# C++ Foundation


## Object Oriented Programming

# Object Oriented Programming

- encapsulation
- information hiding
- abstraction
- separation of concerns
- single repsonsibility principle
- parameterize from above
- liskov substitution principle
- patterns

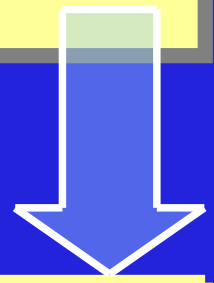
# En(capsule)ation

- Data and functions can be bundled together

```
struct file
{   ...
};
int getc(file*);
int ungetc(int, file*);
```

```
class file
{   ...
    int getc();
    int ungetc(int);
};
```

- An access restriction mechanism



```
class file
{
public:
    int getc();
    int ungetc(int);
private:
    ...
};
```

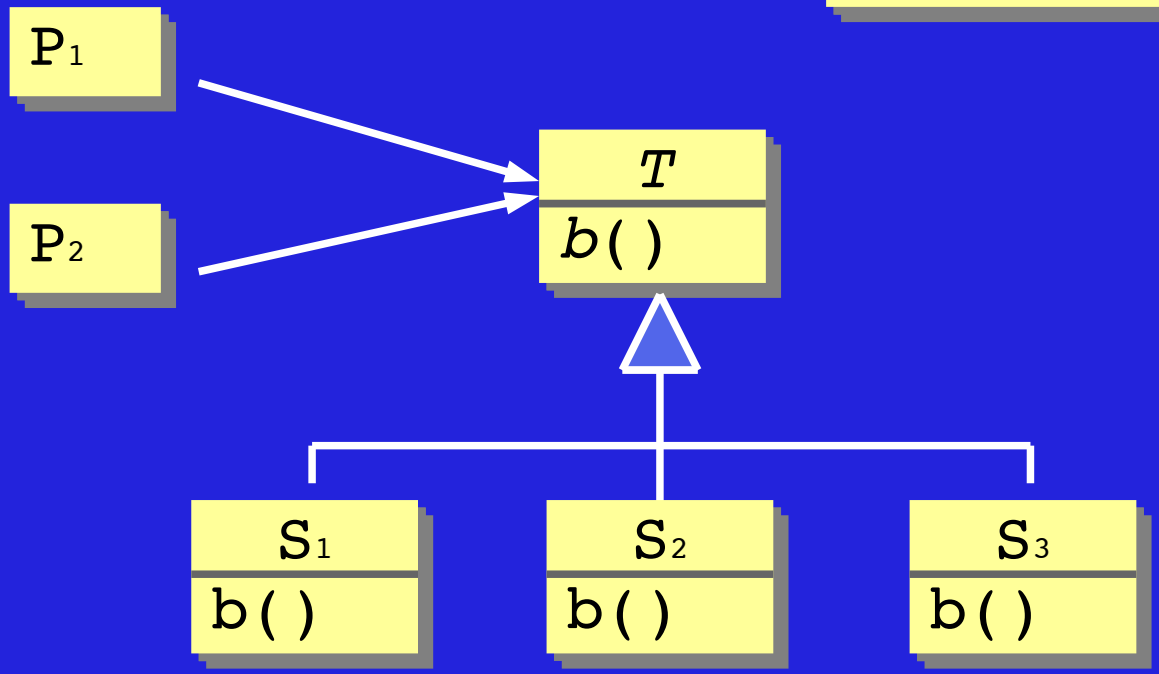
# Information Hiding in C++

- We hide information partly so we can change what's hidden and limit the change's impact
  - public - private
    - change requires recompilation
  - header file - source file
    - change of implementation requires relinking
  - opaque types
    - change of representation requires relinking
  - inheritance hierarchies
    - change of type does not require relinking!

