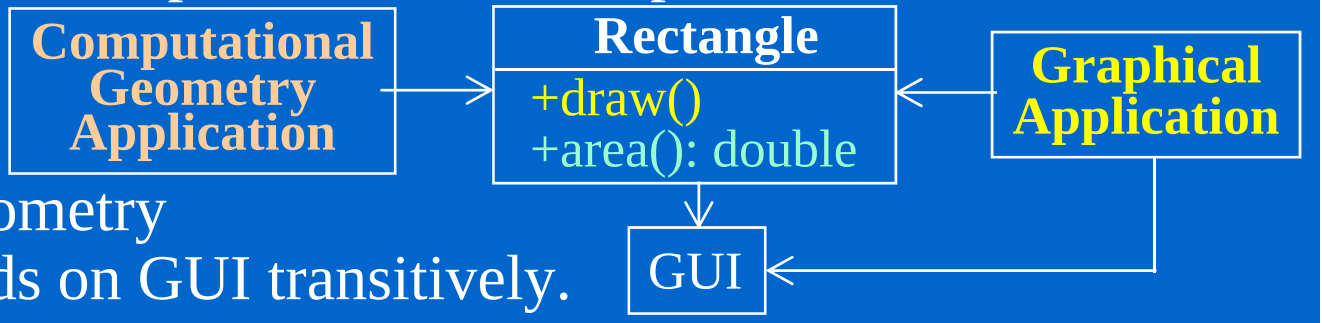

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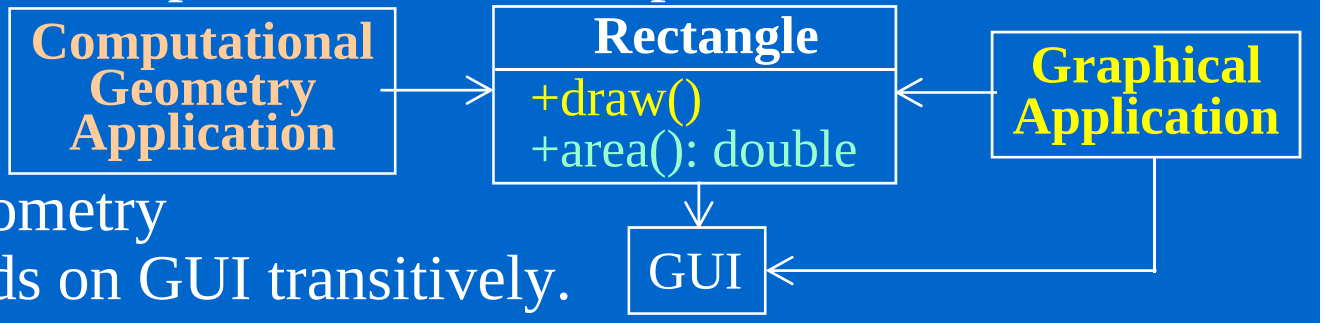

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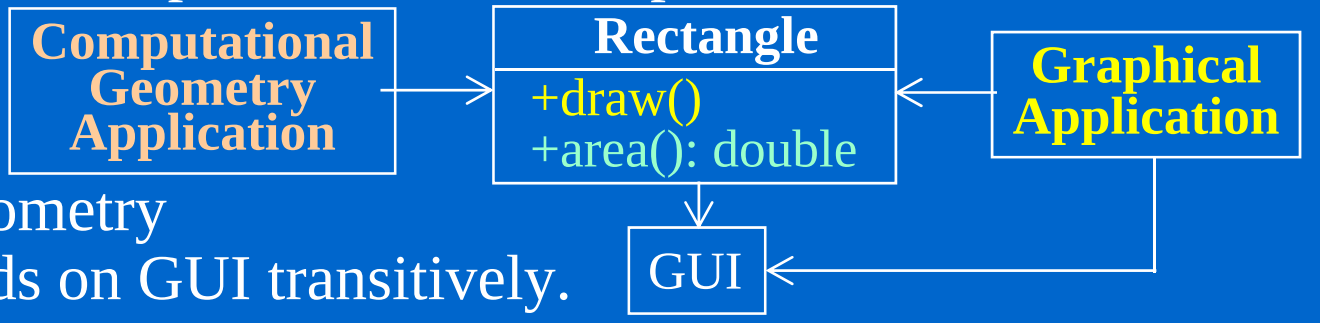

Possible problems:

❶ Computational Geometry Application depends on GUI transitively.

❷ area() and draw() are two unrelated responsibilities

If **GraphicalApplication** causes draw() to change or GUI changes

Single Responsibility Principle

A class should have only one reason to change.

- Each responsibility is an axis of change. When the requirements change, that change is likely manifest through a change in responsibility amongst the classes.
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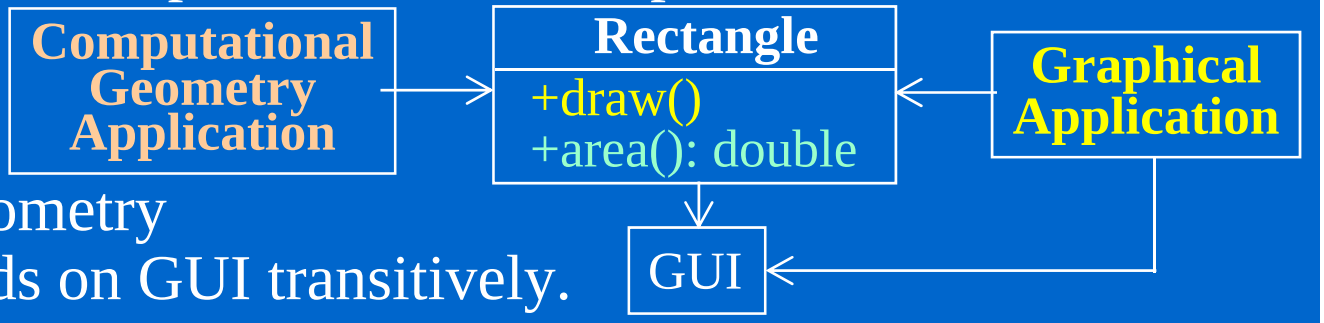

Possible problems:

❶ Computational Geometry Application depends on GUI transitively.

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If **GraphicalApplication** causes draw() to change or GUI changes somehow, these changes force us to rebuild, retest, and redeploy the ComputationalGeometryApplication.

Separated Responsibilities

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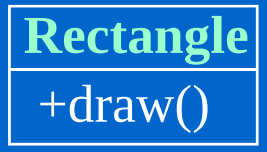

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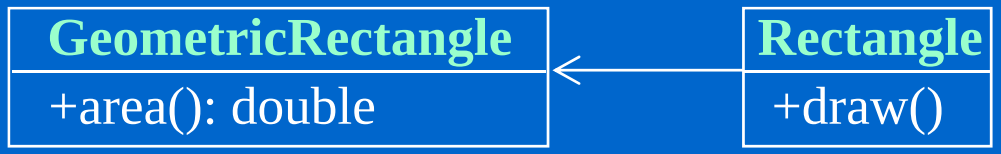

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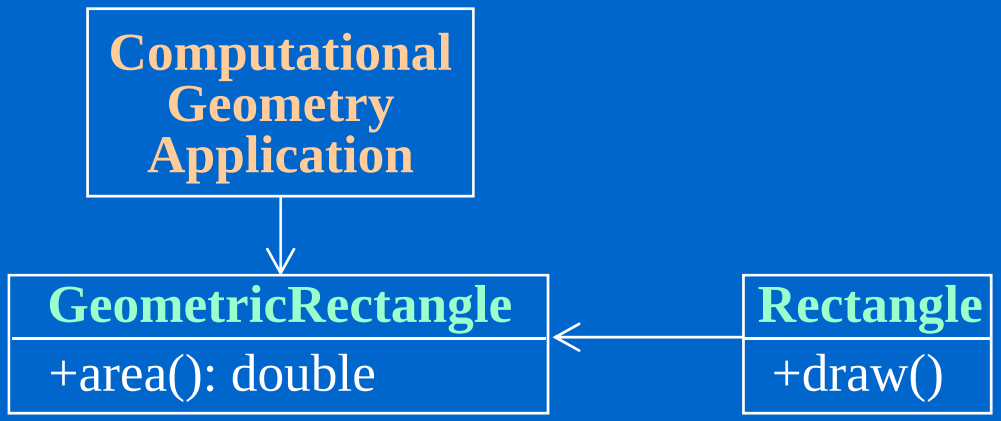

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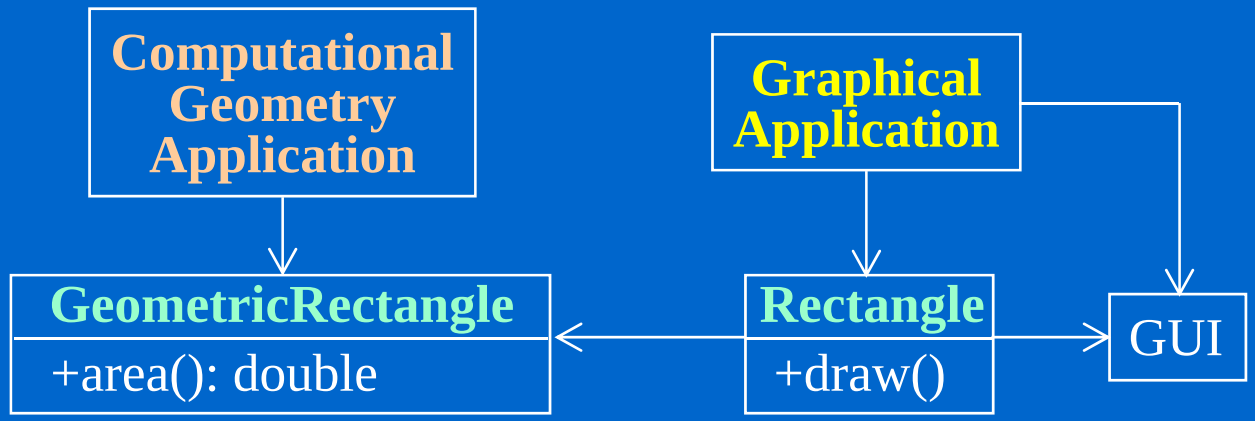

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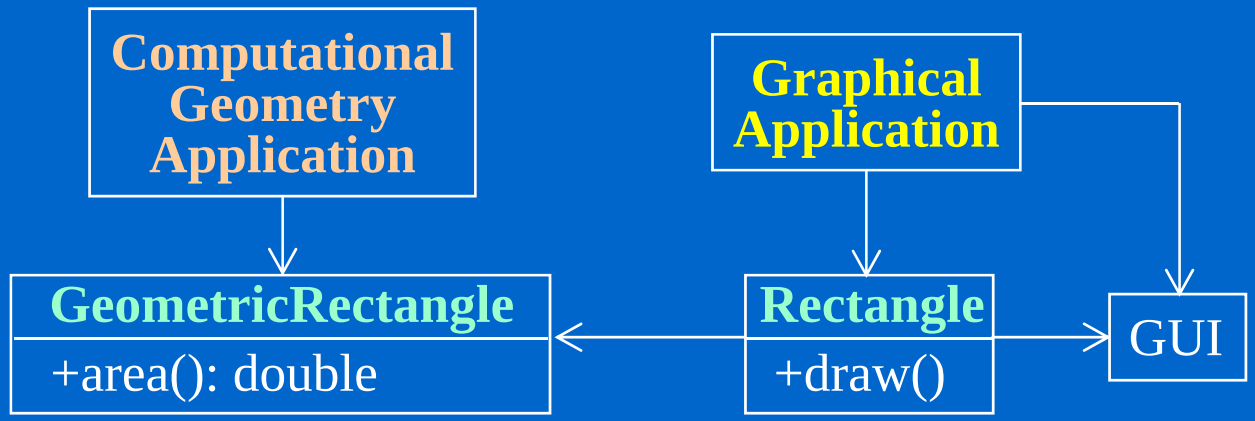

- Now changes made to the way rectangles are rendered cannot affect the **ComputationalGeometryApplication**.

SRP Violation

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class Modem {
public:

    void hangup();


};
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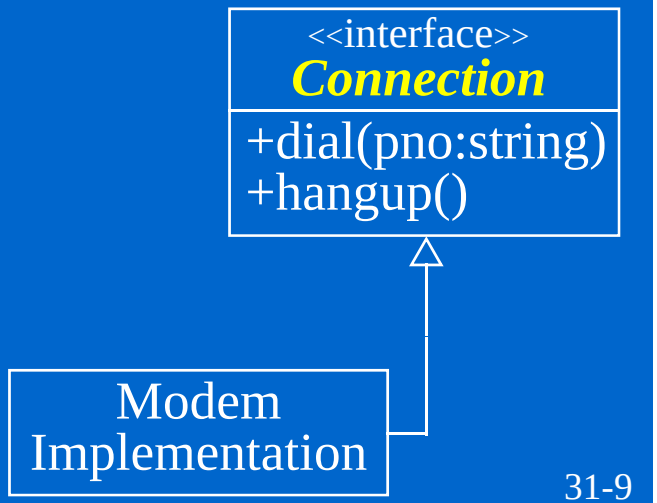

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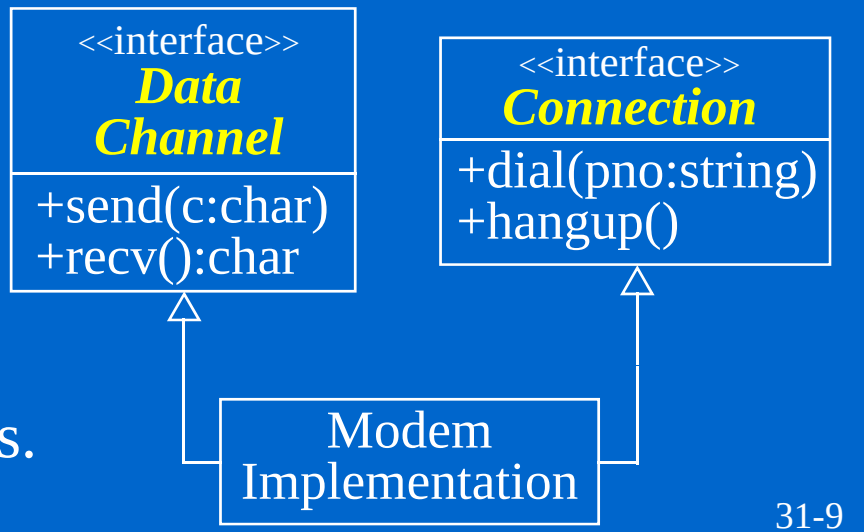

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the key is Abstraction

Interface (Design by Contract, DbC)

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   else if (m.type == Modem::courrier)
      dialCourrier((Courrier&)m, pno, user);
   else if (m.type == Modem::ernie)
      dialErnie((Ernie&)m, pno, user, pw);
   // …
}
```

Adding a new modem would add
else if (m.type == Modem::xxx)
…
everywhere in its client programs

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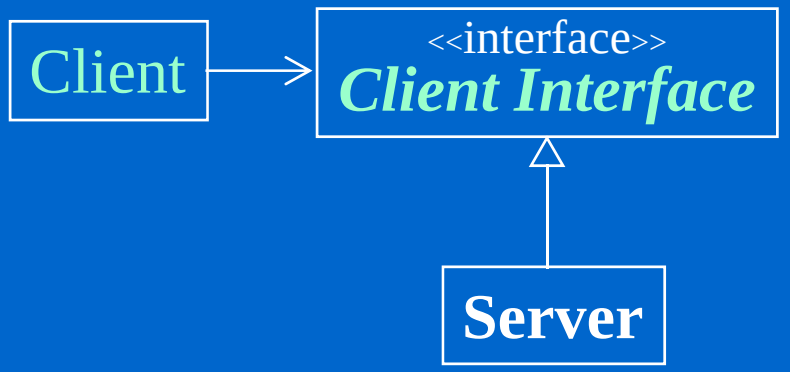

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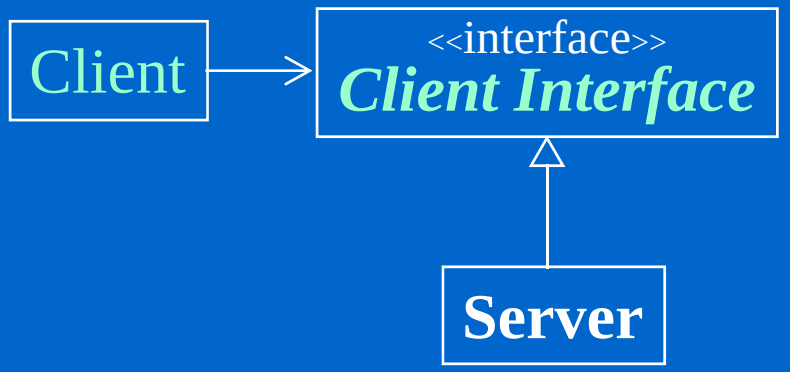

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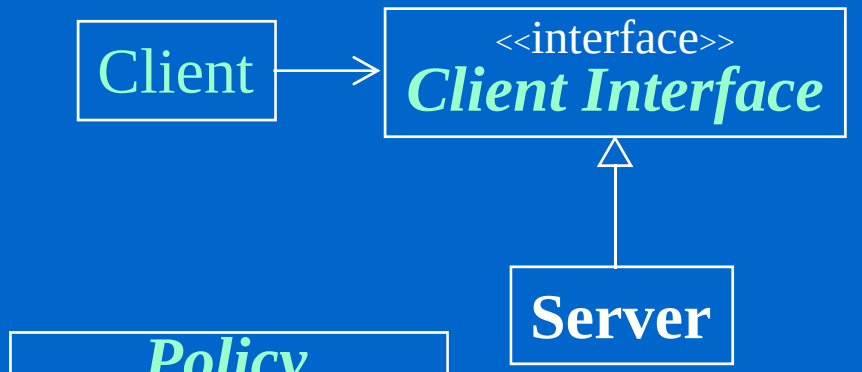

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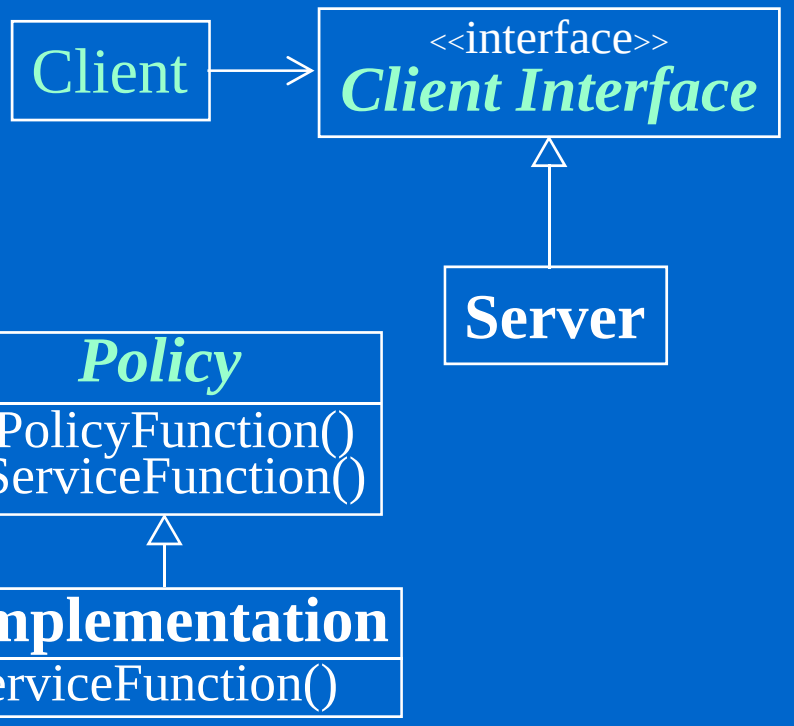

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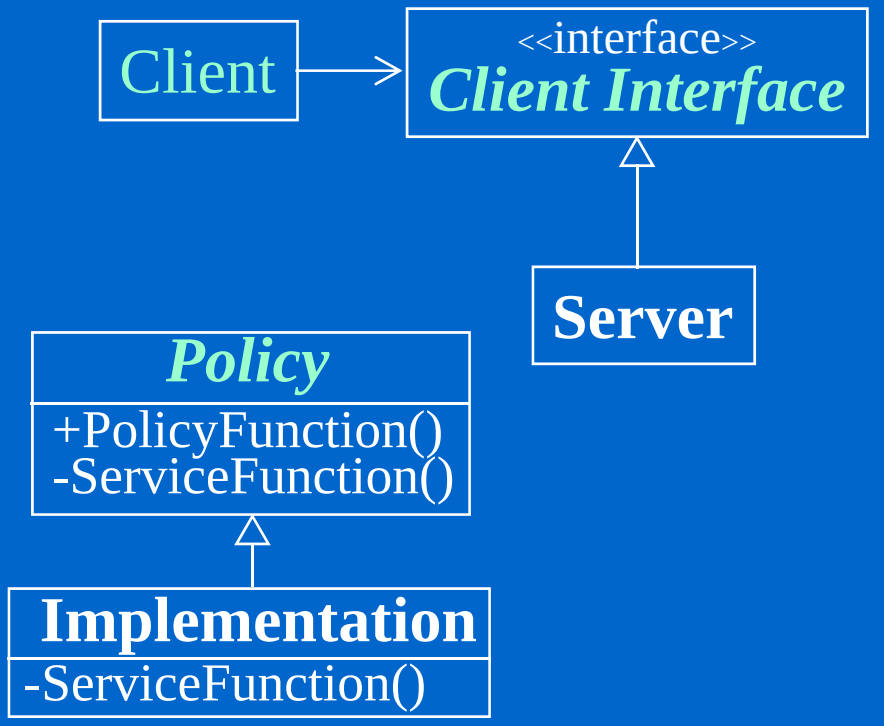

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- If OCP is applied well, further changes of that kind will be achieved by **adding new codes**, not by changing old codes that already work.

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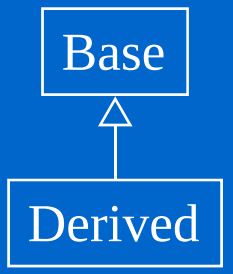

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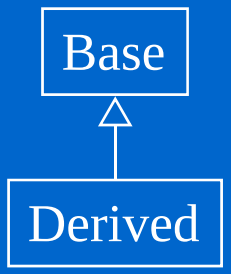

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void client(Base *bp) {
    ....
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```

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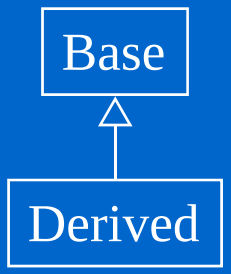

Liskov Substitution Principle

Subtypes must be substitutable for their base types.

- The importance of this principle becomes obvious when you **consider the consequences** of violating it.

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void client(Base *bp) {
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```

