CS 635 Advanced Object-Oriented Design & Programming

Spring Semester, 2006
Doc 16 Prototype
Apr 17, 2007

References

Design Patterns: Elements of Reusable Object-Oriented Software, Gamma, Helm, Johnson, Vlissides, 1995, pp. 117-126

The Design Patterns Smalltalk Companion, Alpert, Brown, Woolf, Addision-Wesley, 1998, pp. 77-90

Java API

Prototype-based Languages

http://en.wikipedia.org/wiki/Prototype-based_programming

JavaScript The Definite Guide 4'th Ed, Flanagan, O'Reilly Press, 2002

Prototype

Specify the kinds of objects to create using a prototypical instance, and create new objects by copying this prototype

Applicability

Use the Prototype pattern when

A system should be independent of how its products are created, composed, and represented; and

When the classes to instantiate are specified at run-time; or

To avoid building a class hierarchy of factories that parallels the class hierarchy of products; or

When instances of a class can have one of only a few different combinations of state.

Insurance Example

Insurance agents start with a standard policy and customize it

Two basic strategies:

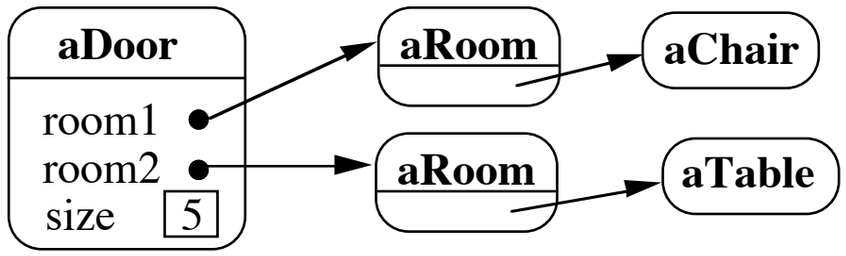
Copy the original and edit the copy

Store only the differences between original and the customize version in a decorator