# Liskov Subtitution Principle

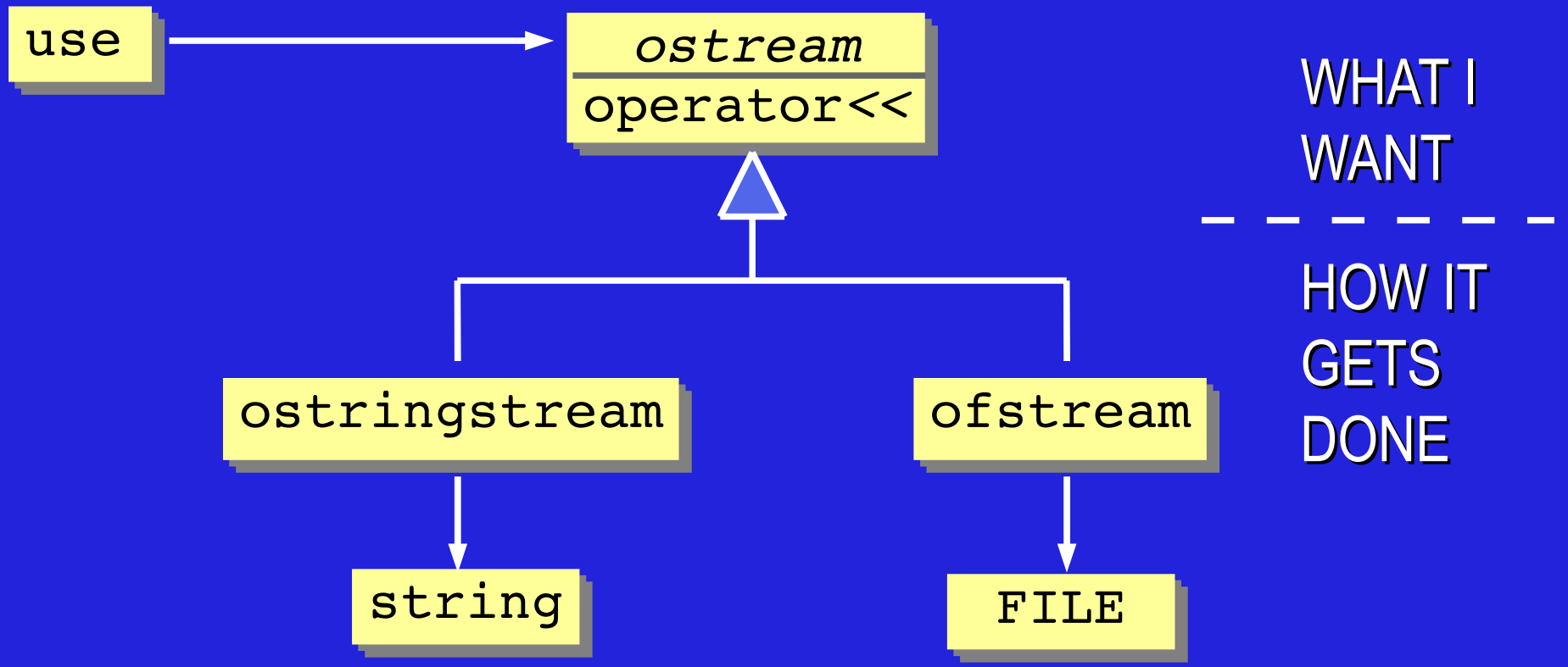
If for each object o1 of type S there is an object o2 of type T such that for all programs P defined in terms of T, the behaviour of P is unchanged when o1 is substituted for o2, then S is a subtype of T.

*Barbara Liskov*



# Liskov Subtitution Principle

- For example...

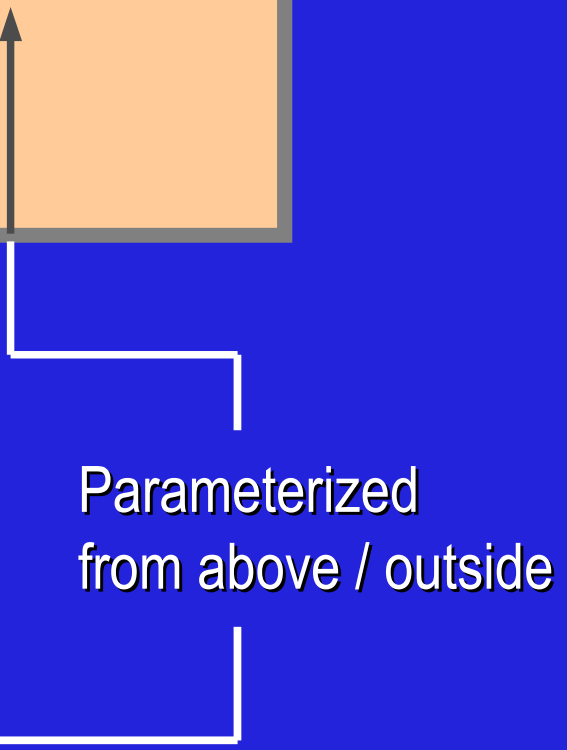


# Parameterize From Above :-)

- Aim to make parameterization an explicit and visible part of the public api of a class/method

```
struct date
{    ...
     void print(std::ostream & os) const
     {
          std::cout << ...;
     }
};
```

```
void example(date when)
{
     when.print(std::cout);
}
```



# Hard-wired From Below :-(

- Complicates testing, increases dependencies

```
struct date
{    ...
     void print() const
     {
          std::cout << ...;
     }
};
```

Non-parameterized
Fixed below / inside

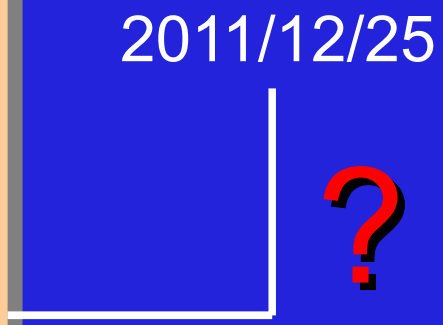
```
void example(date when)
{
     when.print();
}
```

Not-parameterized
from above / outside

# Single Responsibility Principle

- A class should be responsible for one thing and one thing only

```
struct date
{   ...
    void print(std::ostream & os) const
    {
        std::cout << ...;
    }
};
```




```
struct date
{   ...
    int year() const;
    int month() const;
    int day() cont;
};
```