```
void main() {
    Derived dObj;
    f(&dObj);
}
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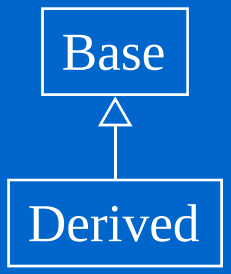

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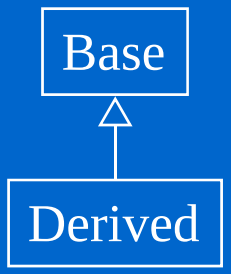

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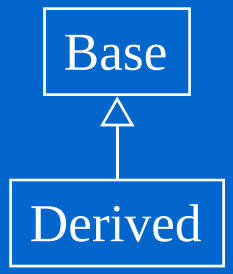

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```
struct Point {
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struct Circle: public Point {
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double areaTriangle(Point *vertices[3]) { // not closed




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struct Point {
    double x, y;
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struct Circle: public Point {
    double radius;
};
double areaTriangle(Point *vertices[3]) { // not closed
    for (int i=0; i<3; i++)
        if (dynamic_cast<Circle *>(vertices[i])) // cannot take a Circle
            return -1.0;

}
```

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double areaTriangle(Point *vertices[3]) { // not closed
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        if (dynamic_cast<Circle *>(vertices[i])) // cannot take a Circle
            return -1.0;
    … // calculate the area
}
```

Rectangle and Square

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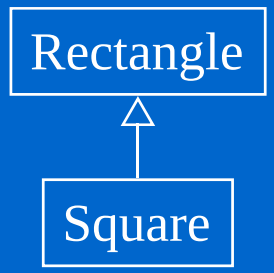

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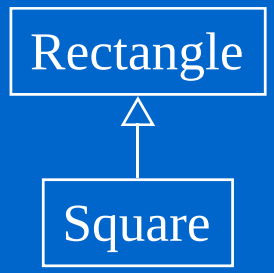


```
class Rectangle {
public:
    virtual void setWidth(double w) {m_width=w;}
    virtual void setHeight(double h) {m_height=h;}
    double getWidth() {return m_width;}
    double getHeight() {return m_height;}
private:
    Point m_topLeft; double m_width, m_height;
};
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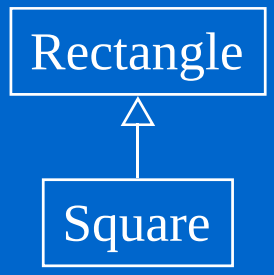


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private:
    Point m_topLeft; double m_width, m_height;
};
```

```
class Square: public Rectangle {
public:
    void setWidth(double w) {Rectangle::setWidth(w); Rectangle::setHeight(w);}
    void setHeight(double h) {Rectangle::setWidth(h); Rectangle::setHeight(h);}
};
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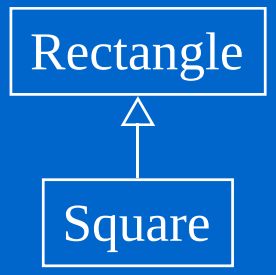


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};
```

- **Is a Square substitutable for a Rectangle in all sorts of clients?**

Rectangle and Square (cont'd)

```
Square s;
s.setWidth(1); // set both width and height to 1
s.setHeight(2); // set both width and height to 2
// good, won't be able to mess a square with different width and height
```

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```
void f(Rectangle& r) {
    r.setWidth(32); // if r is a Square, width and height will be set to 32
}                           // if r is a Rectangle, only width is set to 32
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    r.setWidth(5);
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        r.setWidth(5); r.setHeight(4);
        assert(r.area() == 20);
    }
}
```

Interface Segregation Principle

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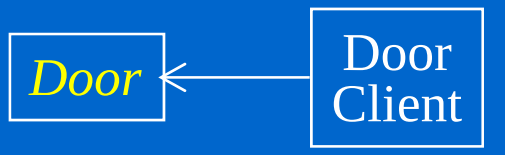

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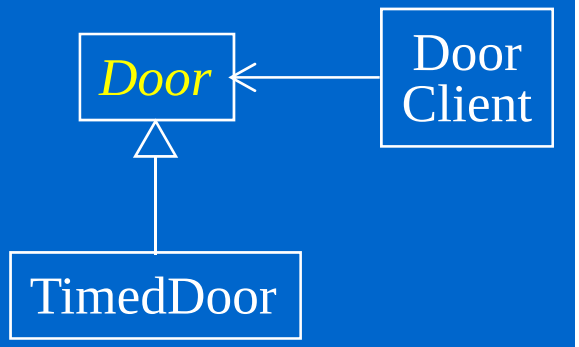


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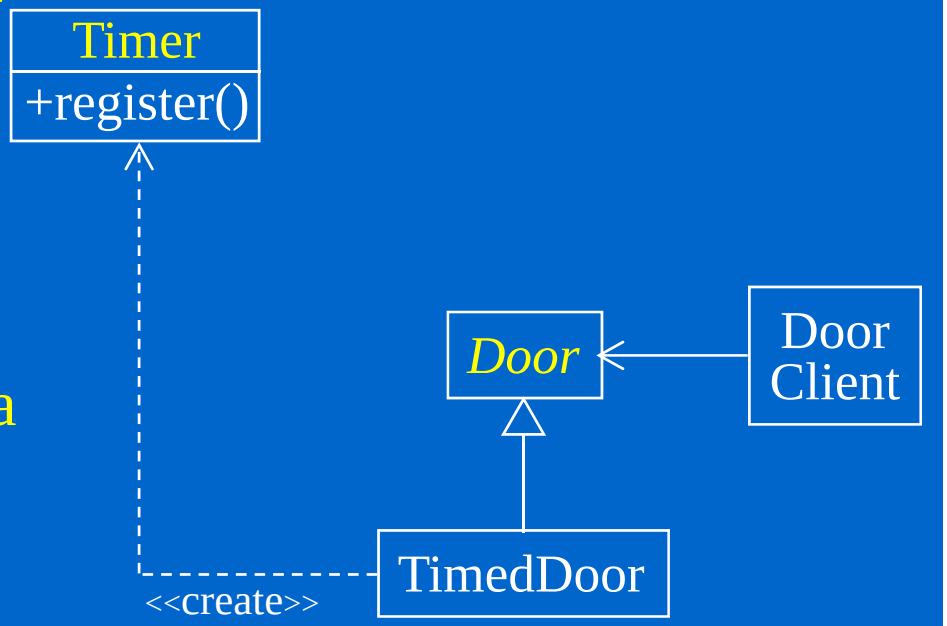


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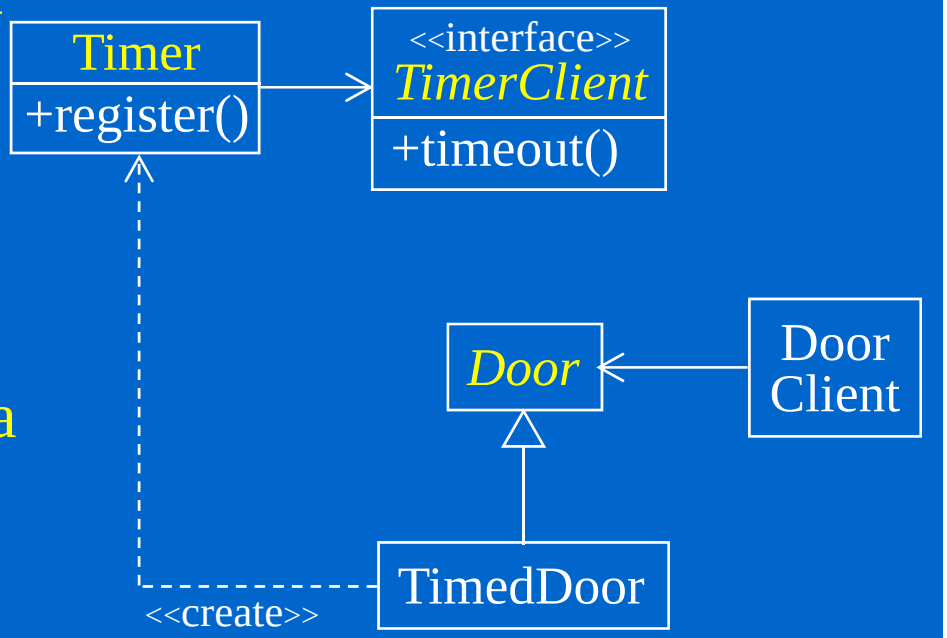


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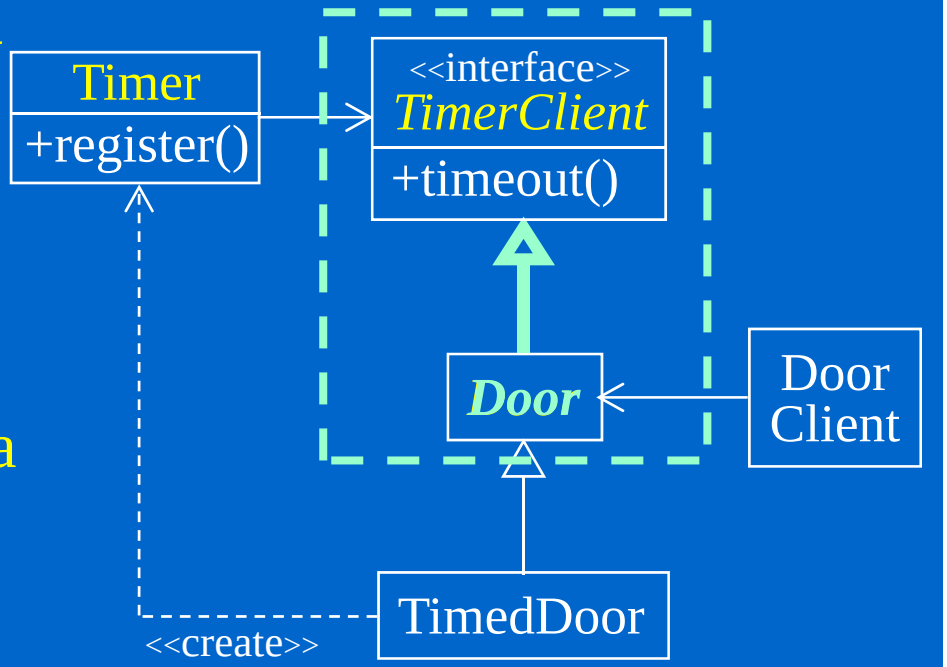


```
class Door: public TimerClient
{
public:
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    virtual void unlock();
    virtual bool isDoorOpen();
};
```

```
class Timer {
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class TimerClient {
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Interface Pollution

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Client should not be forced to depend on methods that they do not use.

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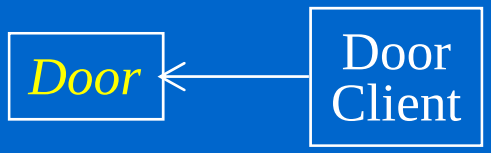

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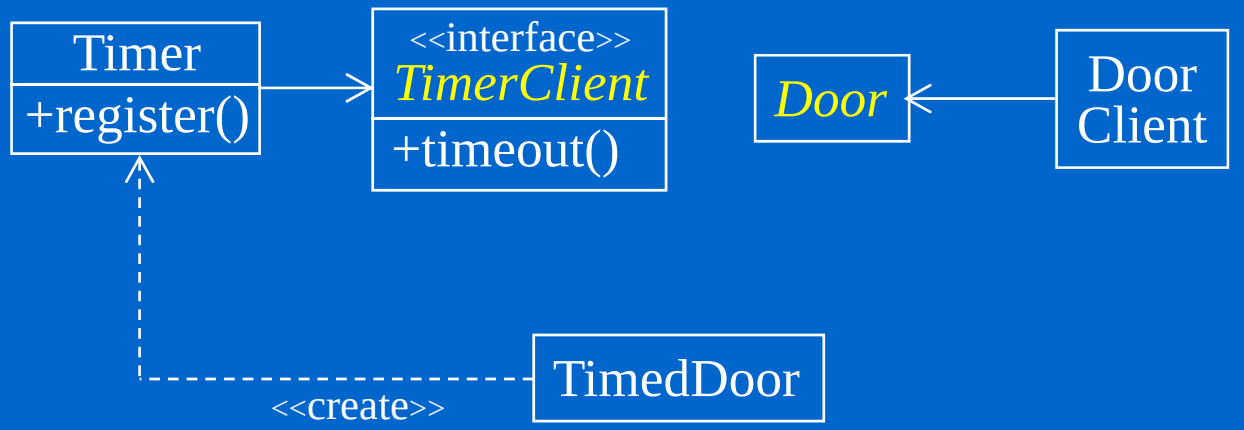

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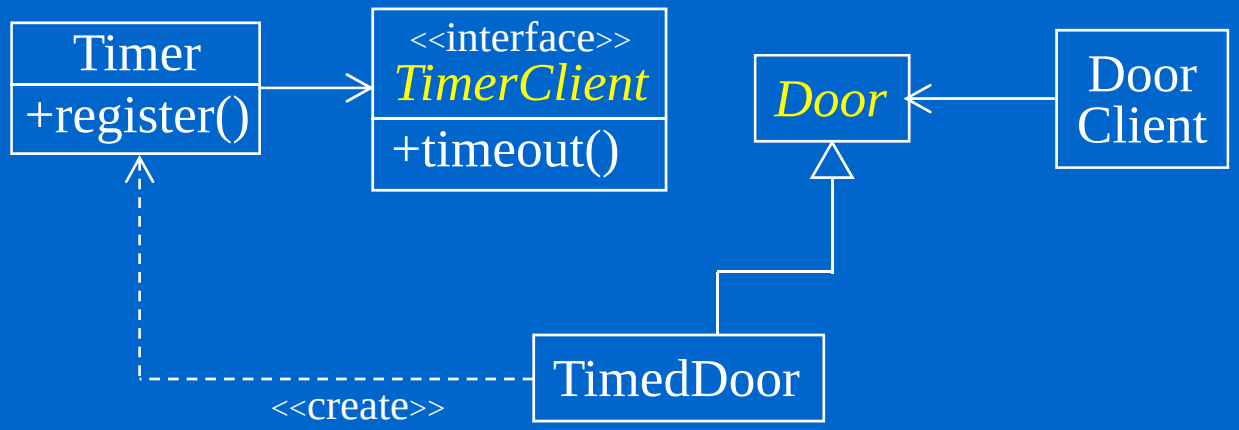

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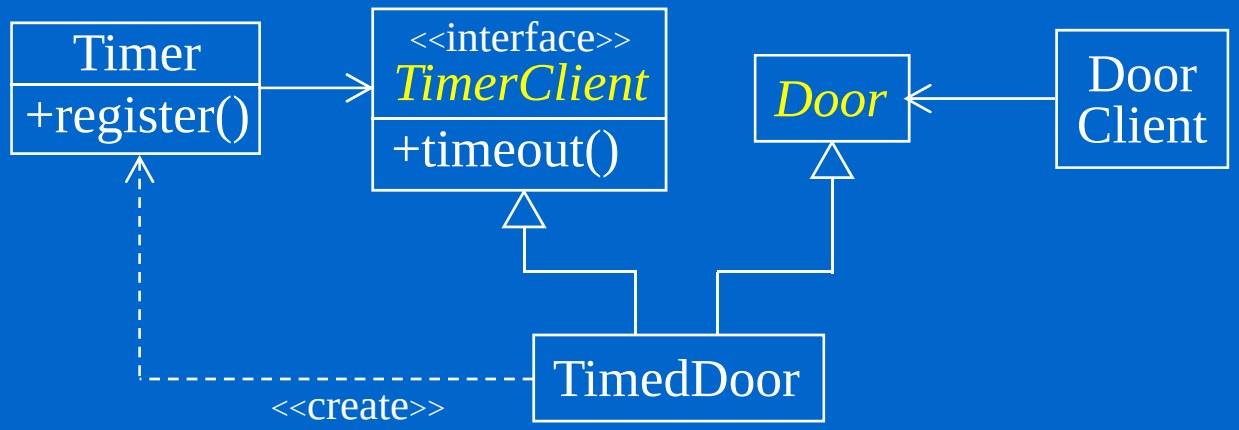

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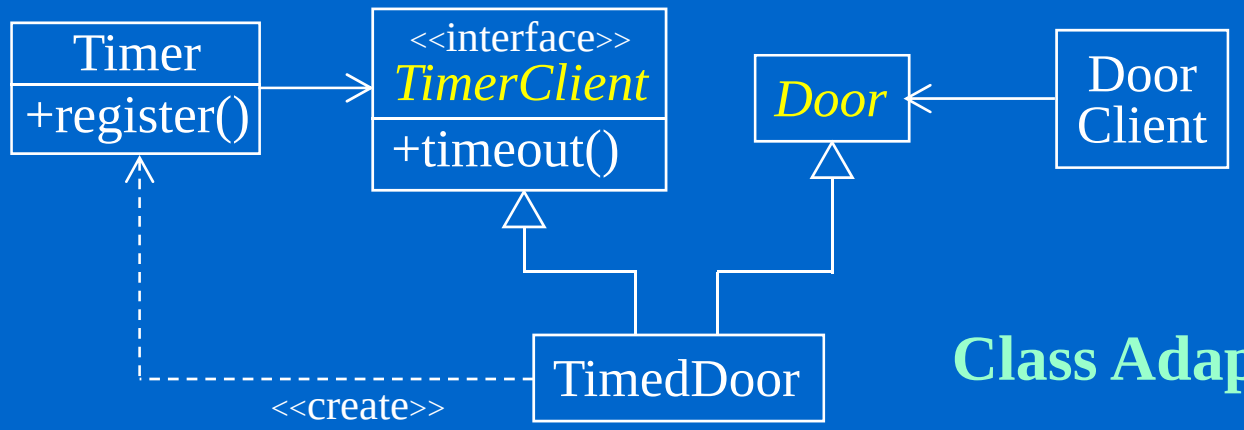

Class Adapter Pattern

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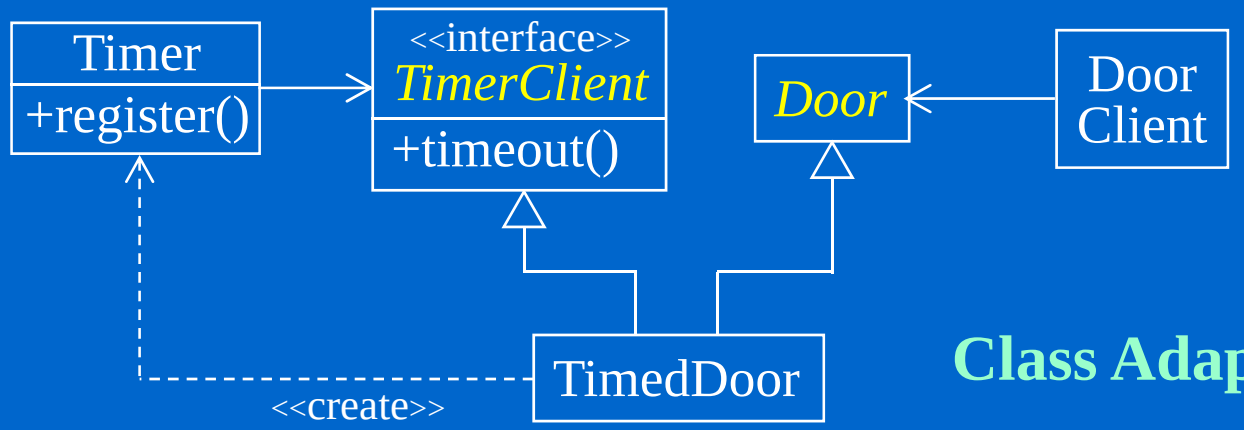

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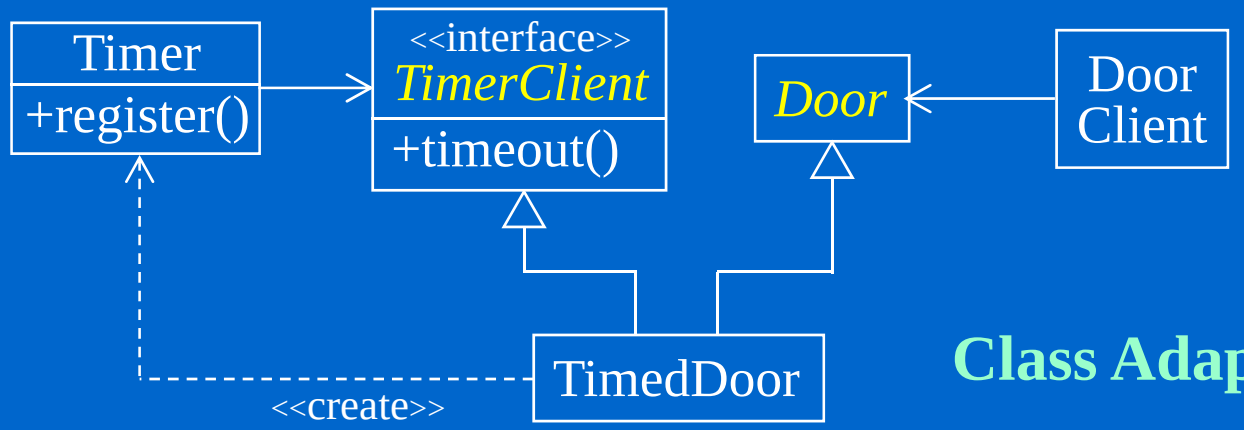

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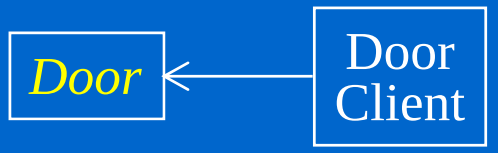

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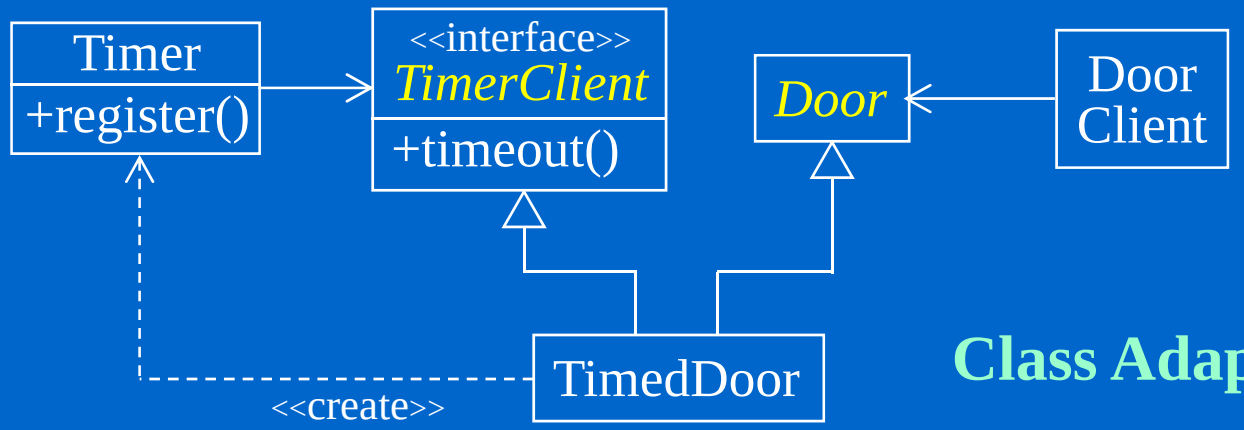

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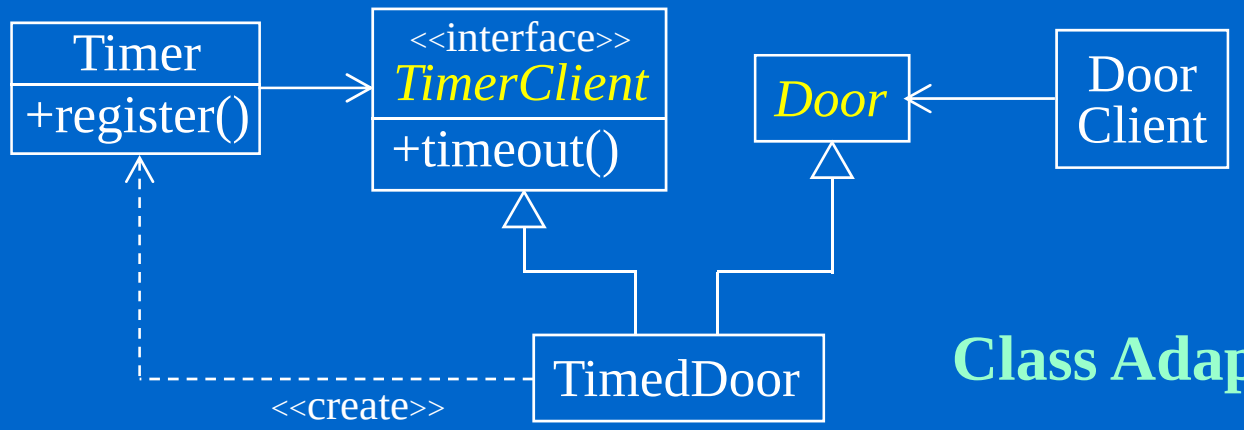

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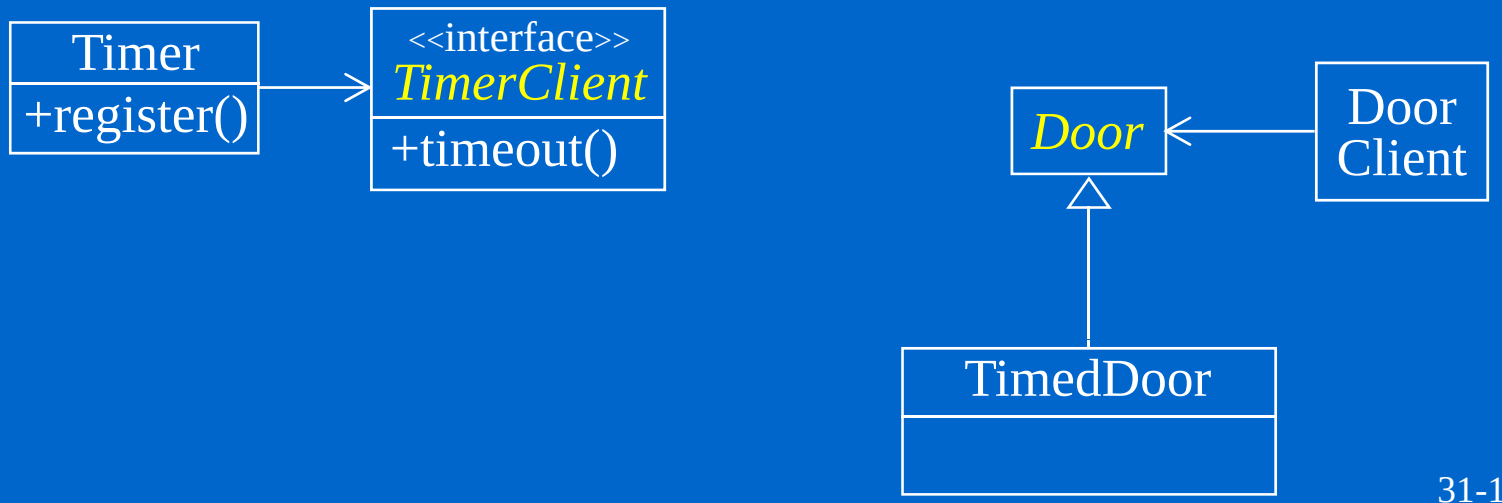

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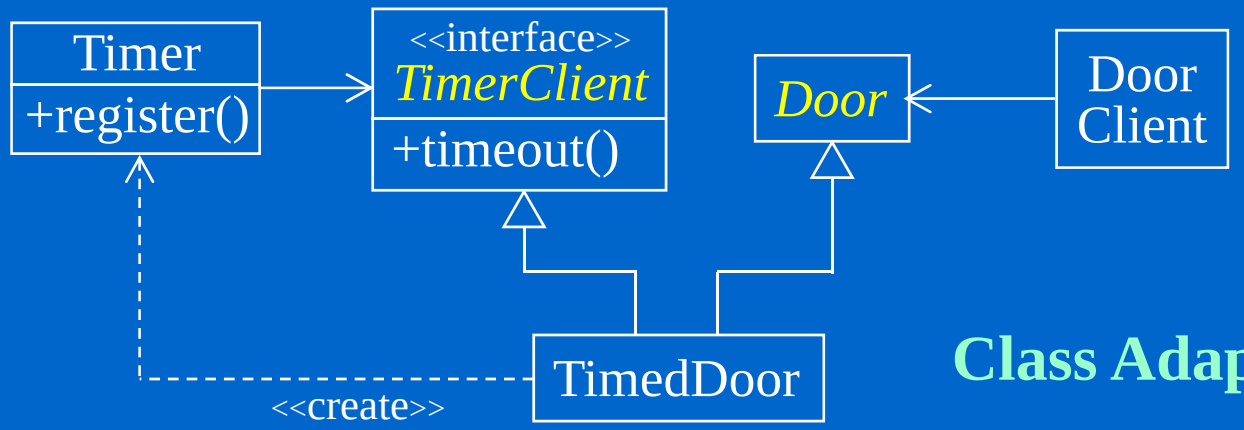

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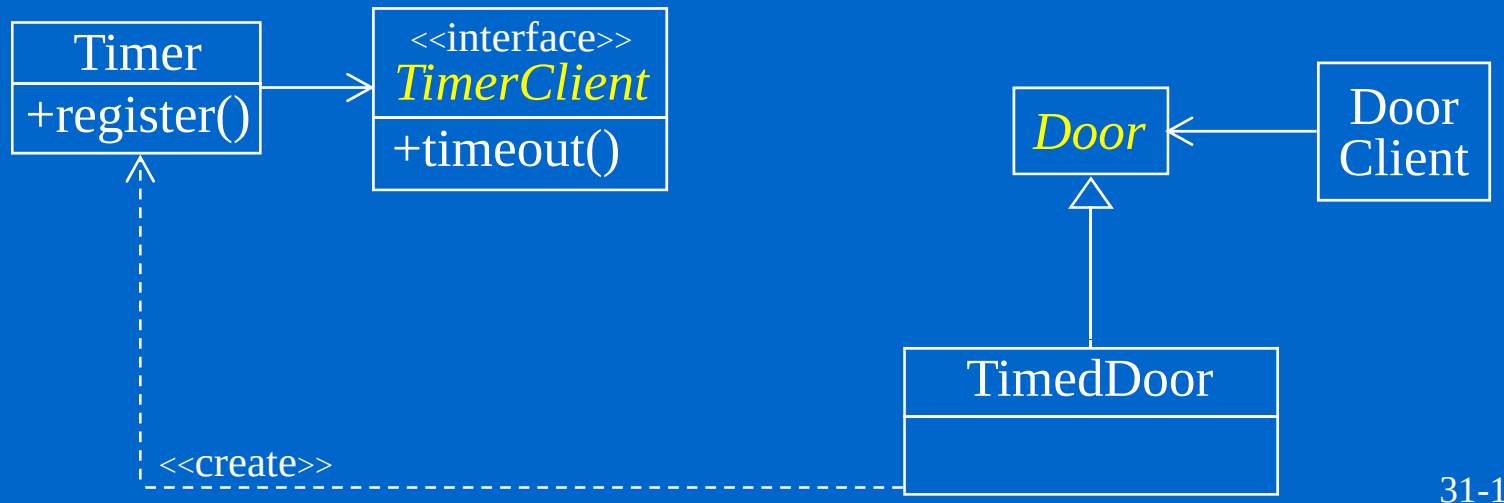

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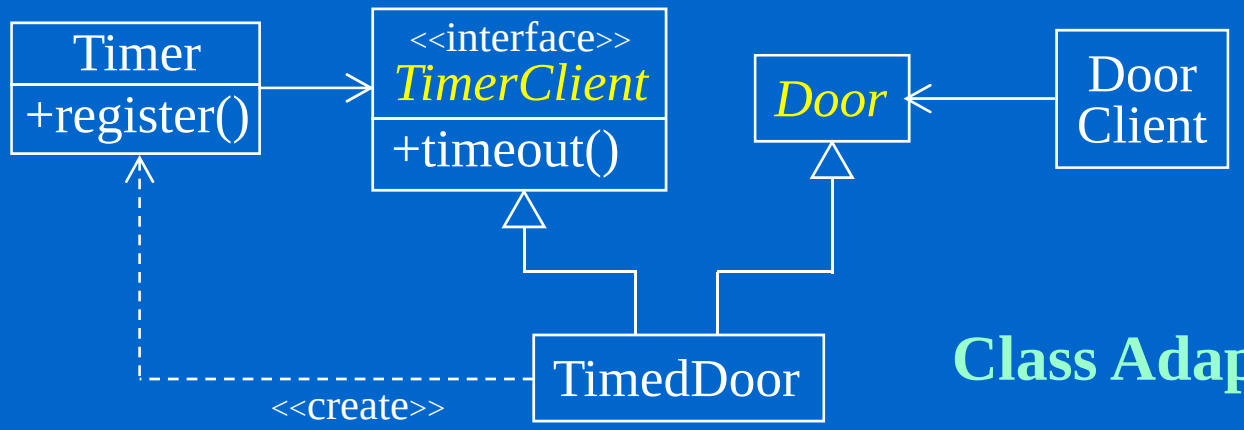

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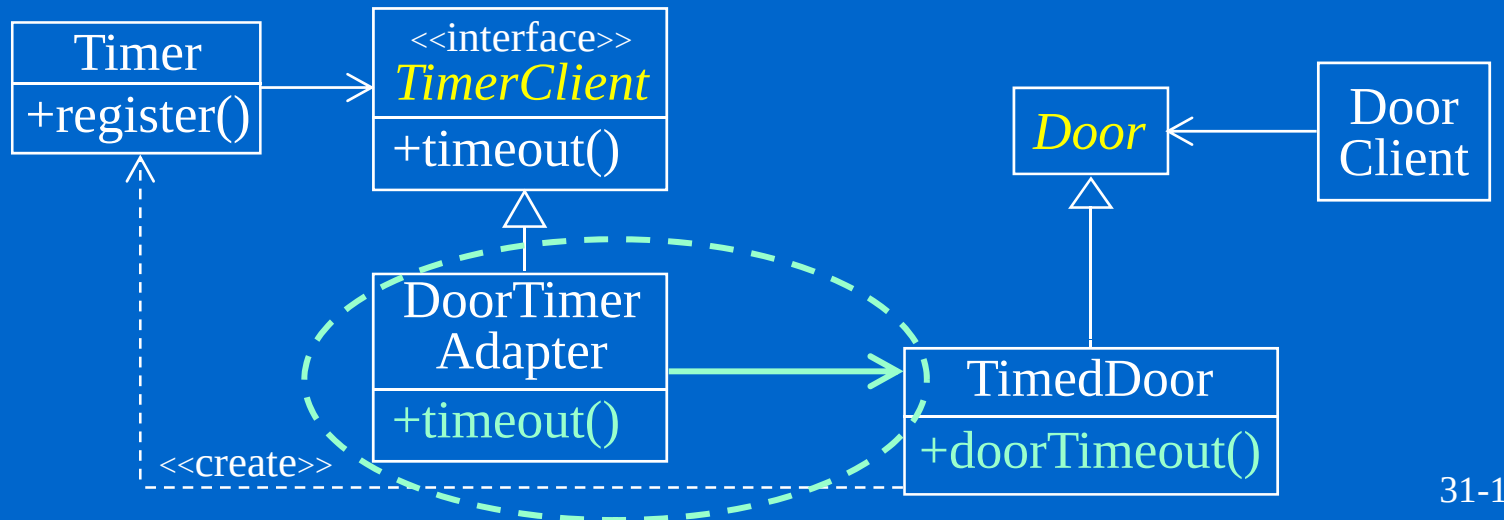

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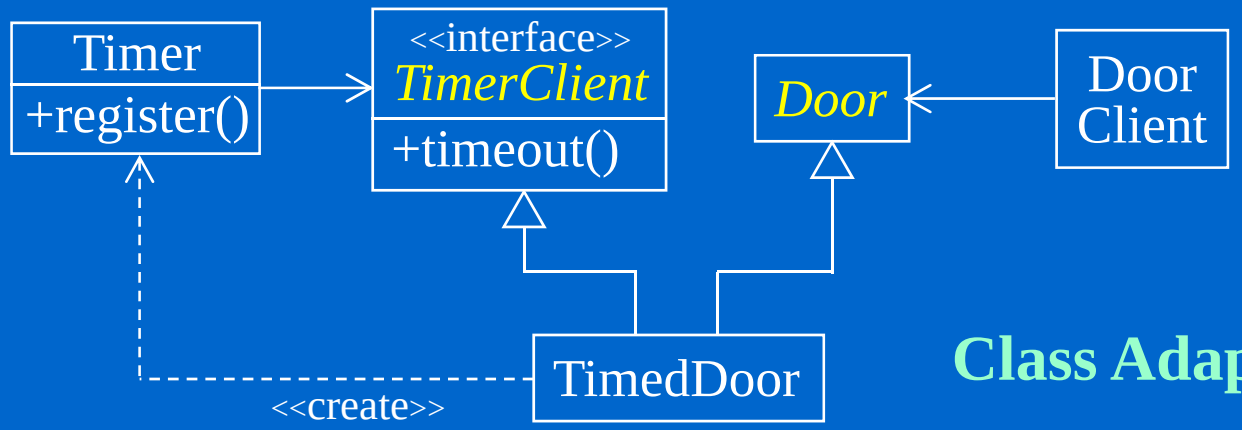

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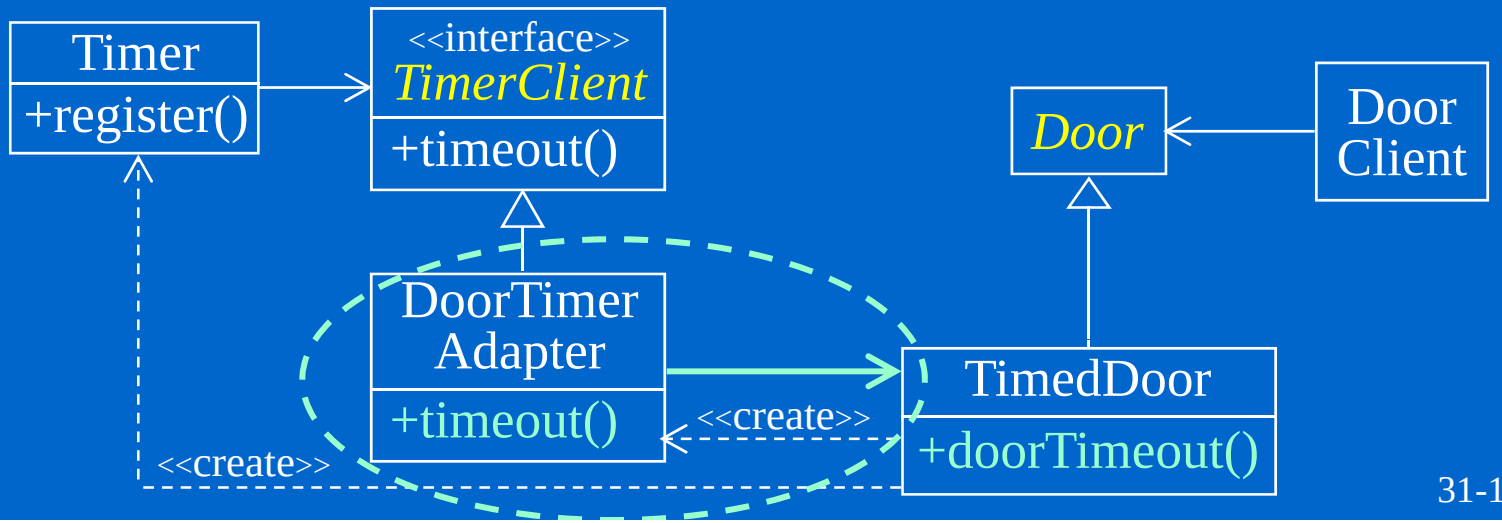