# Separation of Concerns

- Understandability
- Separability
- Protection from Change

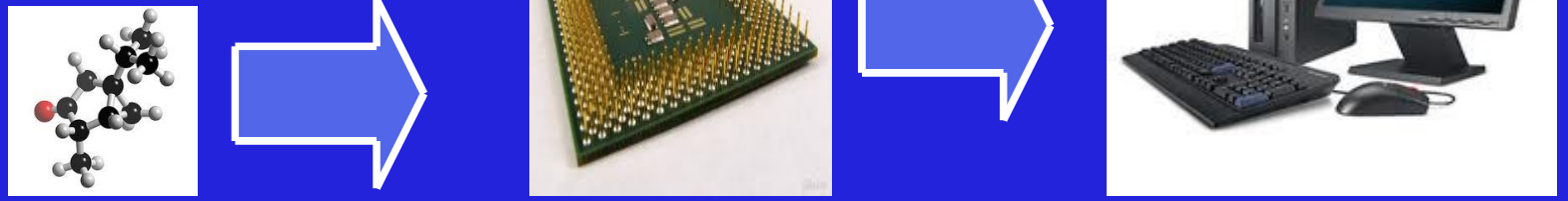
```
a = f() *  g() + h();
a = f() * (g() + h());
```

# Abstraction

- We also hide information when creating crisp new semantic levels

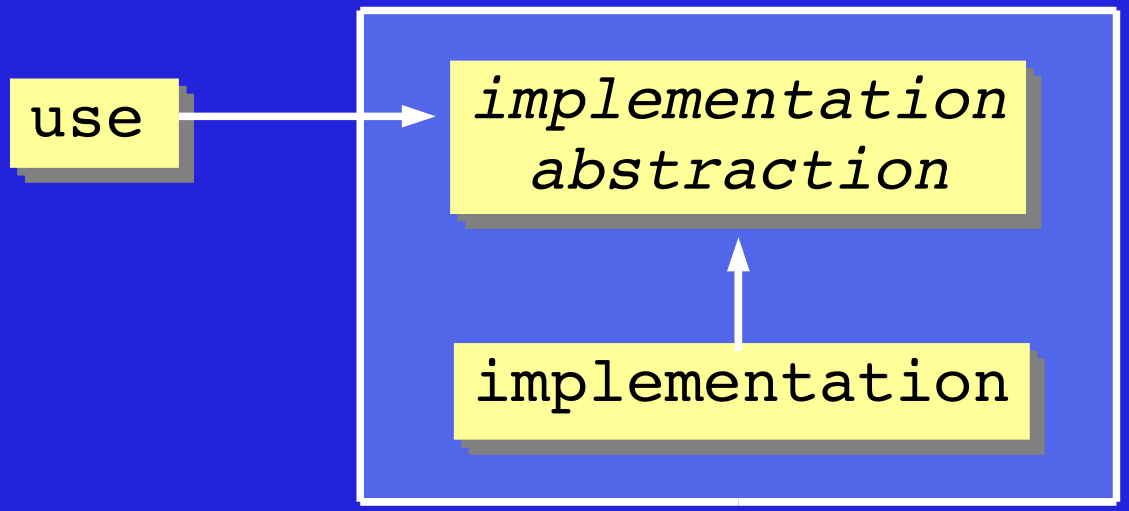
*Edsger Dijkstra*

> Being abstract is something profoundly different from being vague... The purpose of an abstraction is not to be vague, but to create a *new semantic level* in which one can be absolutely precise.

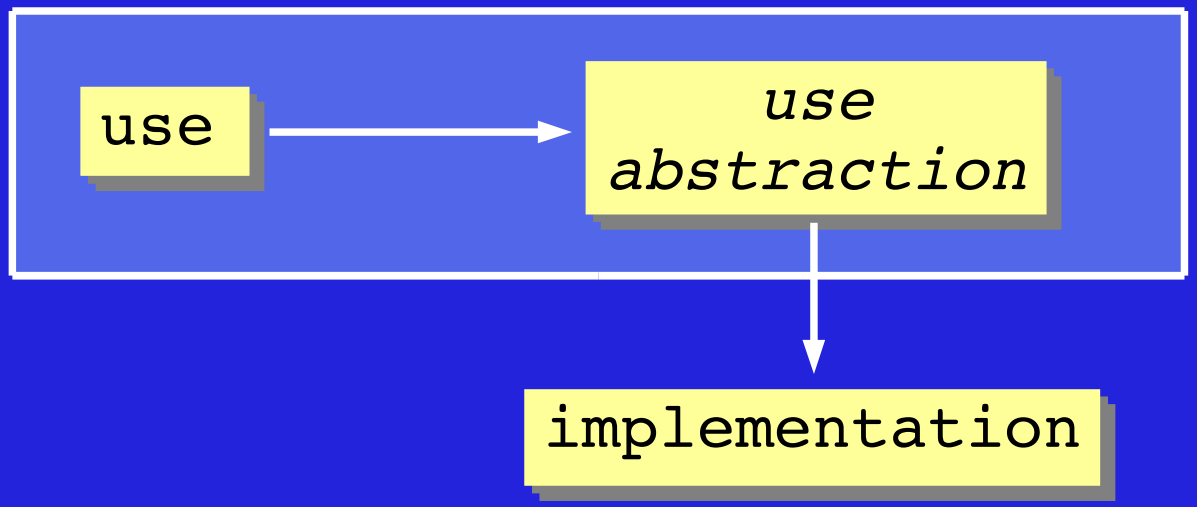


# Abstraction

- How different are the semantic levels?