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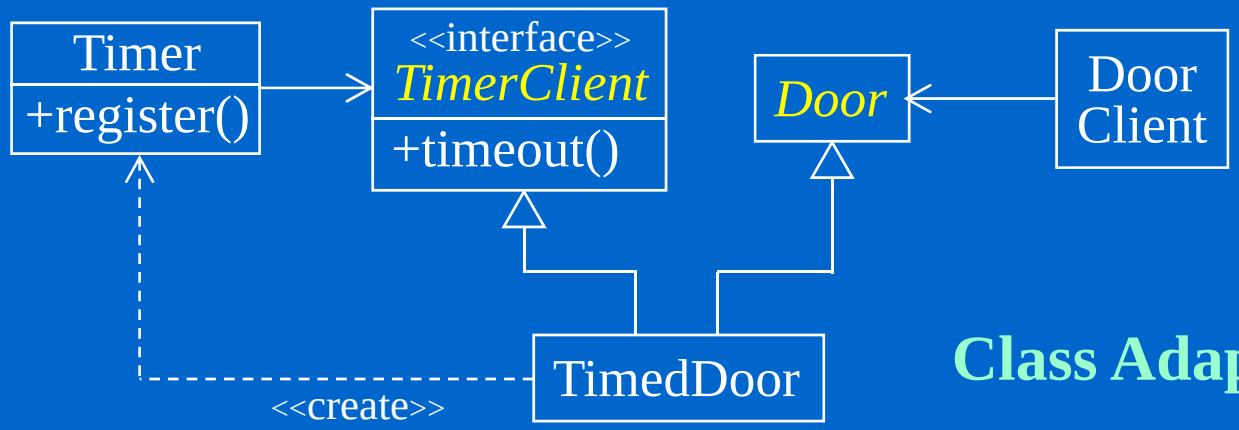

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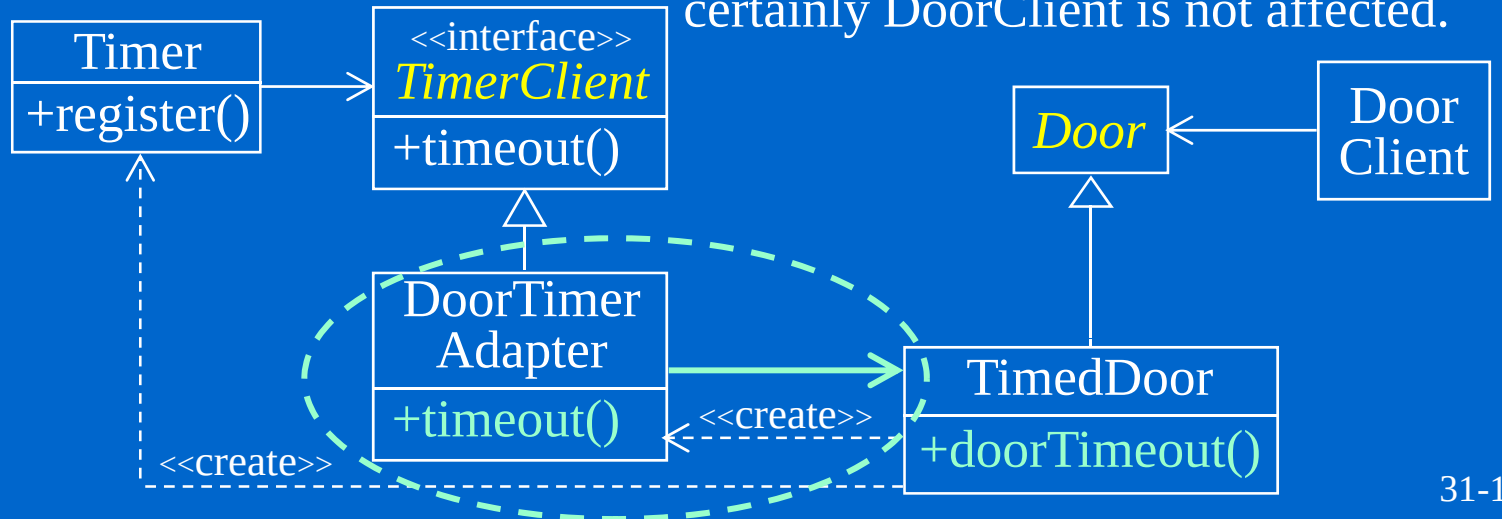

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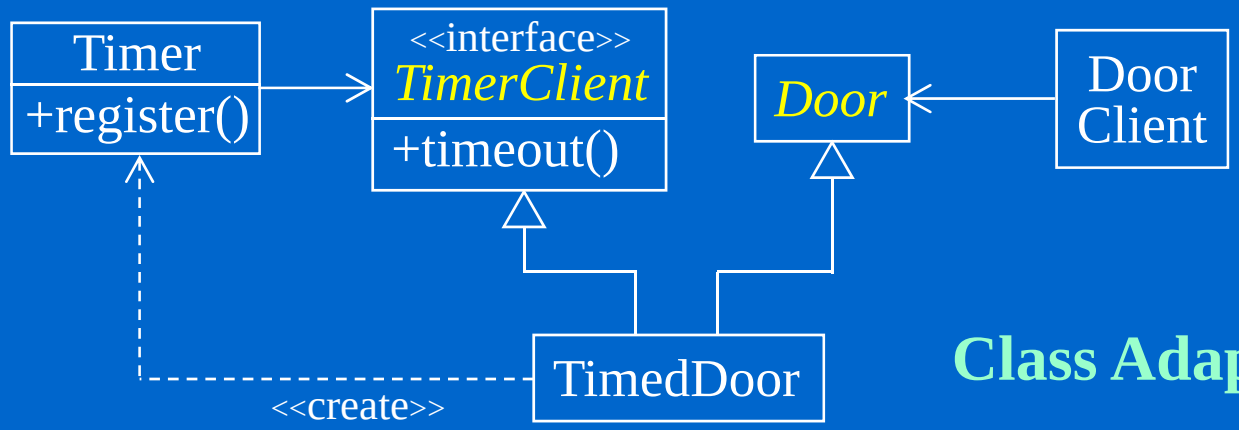

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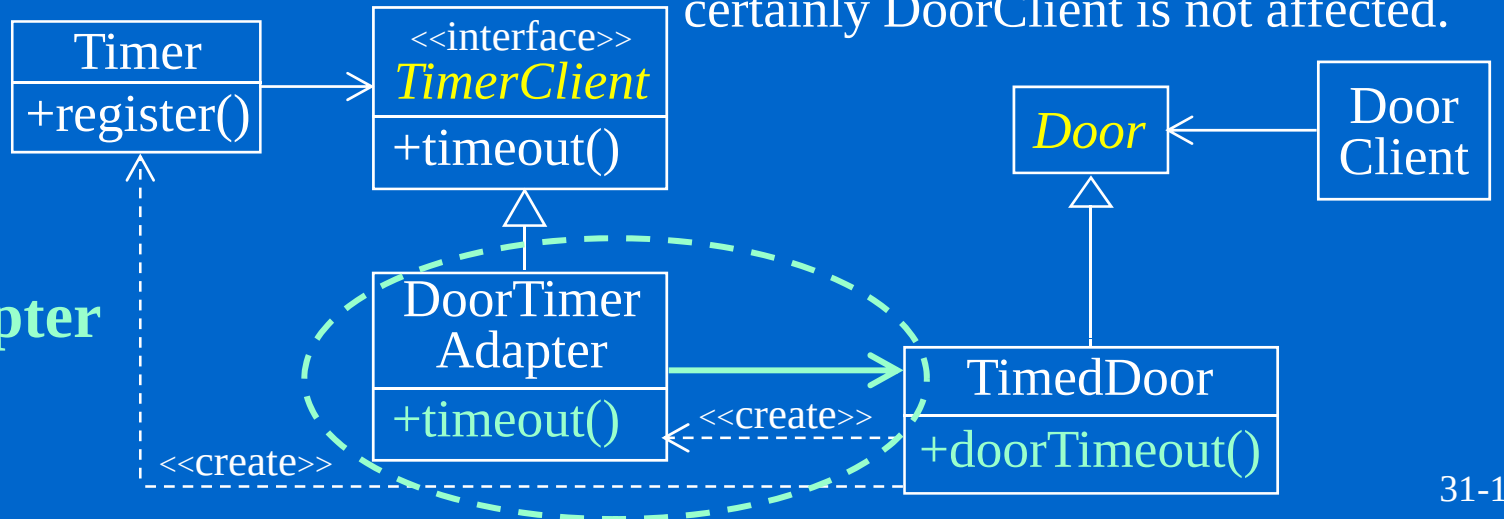

Object Adapter Pattern

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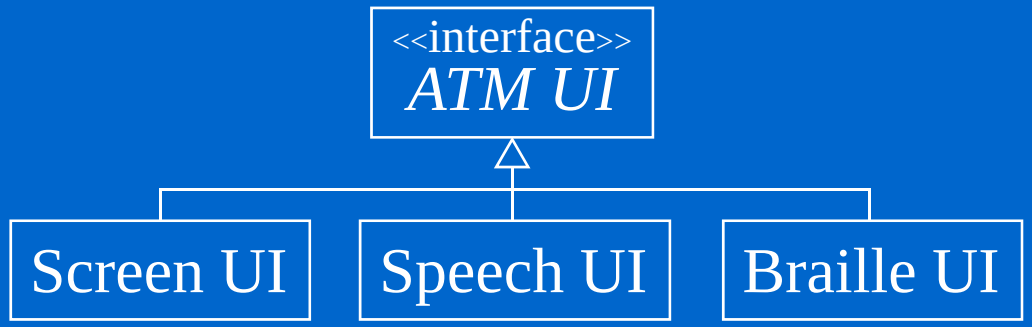

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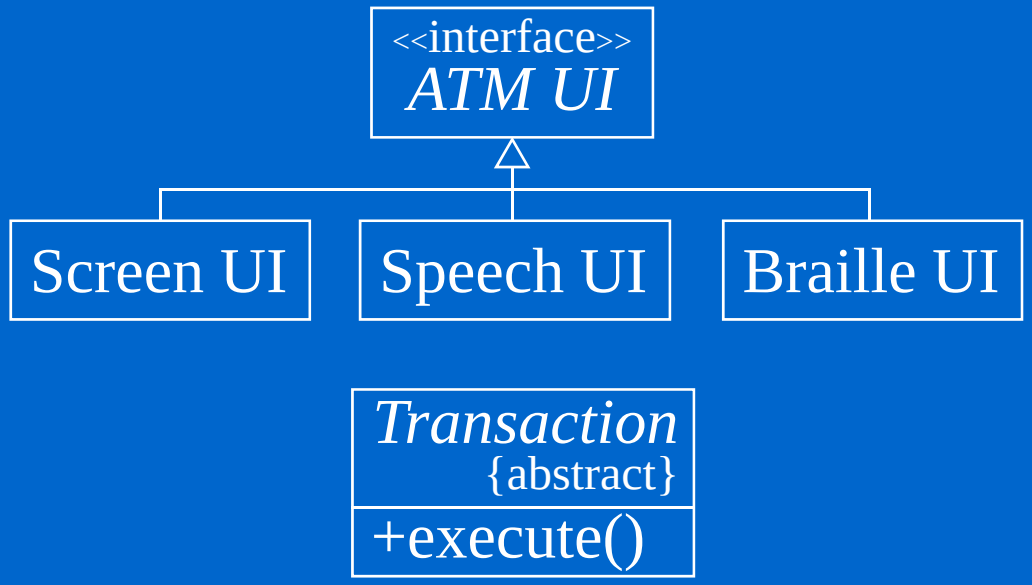

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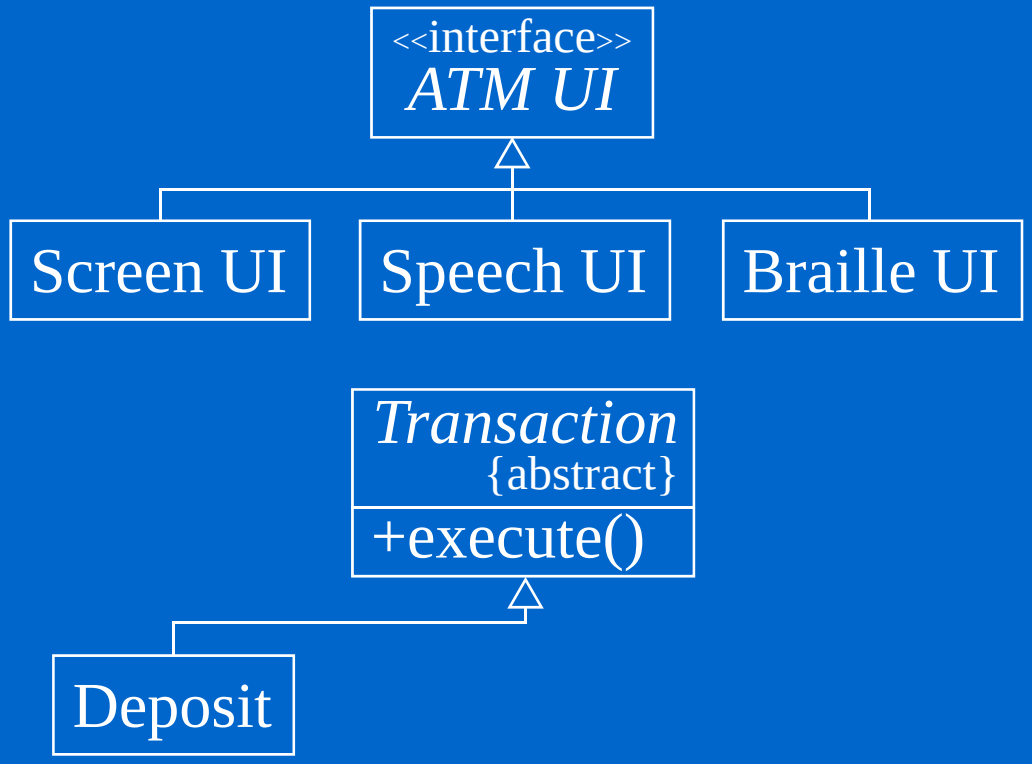

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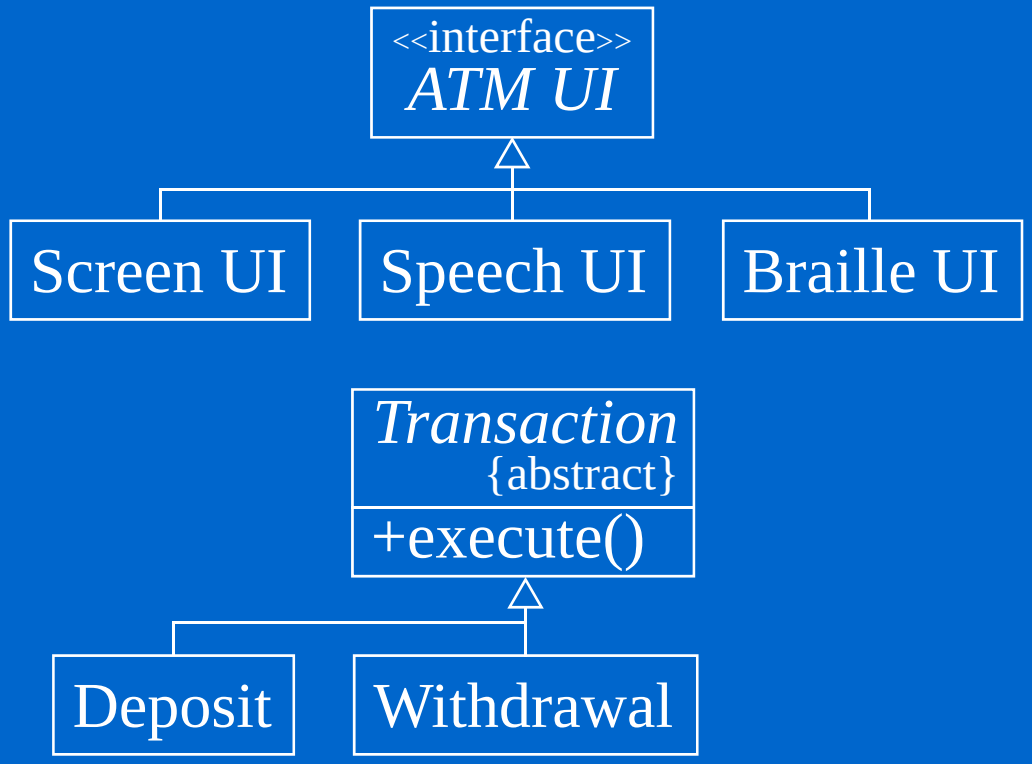

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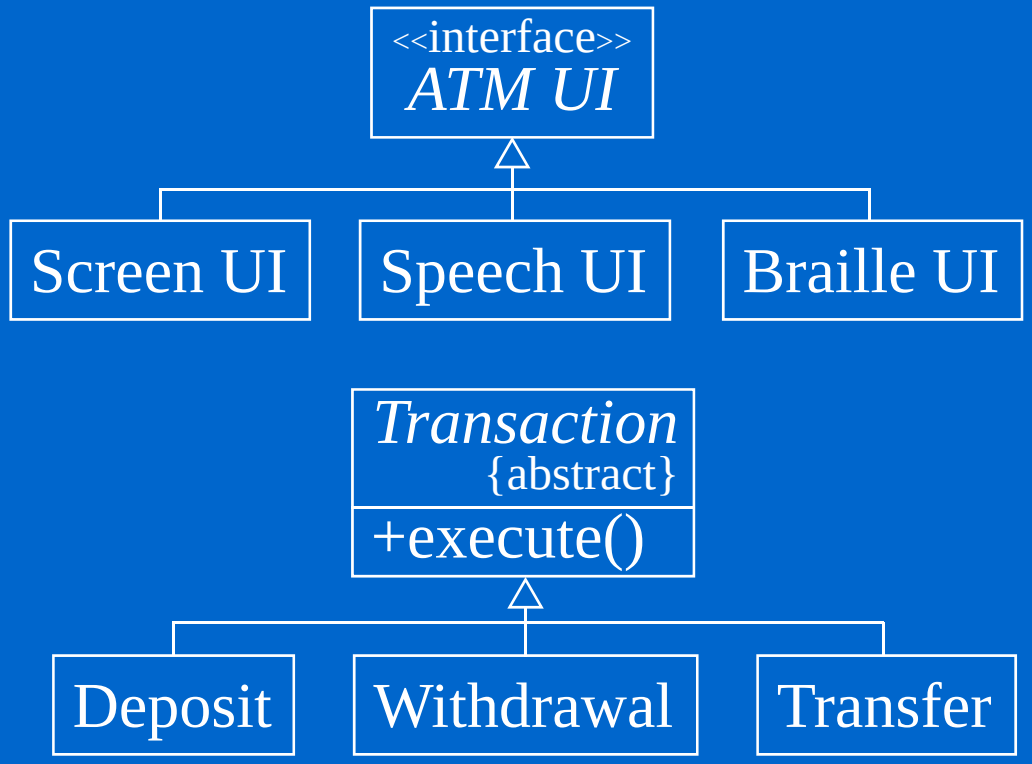

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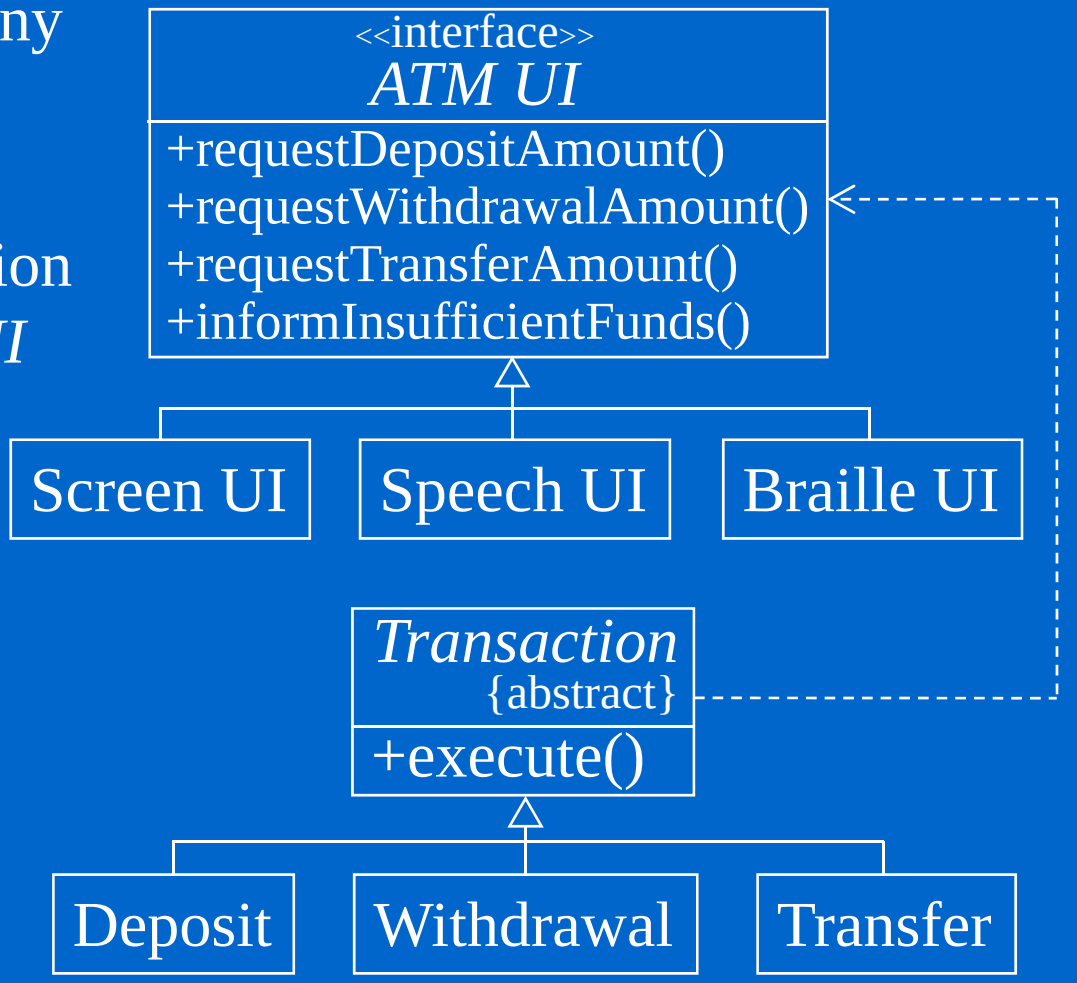

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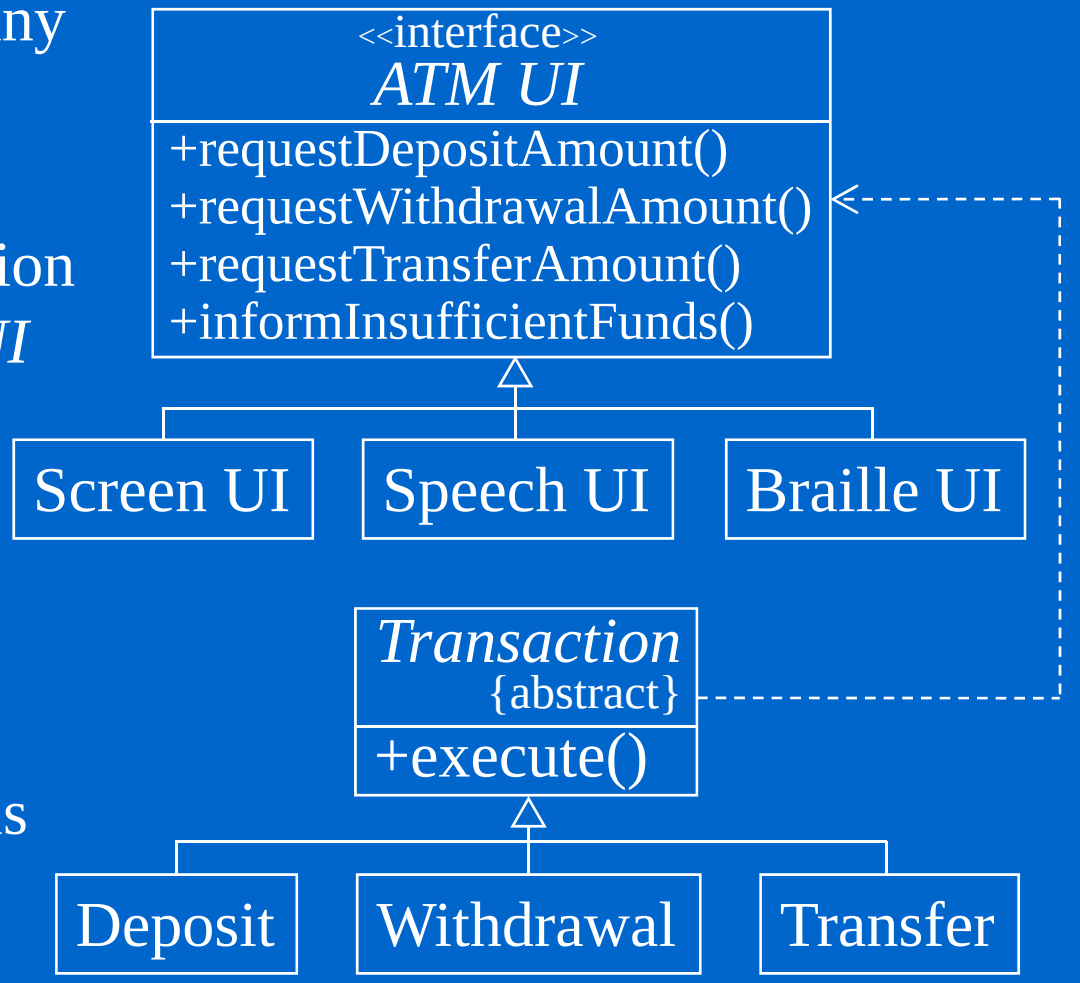

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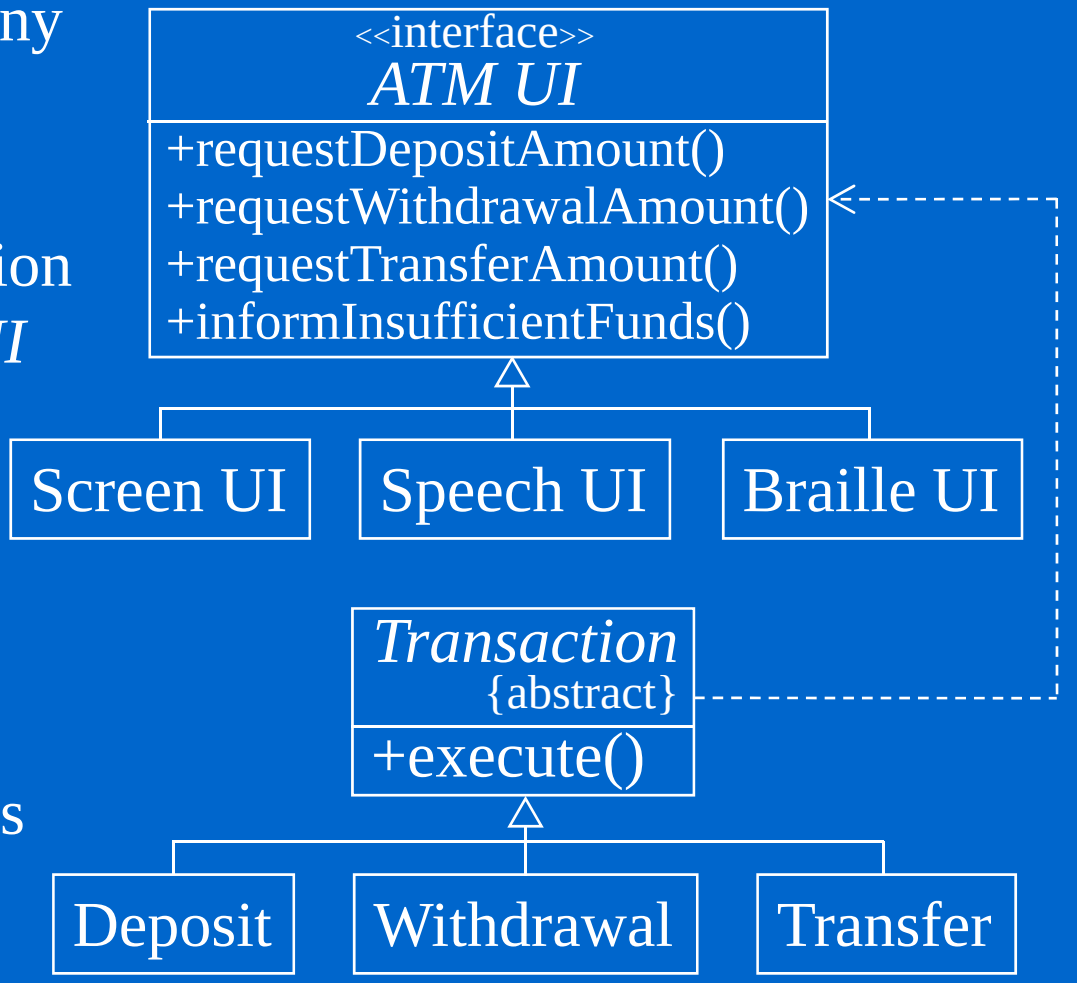

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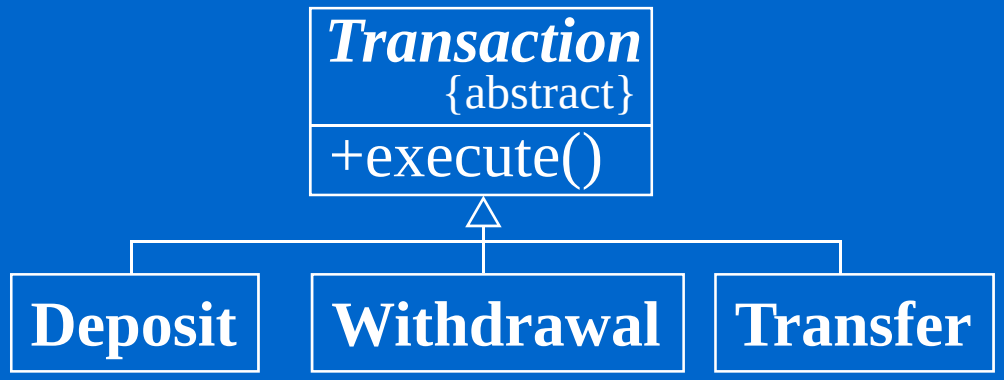

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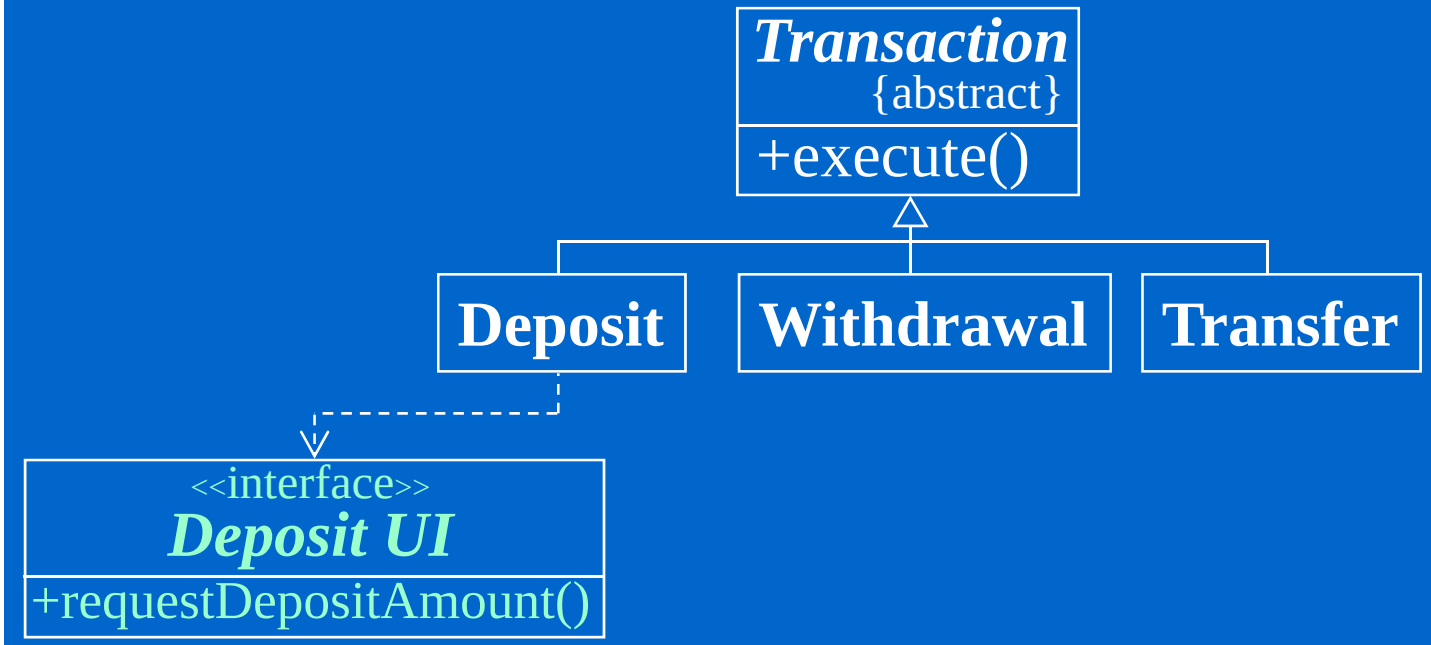

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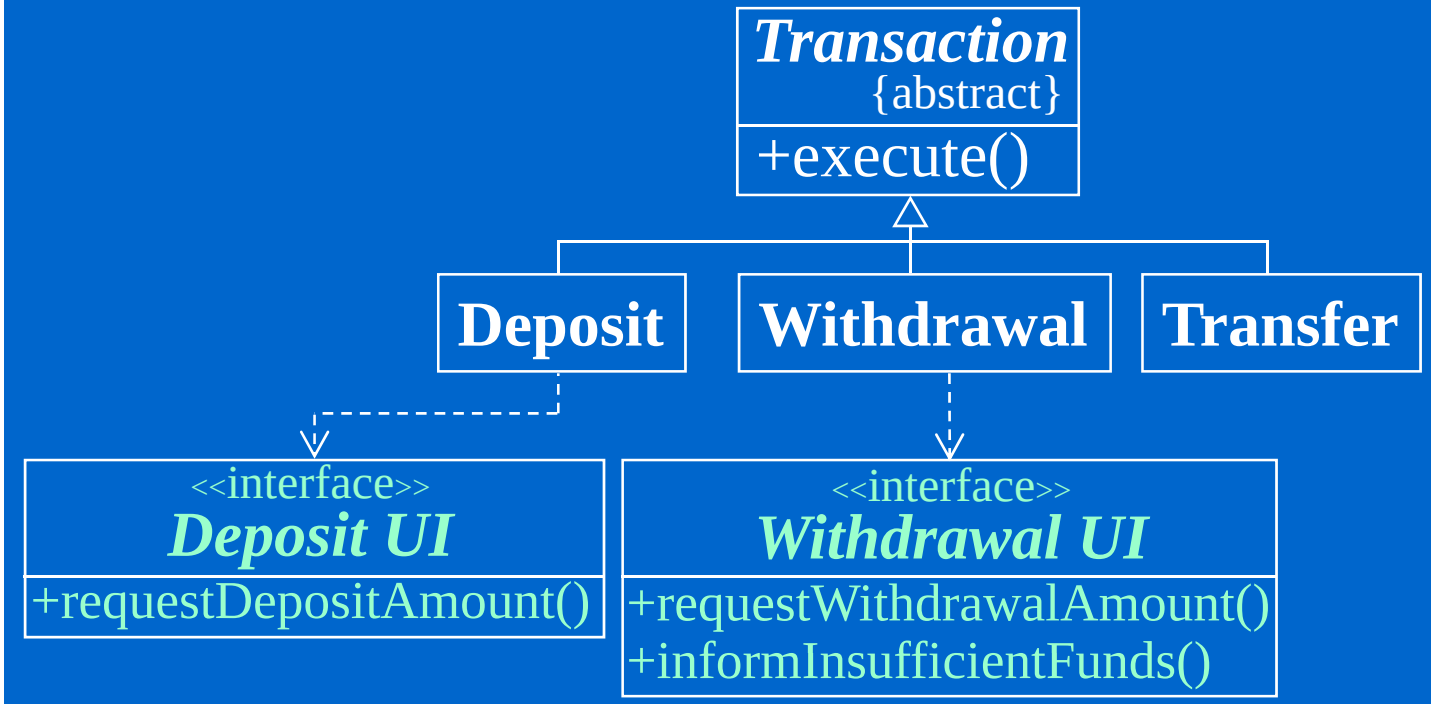

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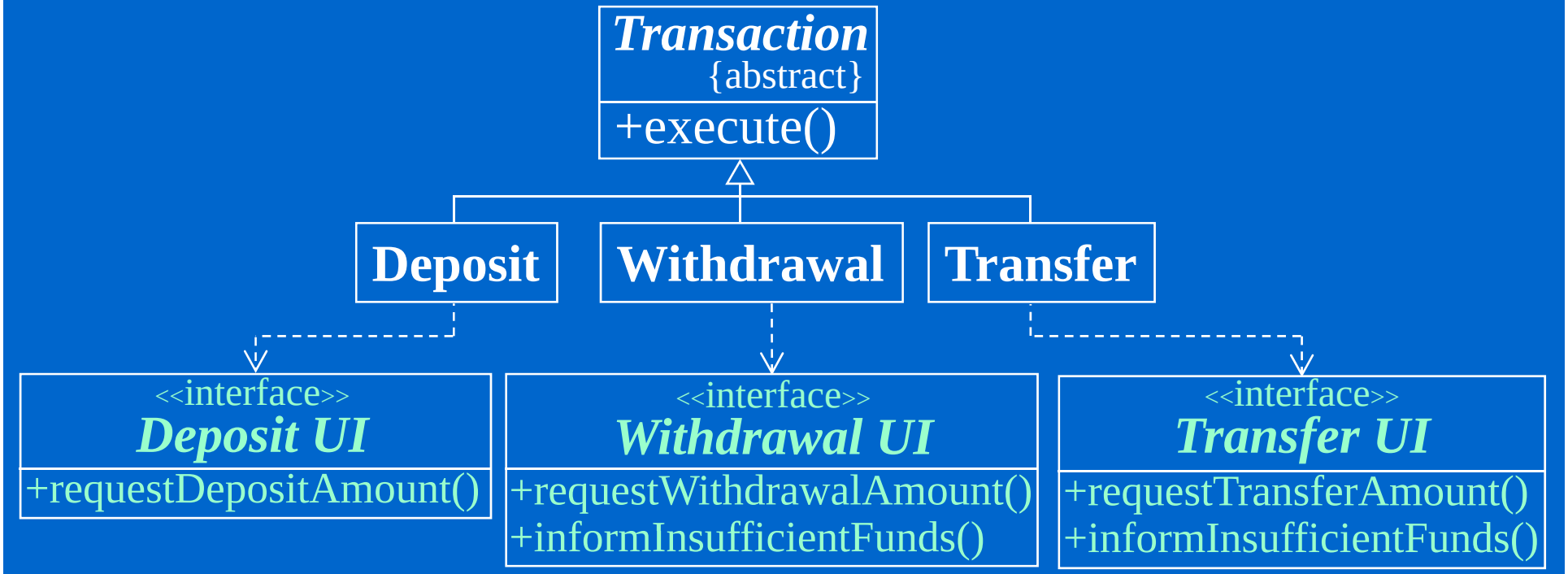