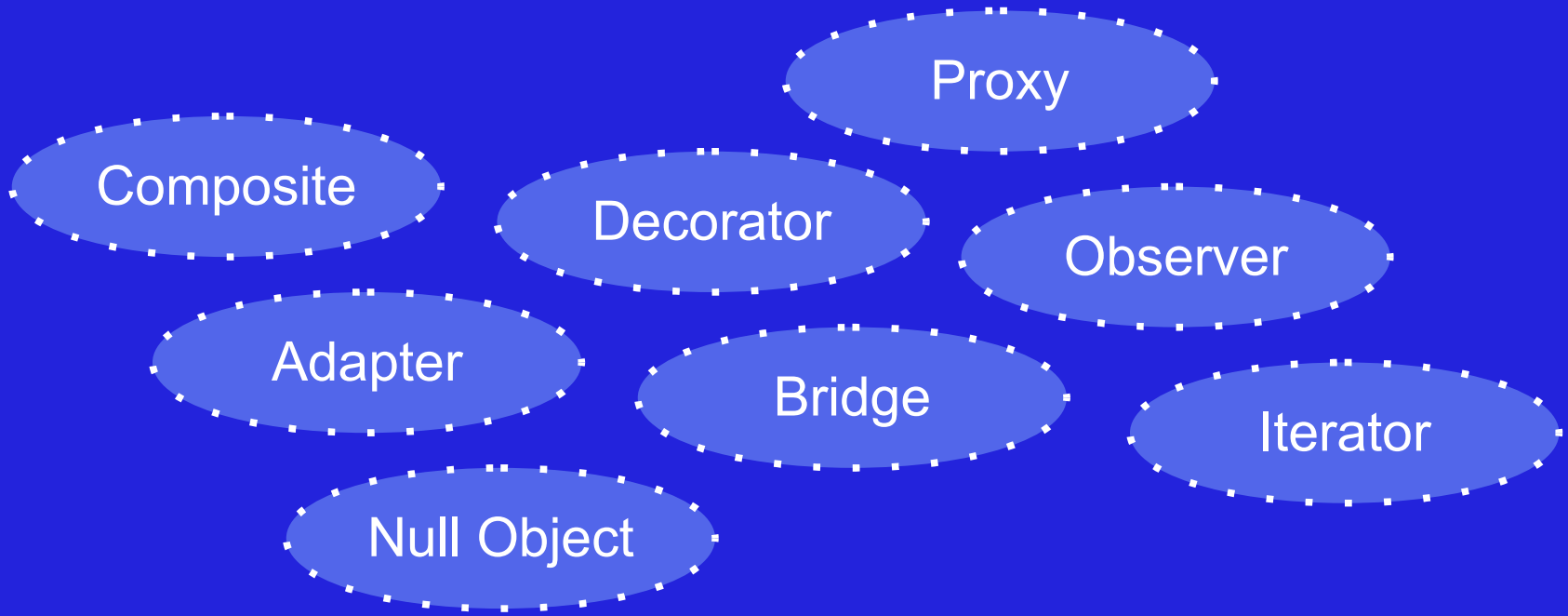

Some abstractions are weak and abstract away little little




Some abstractions are strong and abstract away a lot more

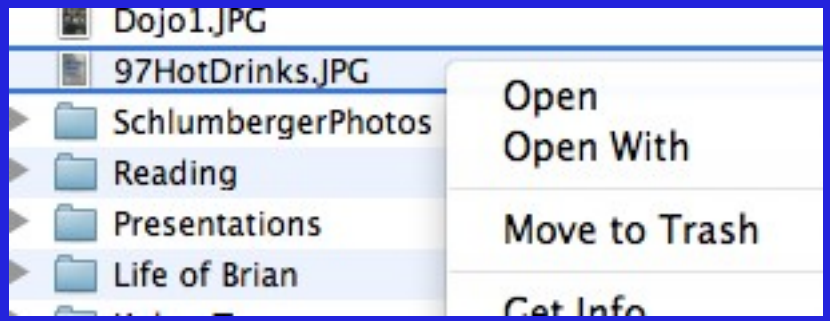
# Patterns

- A class is not a useful unit of design!
- Patterns help you raise the level of abstraction
- Patterns document the role each class plays in a cluster of collaboration
- There are many named patterns