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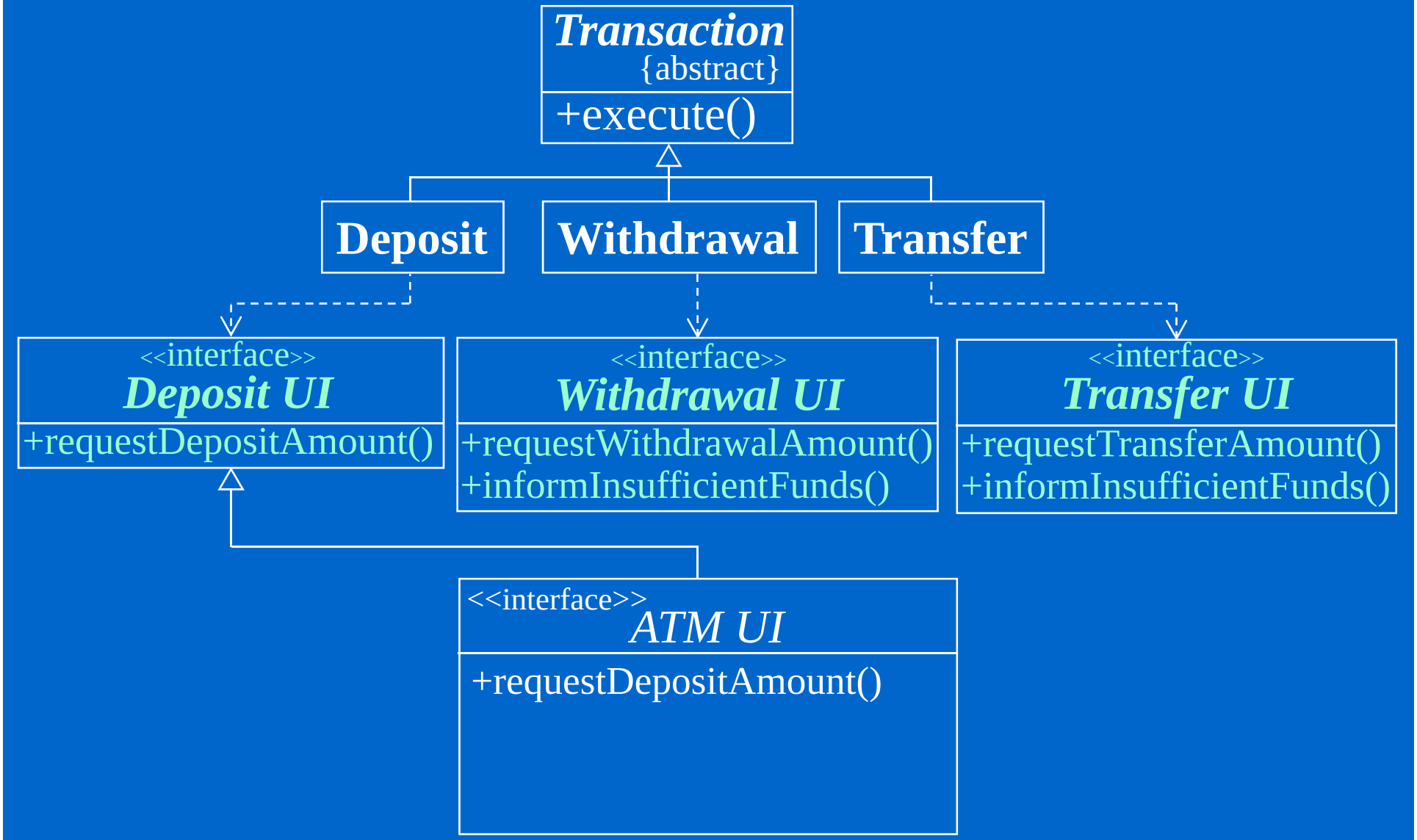

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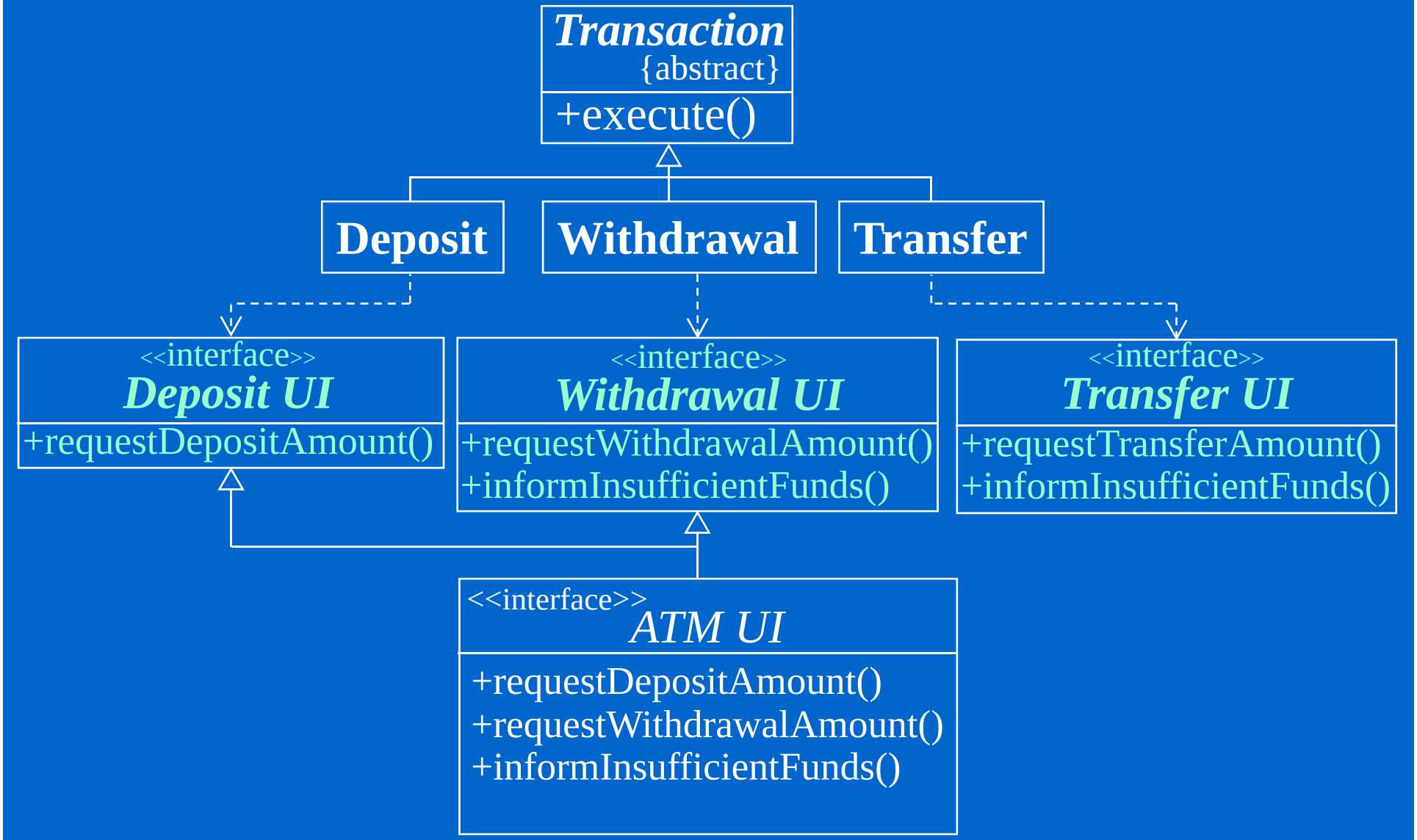

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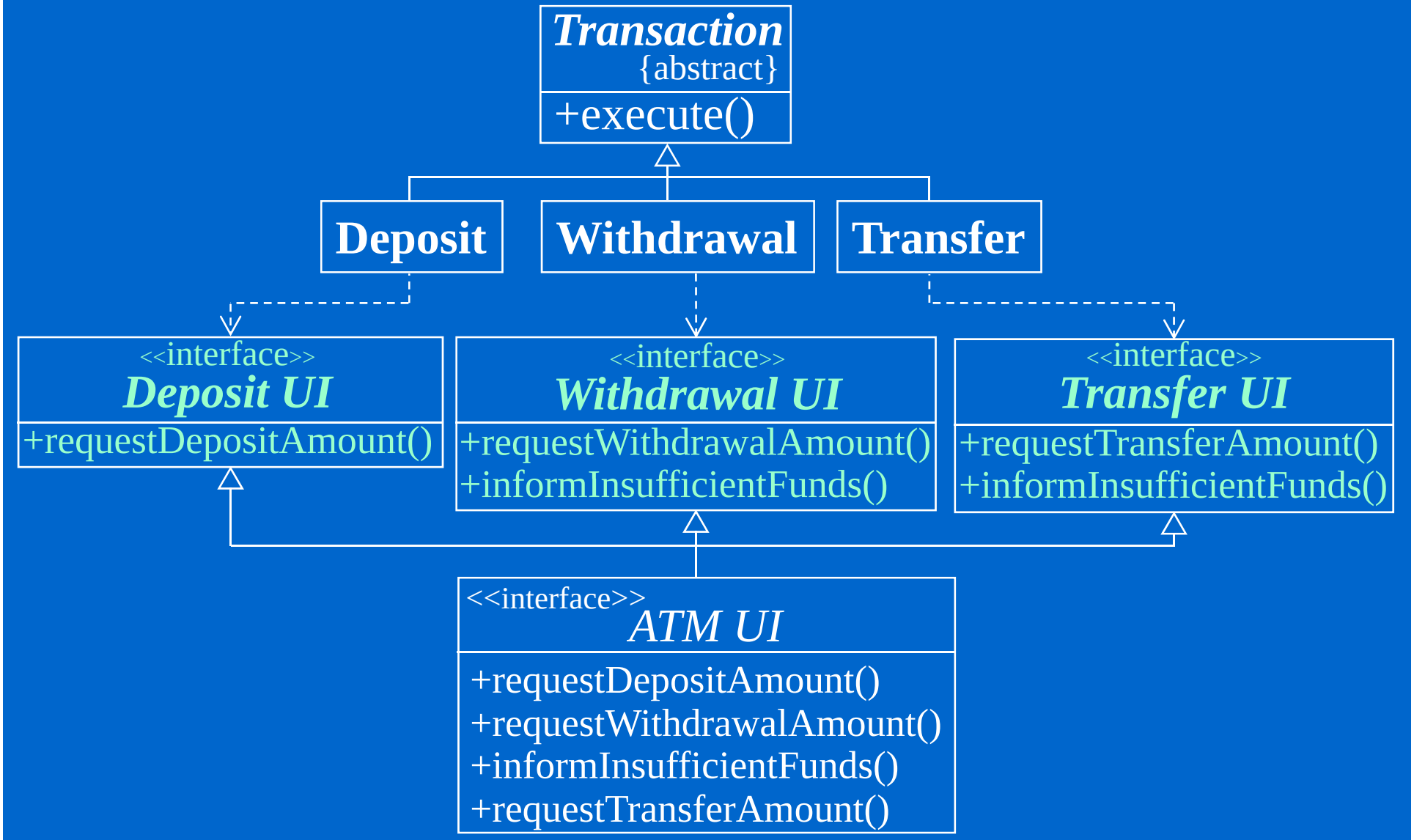

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- The dependency structure of a **well-designed, object-oriented program** is "**inverted**" with respect to the dependency structure that normally results from traditional procedural designs.

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- Forward class declarations make it possible for classes to have *circular relationships* without having *circular dependencies* between header files.

Application's Most Valuable Part

- The high-level modules contain the important **policy decisions** and **business models** of an application.

Policy Layer

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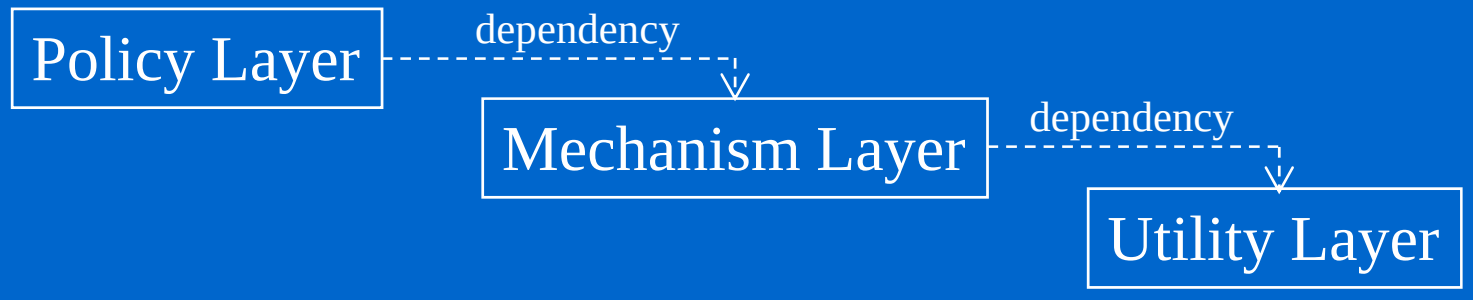
- **Naïve layering scheme**: policy layer is sensitive to changes in mechanism layer and all the way down to utility layer



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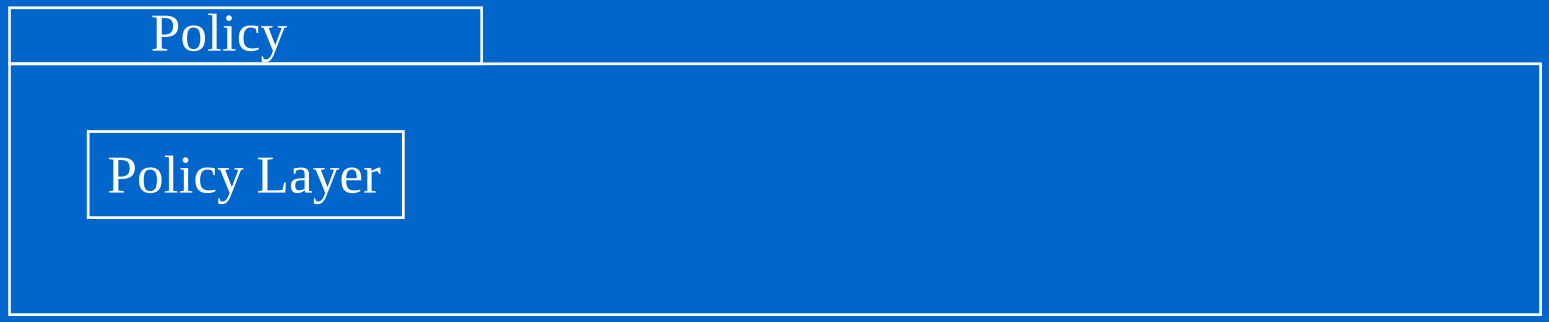

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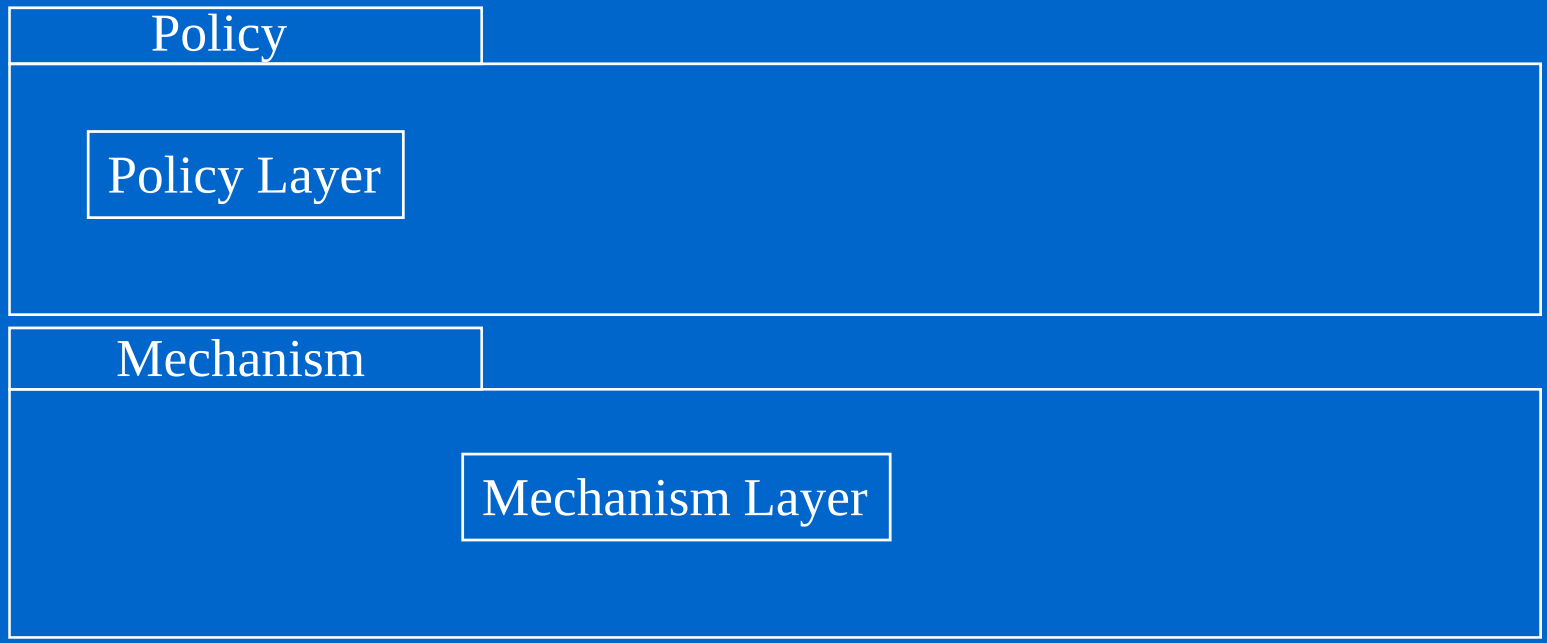

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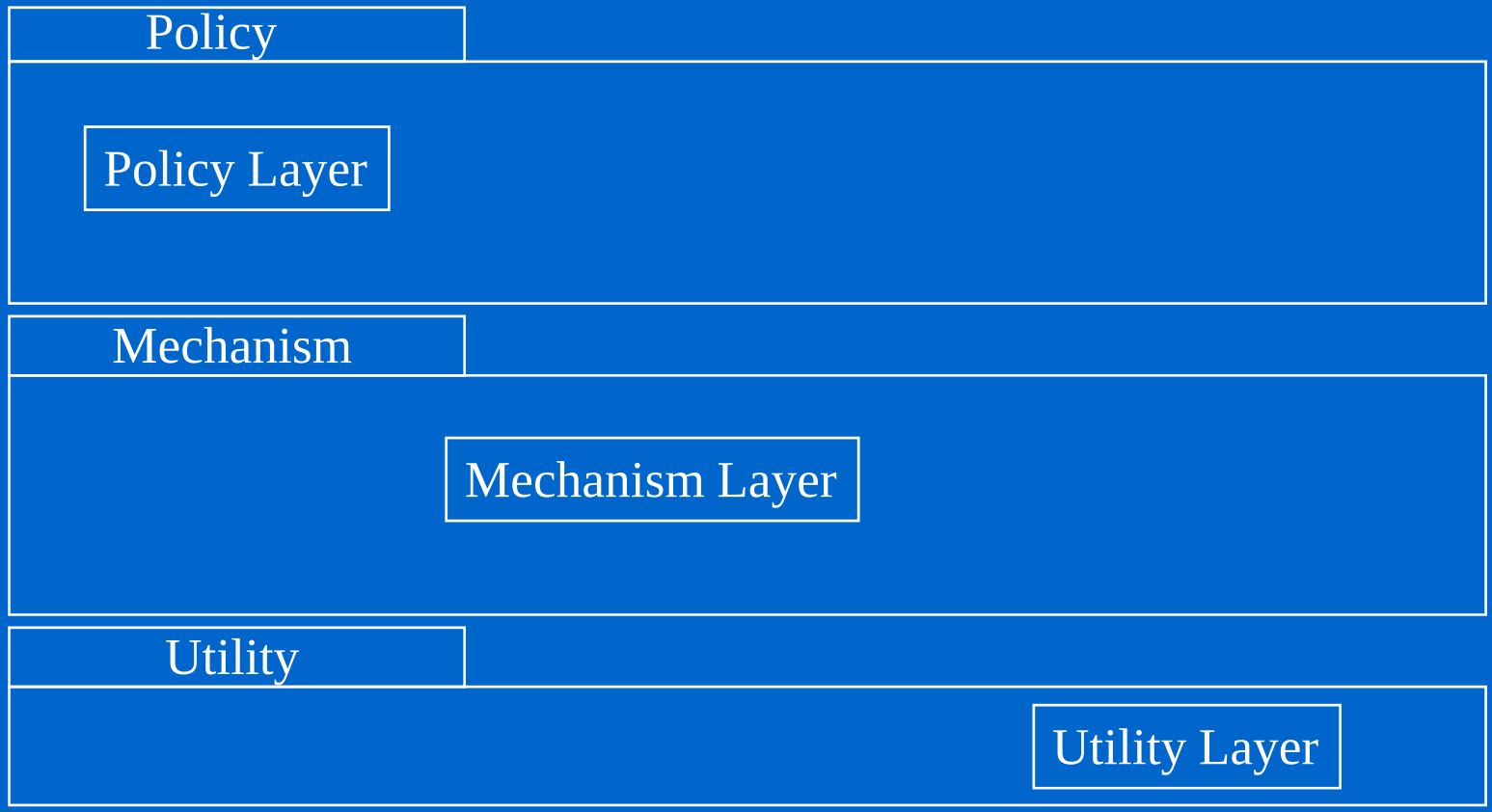