# Deleting Files & Folders on a Mac

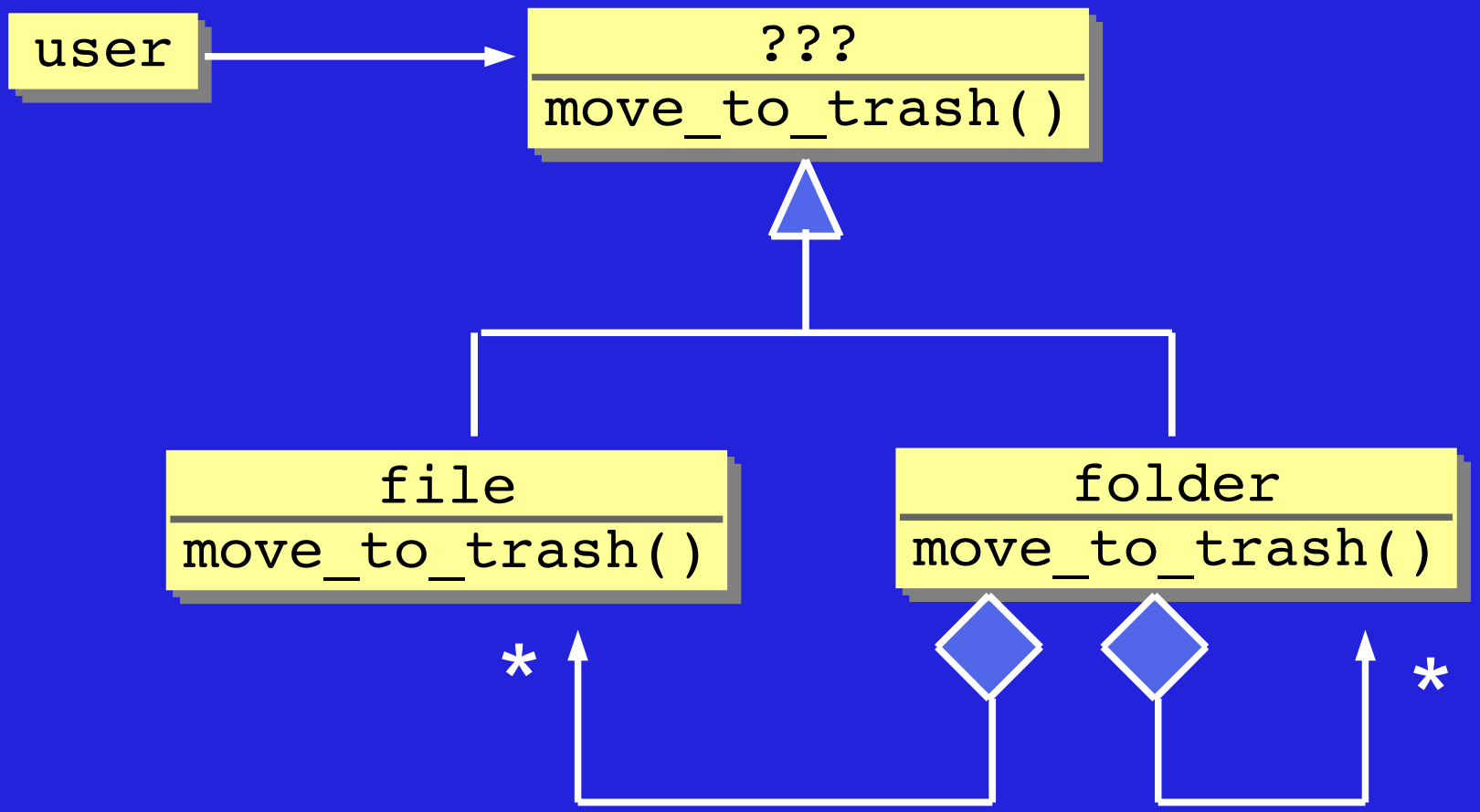
- Right click on the file or folder
- Click Move To Trash



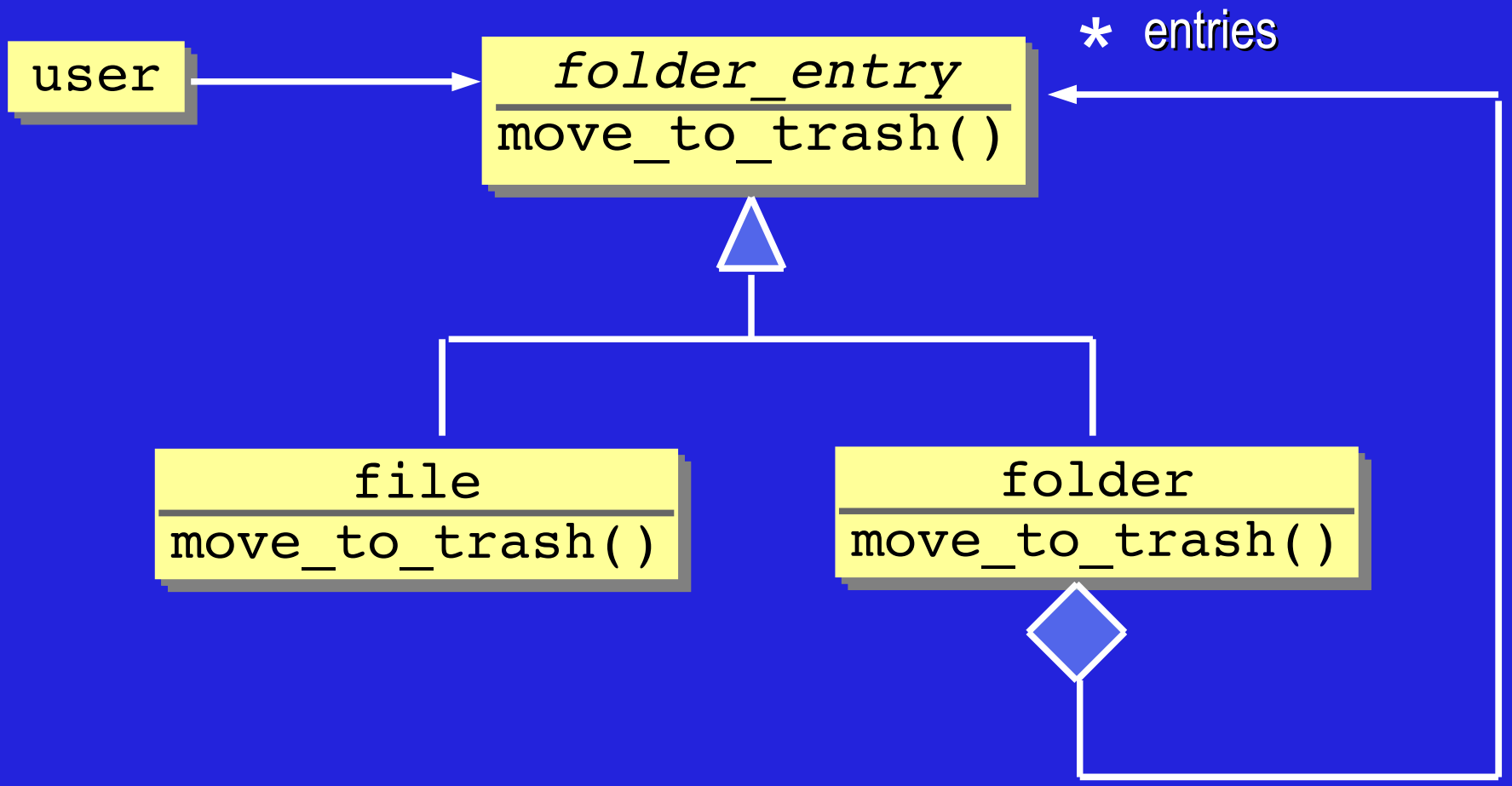

```
file
move_to_trash()
```


```
folder
move_to_trash()
```