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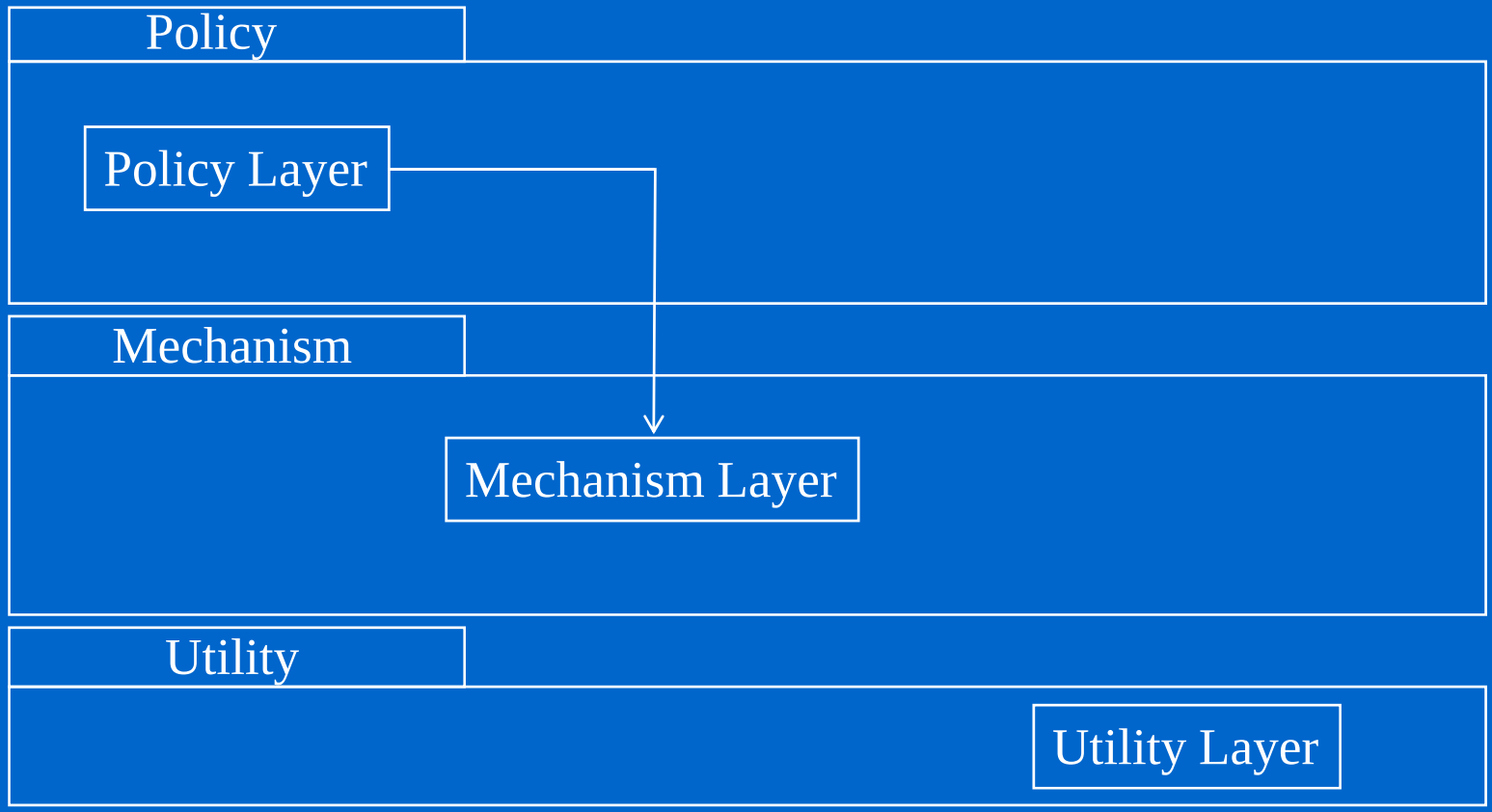

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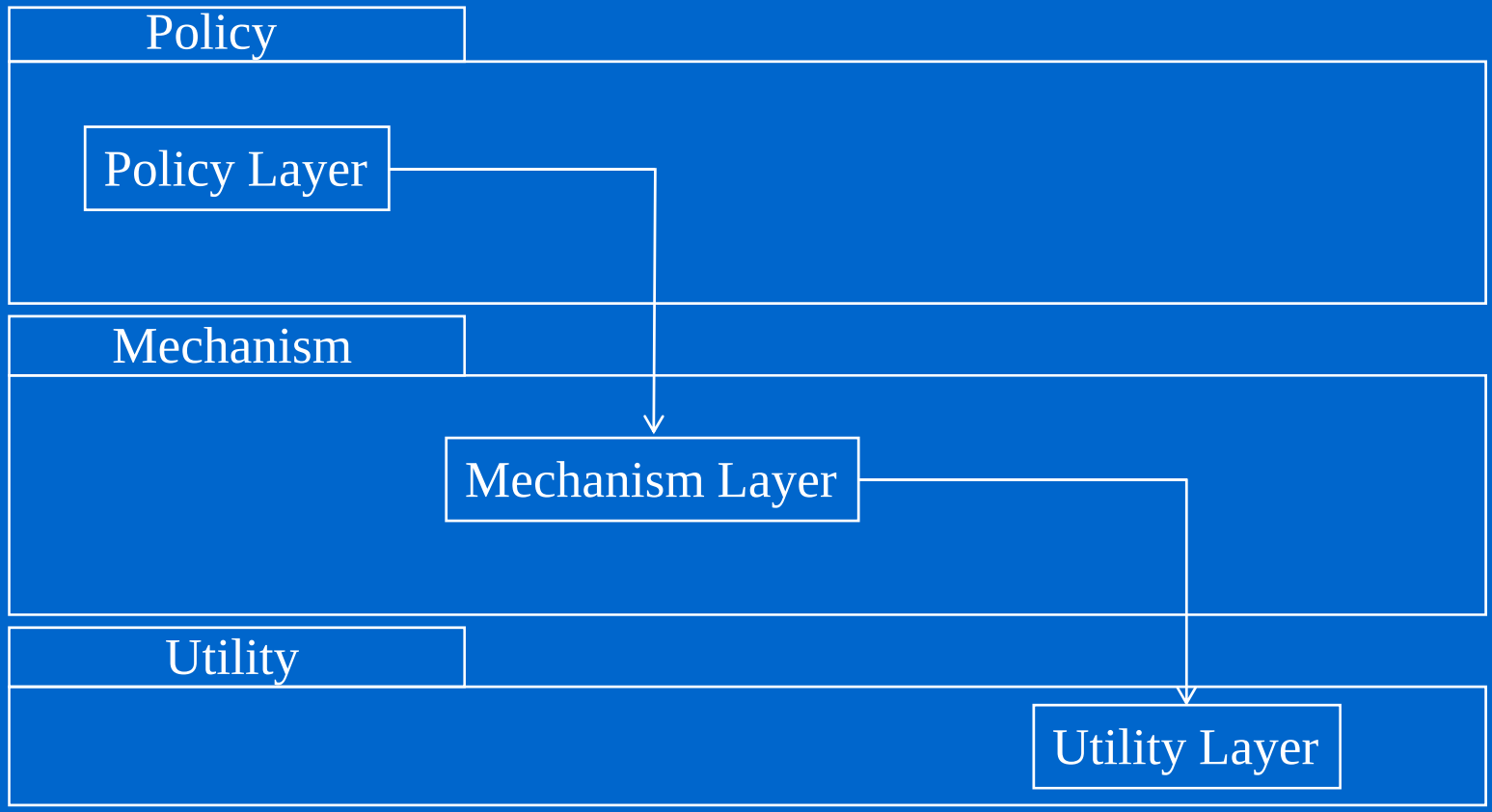

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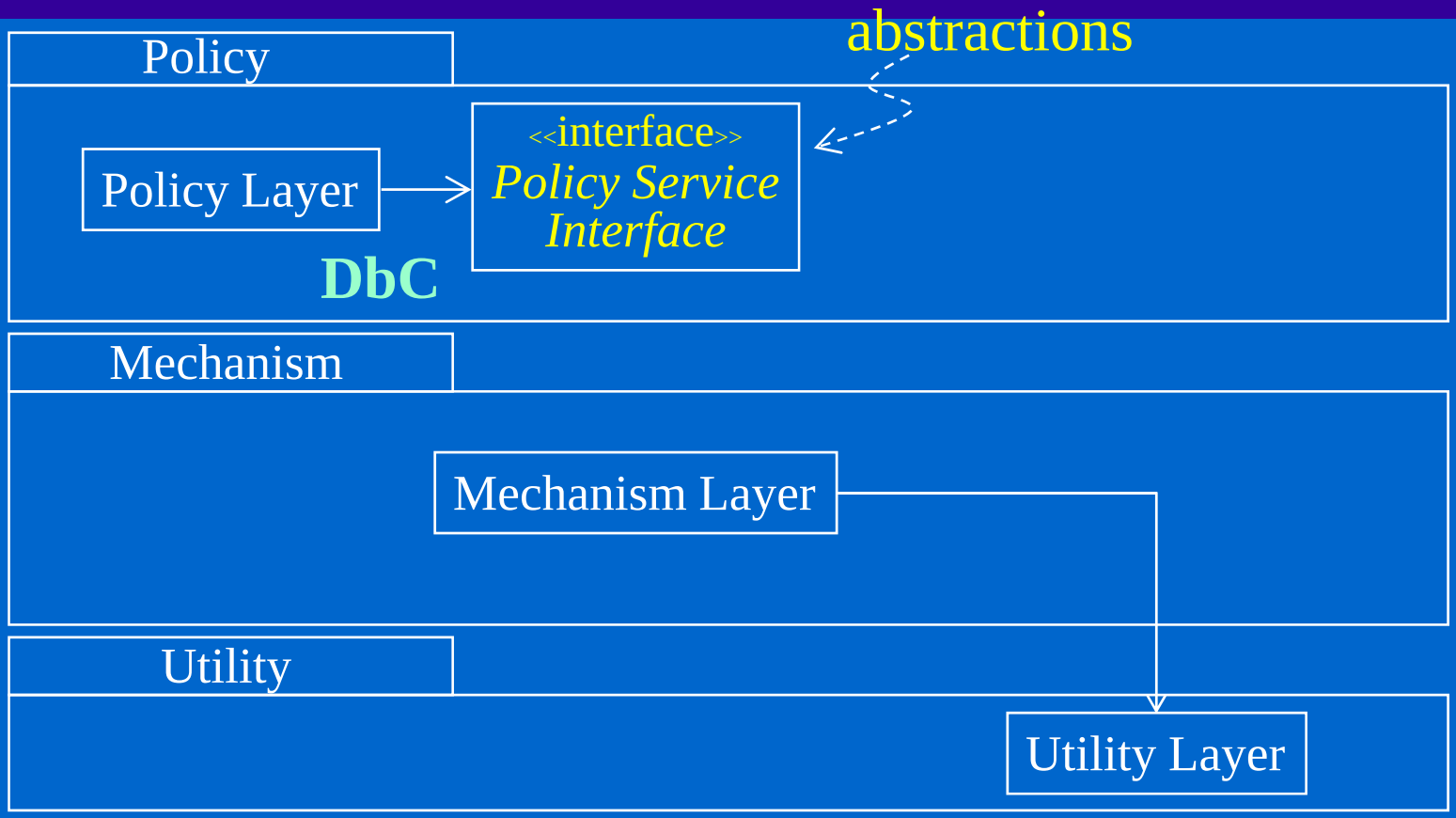

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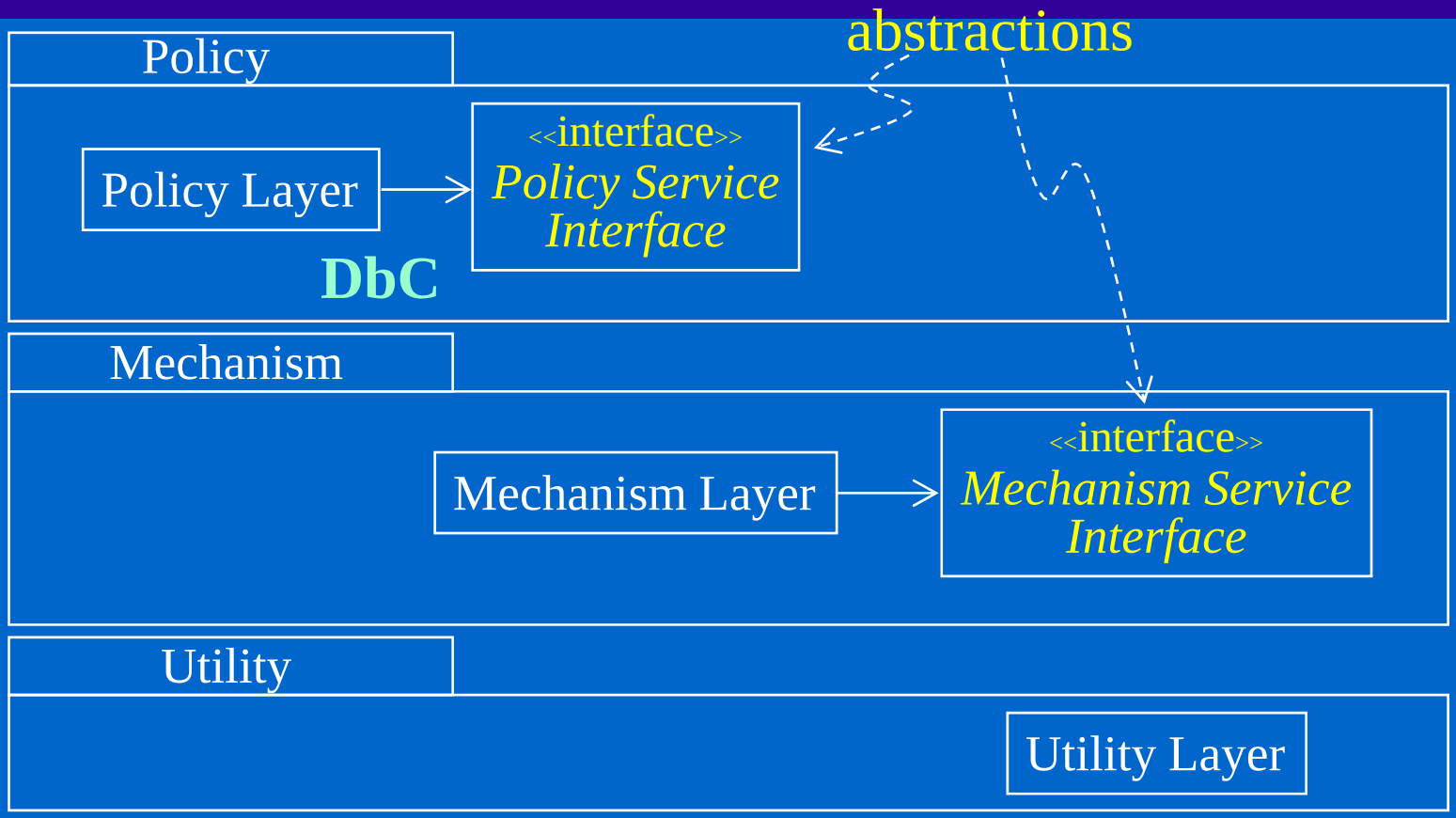

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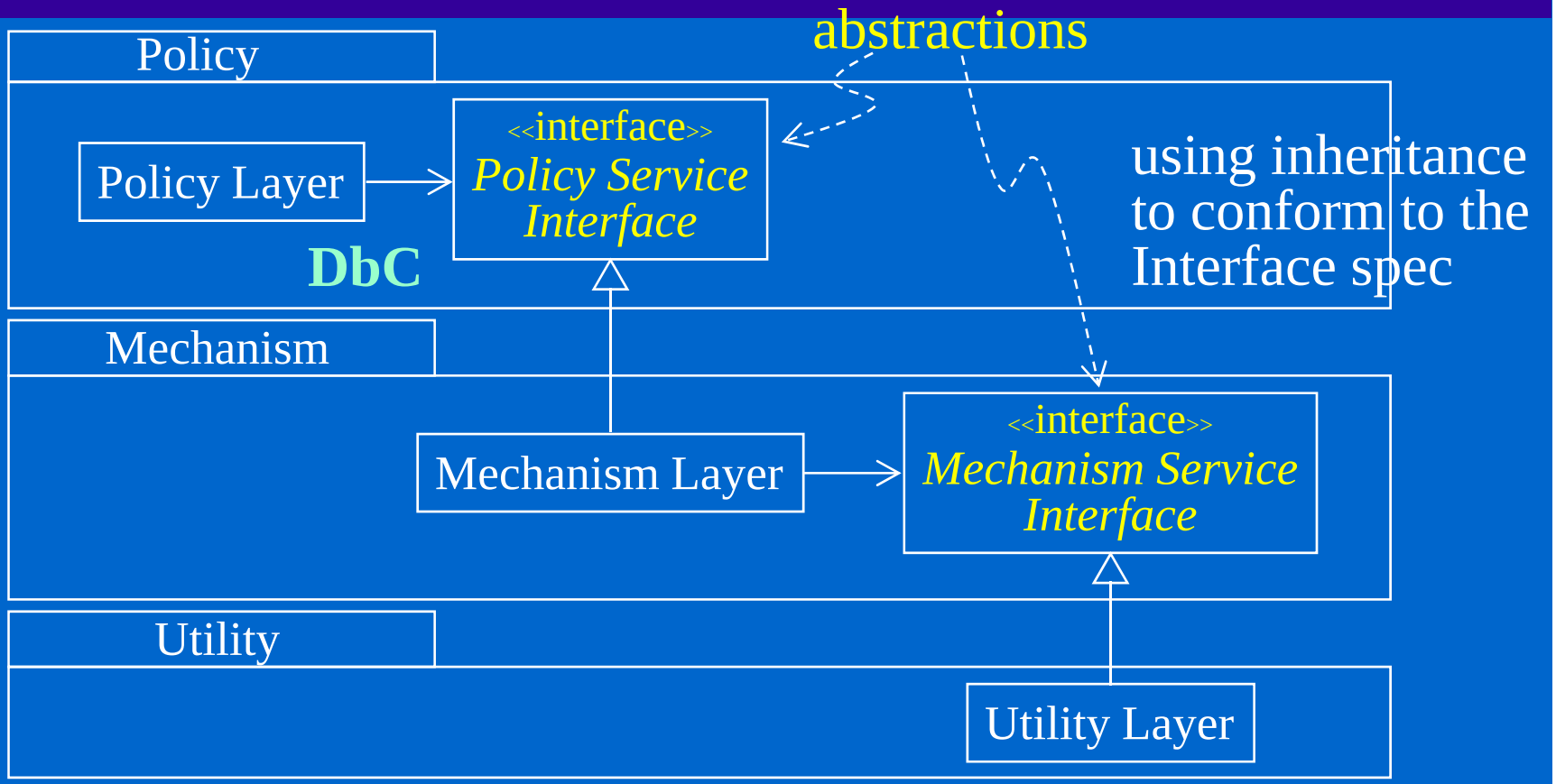