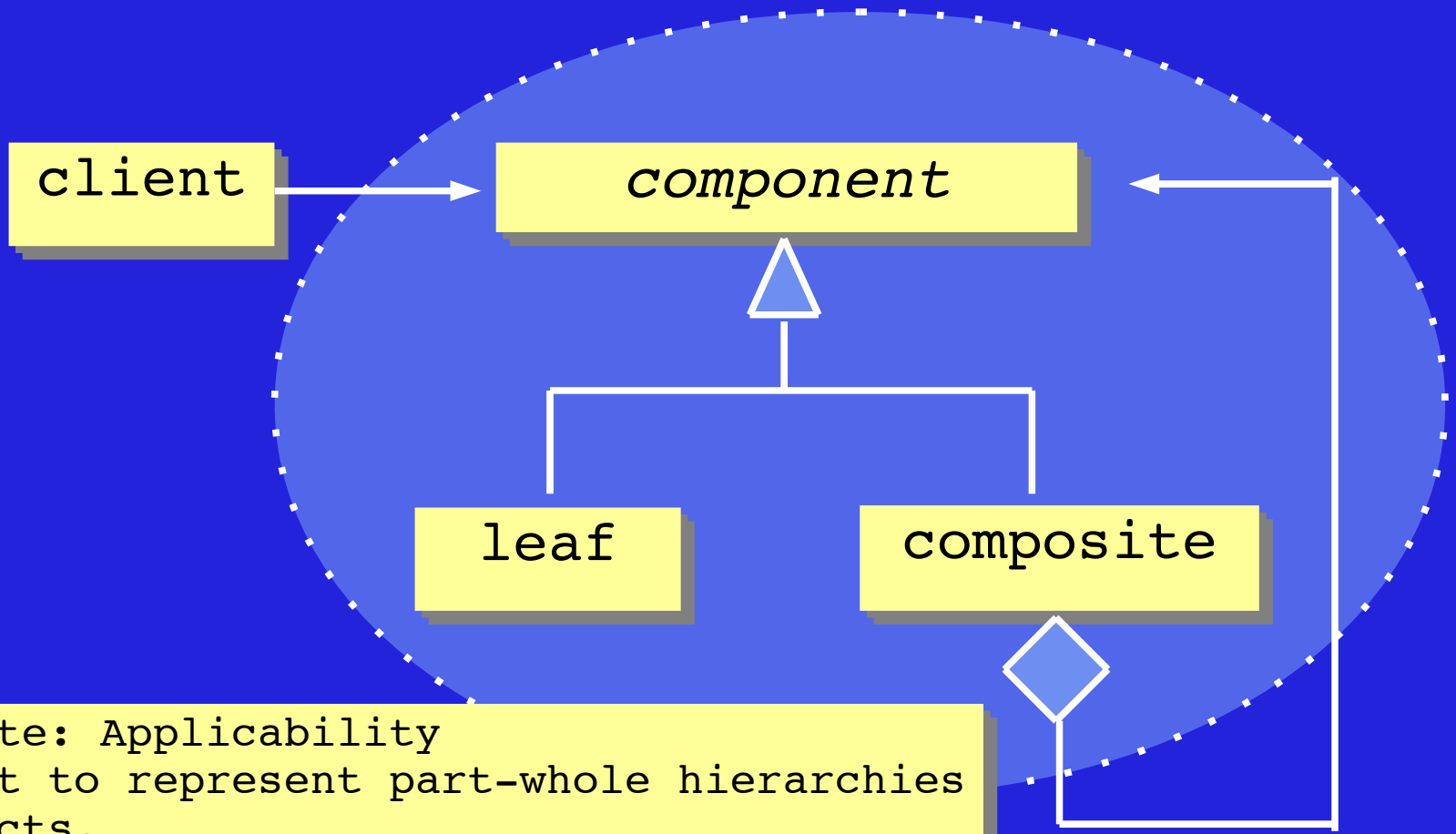
# Files and Folders



# Files and Folders and Folder Entries

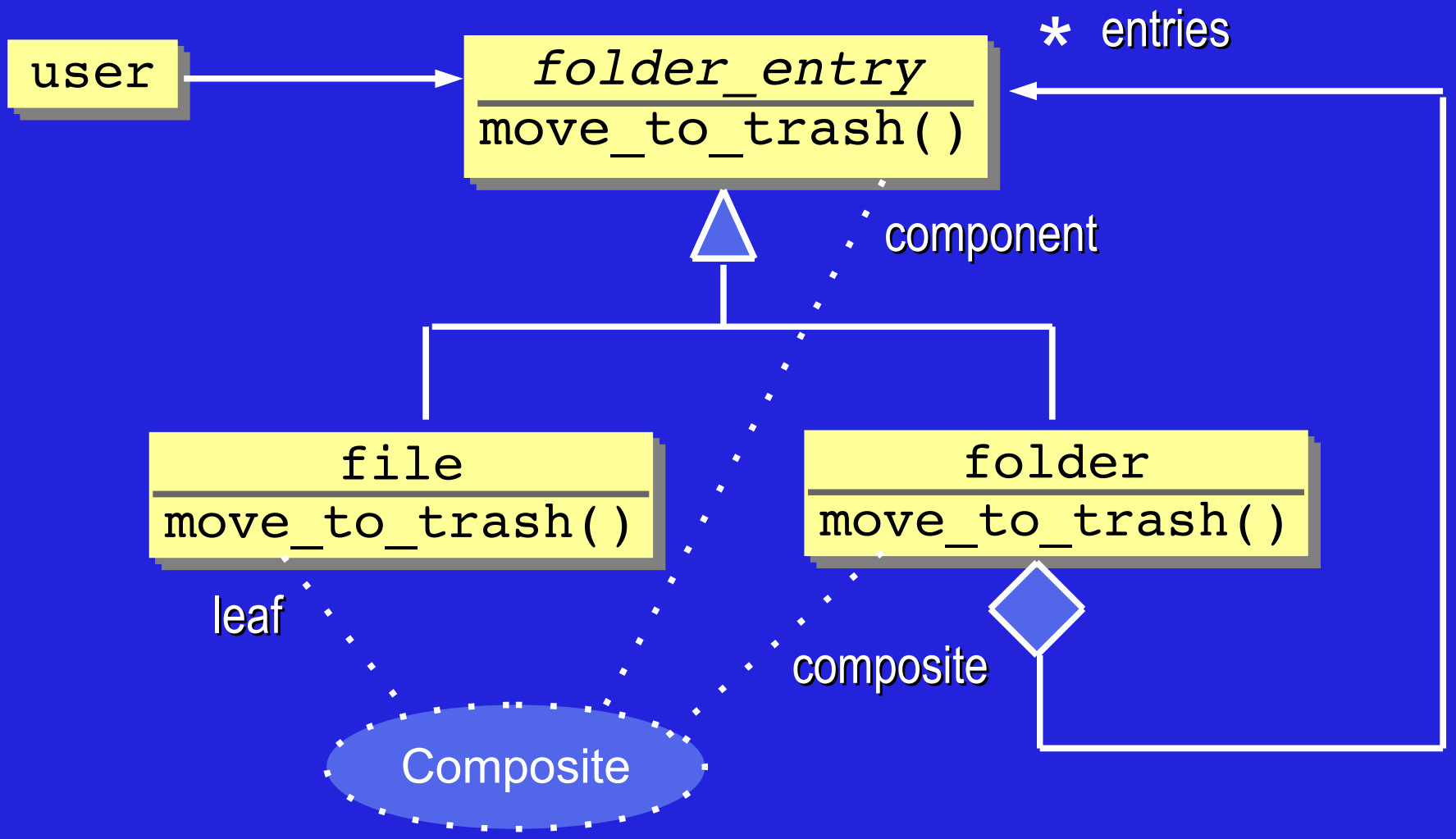


# The Composite Pattern

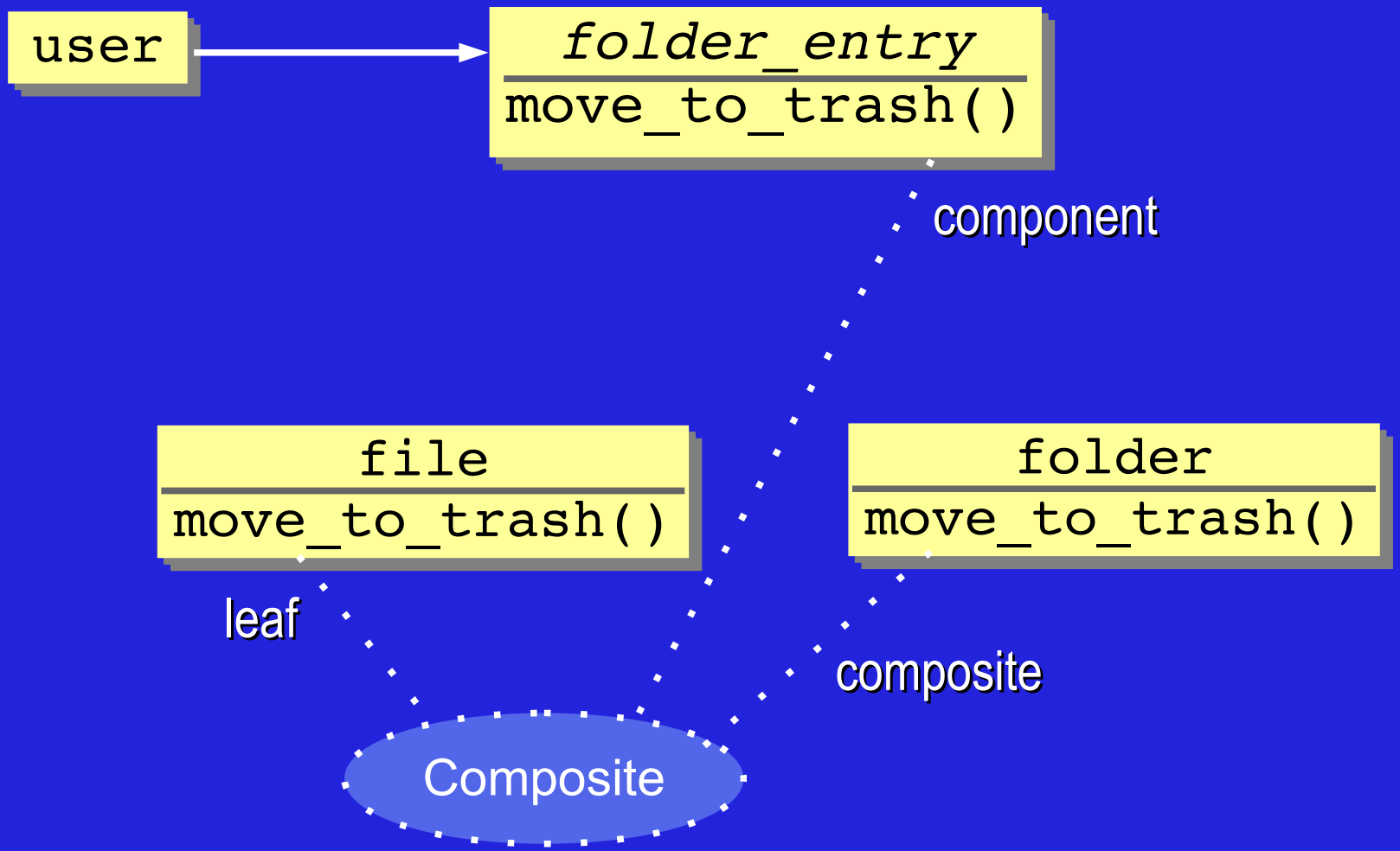



Composite: Applicability
You want to represent part-whole hierarchies of objects.
You want clients to be able to ignore the differences between compositions of objects and individual objects. Clients will treat all objects in the composite structure uniformly.

# Files and Folders



# Patterns


user
folder_entry
move_to_trash()
component
file
move_to_trash()
folder
move_to_trash()
leaf
composite
Composite