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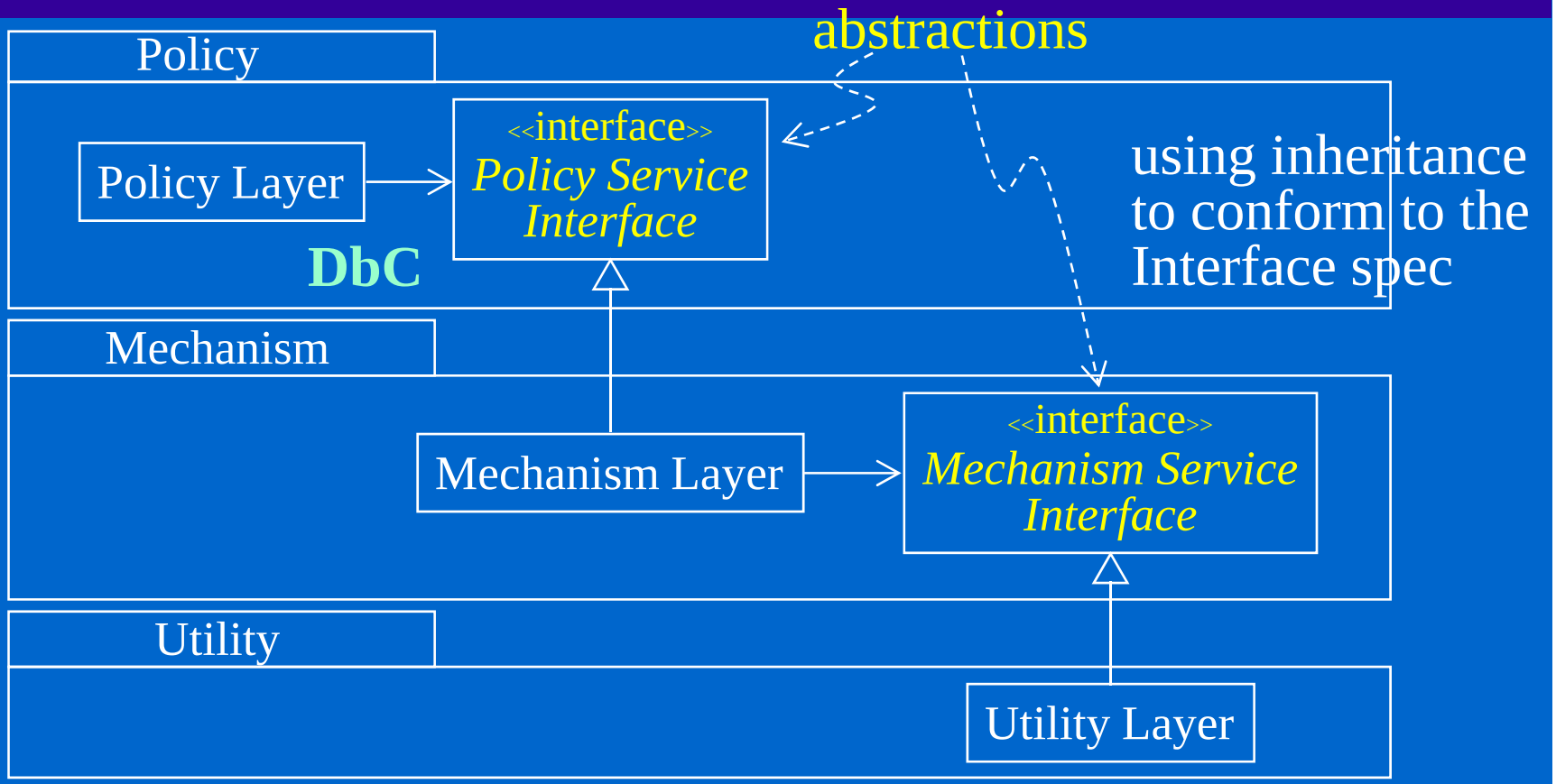

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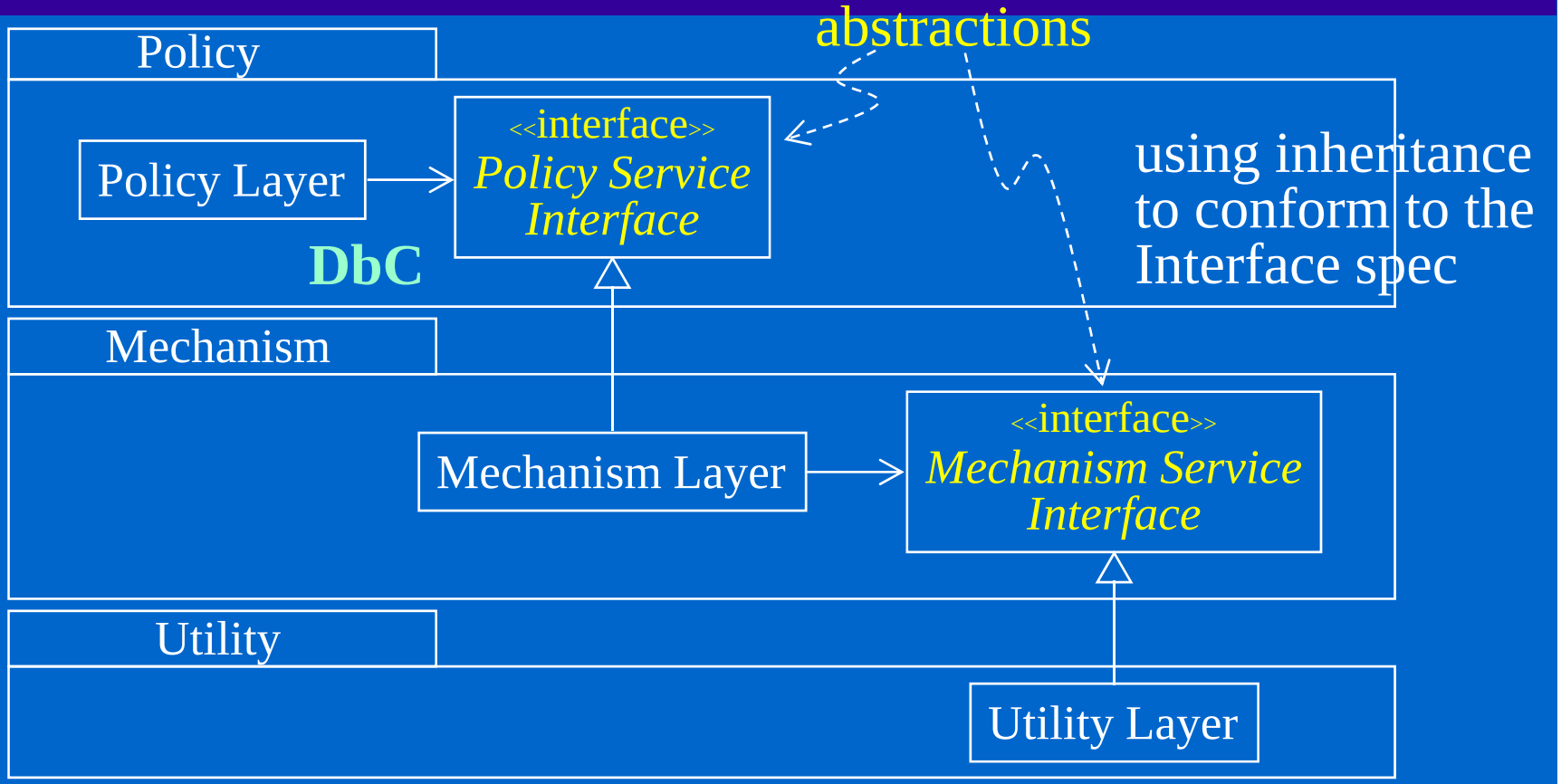

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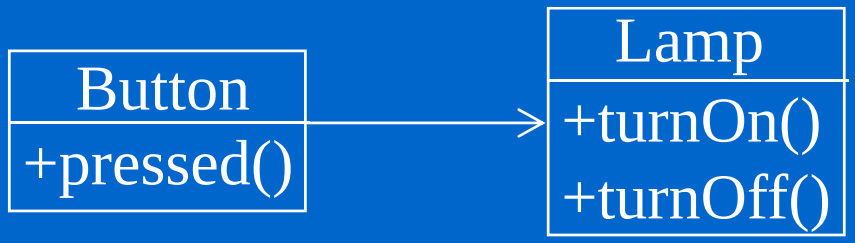

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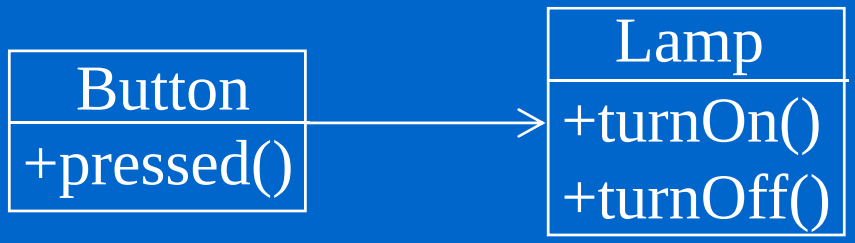

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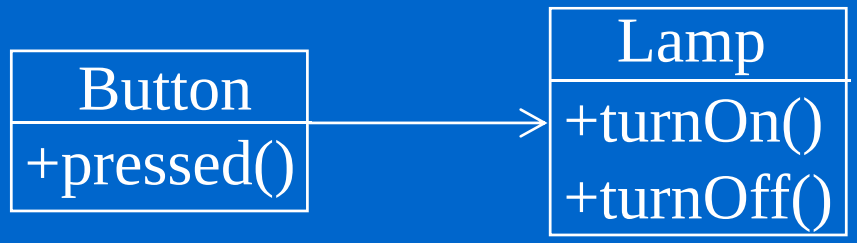

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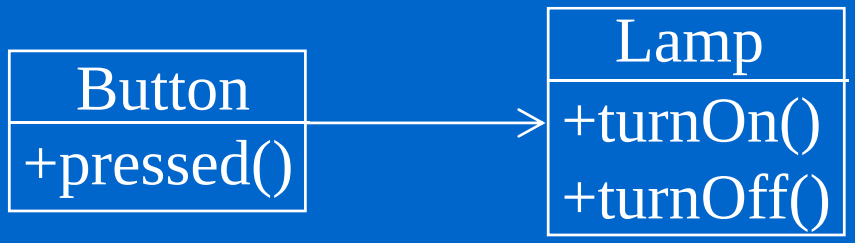

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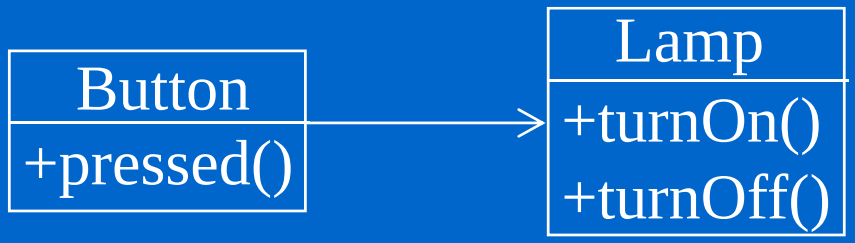

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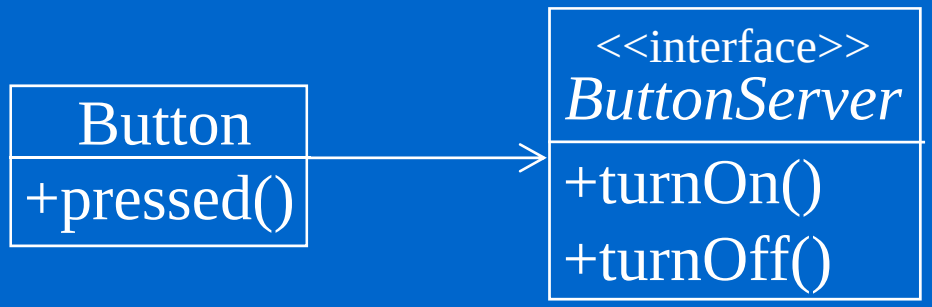

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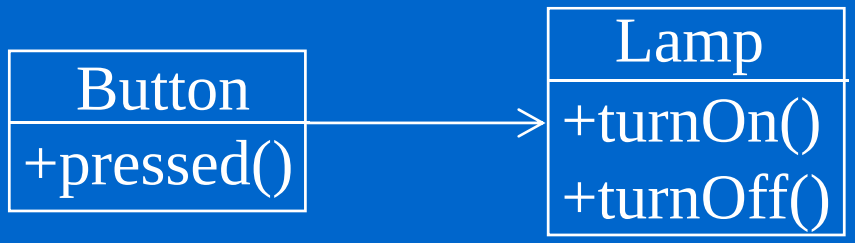

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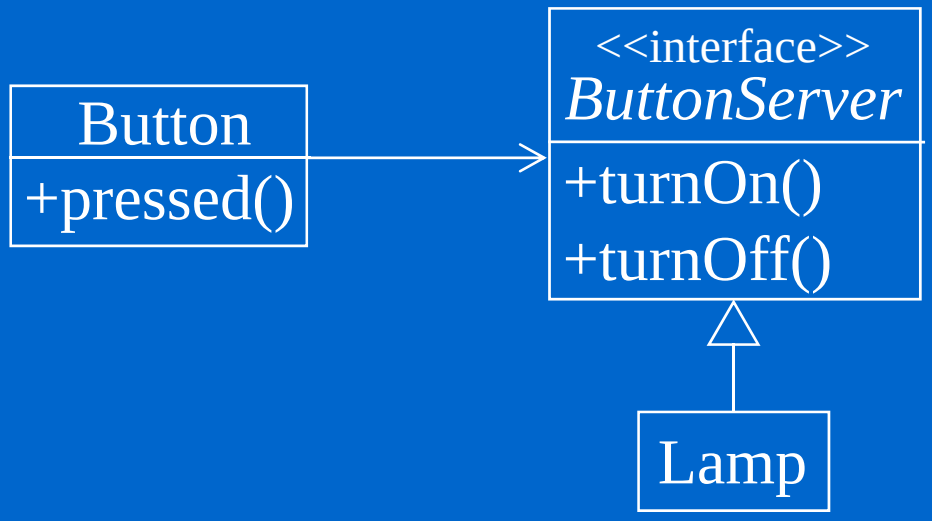

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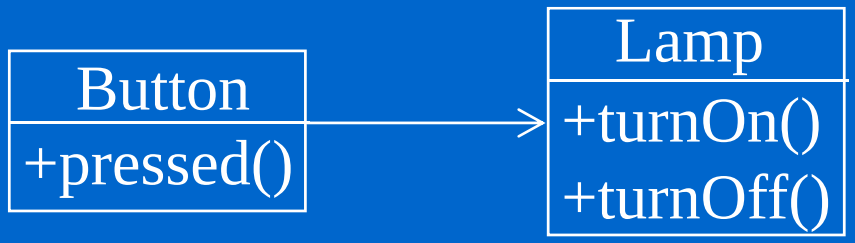

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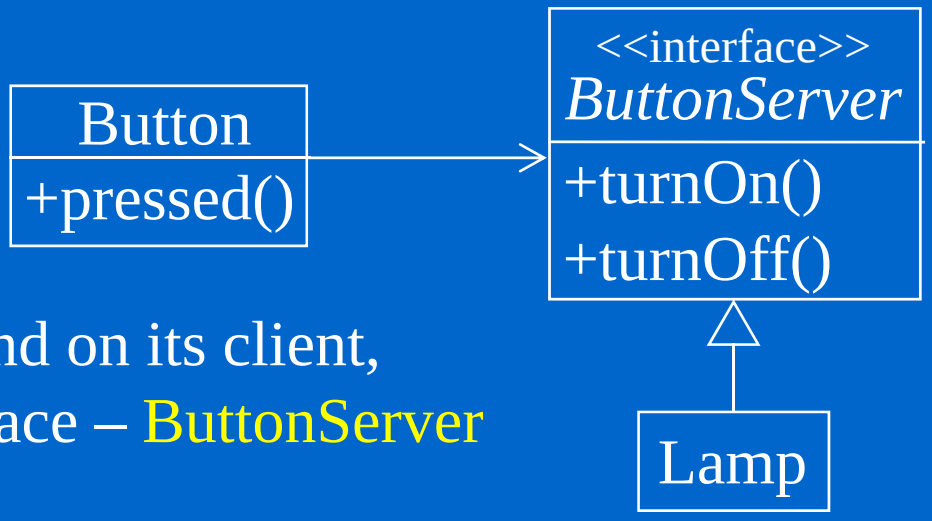

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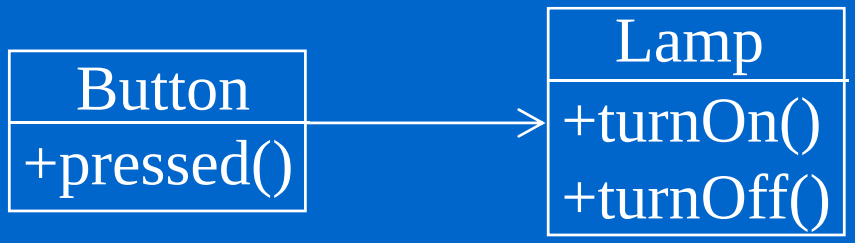

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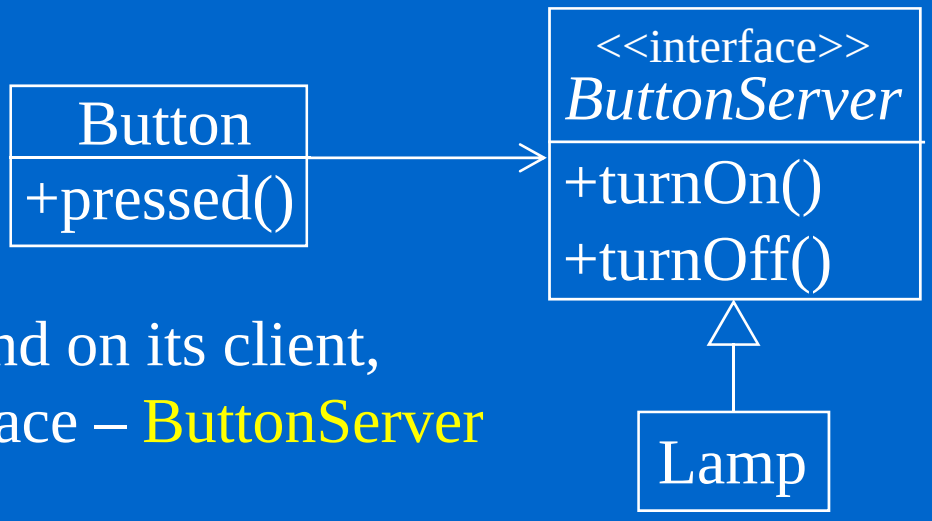

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can be renamed to something more generic like SwithchableDevice

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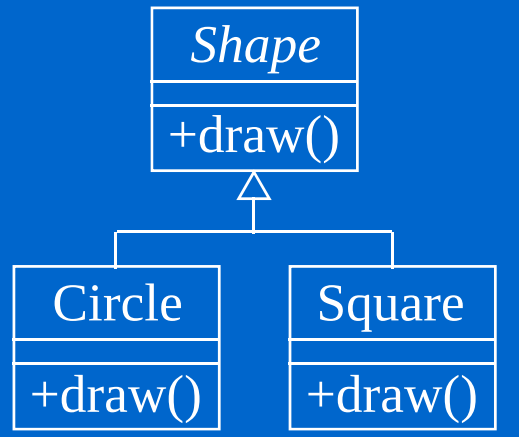

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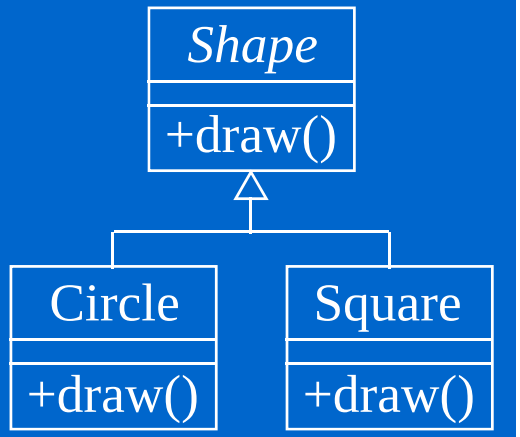

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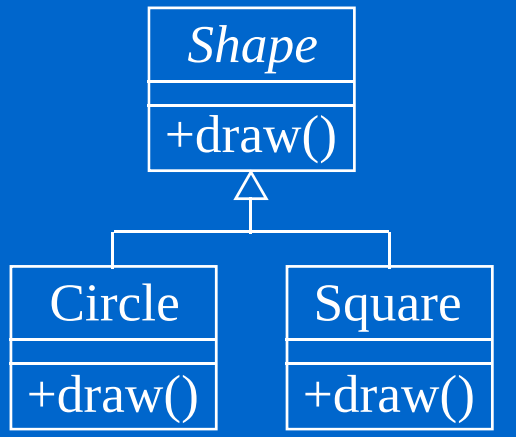

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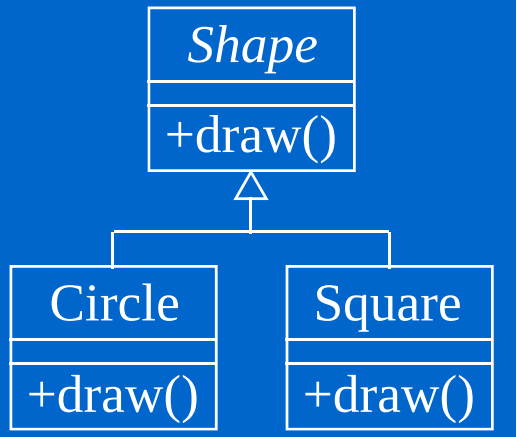

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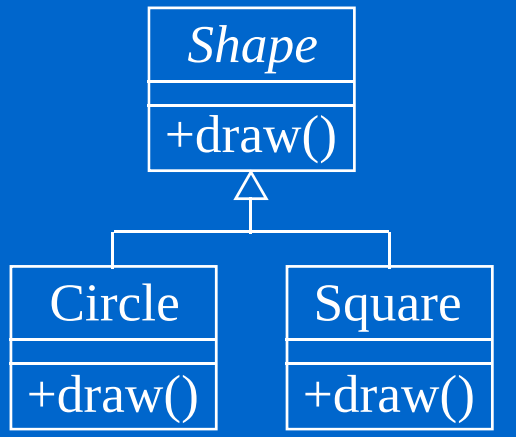

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This exhaustive list should appear only once in the program and no more.

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