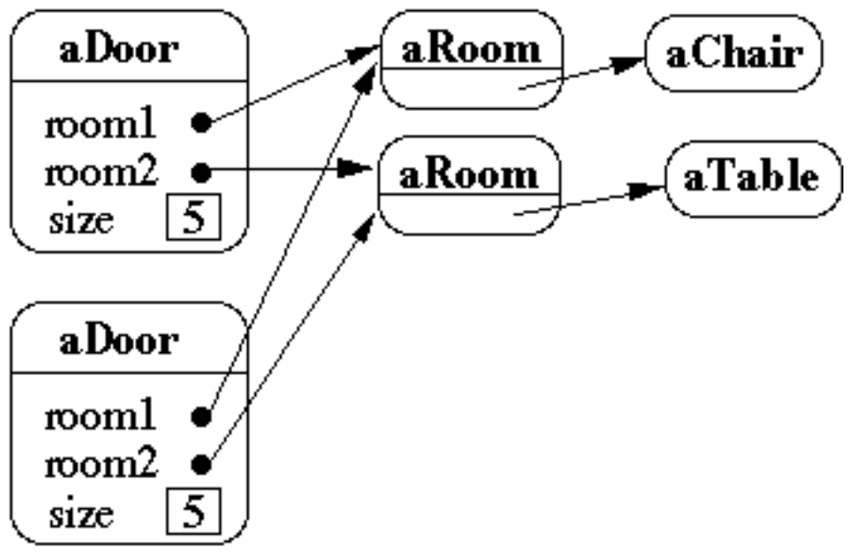
Copying Issues

Shallow Copy Verse Deep Copy

Original Objects

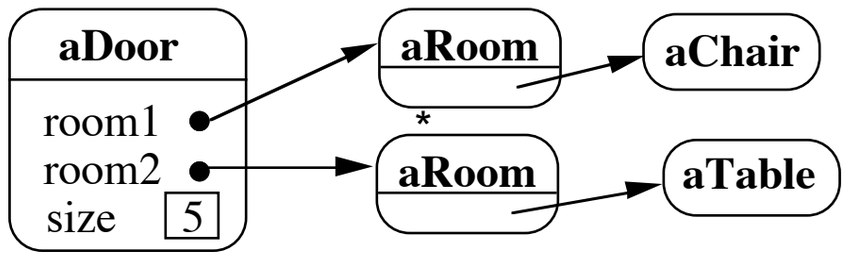


Shallow Copy

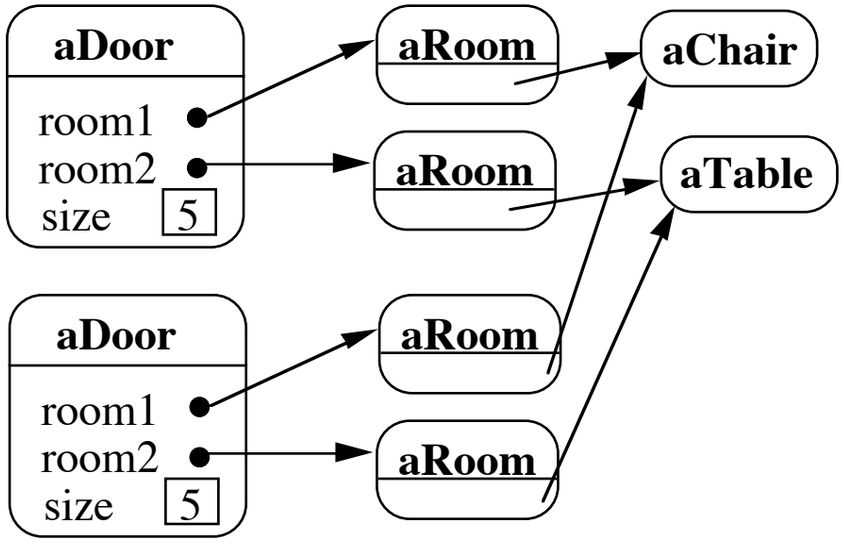


Shallow Copy Verse Deep Copy

Original Objects



Deep Copy



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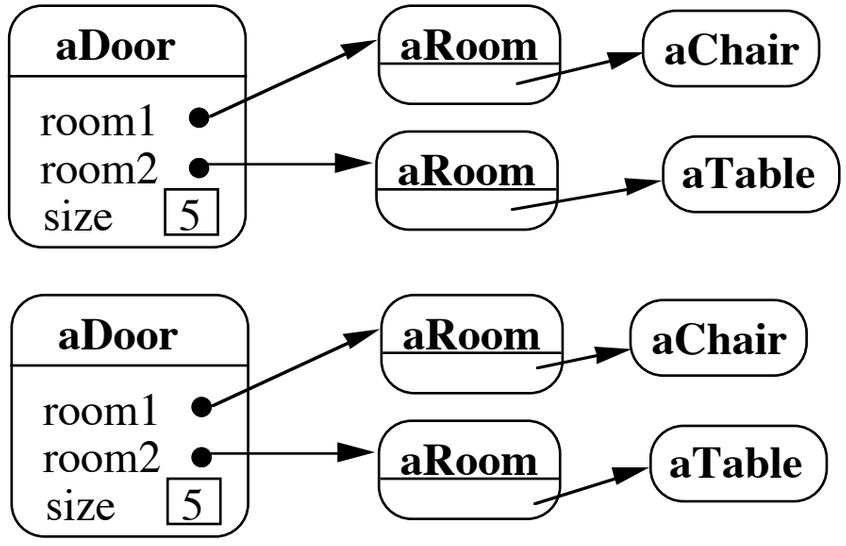

Cloning Issues - C++ Copy Constructors

```
class Door {
        public:
                Door();
                Door( const Door&);
                virtual Door* clone() const;

                virtual void Initialize( Room*, Room* );
                // stuff not shown
        private:
                Room* room1;
                Room* room2;
        }

Door::Door ( const Door& other ) //Copy constructor {
        room1 = other.room1;
        room2 = other.room2;
        }

Door* Door::clone()  const {
        return new Door( *this );
        }
```

Cloning Issues - Java Clone

Shallow Copy

```
class Door implements Cloneable {
        private Room room1;
        private Room room2;

        public Object clone() throws  CloneNotSupportedException {
                return super.clone();
        }
}
```

Deep Copy

```
public class Door implements Cloneable {
        private Room room1;
        private Room room2;

        public Object clone() throws CloneNotSupportedException {
                Door thisCloned =(Door) super.clone();
                thisCloned.room1 = (Room)room1.clone();
                thisCloned.room2 = (Room)room2.clone();
                return thisCloned;
        }
}
```

Prototype-based Languages

No classes

Behaviour reuse (inheritance)

Cloning existing objects which serve as prototypes

Some Prototype-based languages

Self

JavaScript

Squeak (eToys)

Perl with Class::Prototyped module

JavaScript Example

```
Circle.prototype.pi = 3.14159;

function Circle_circumference() {
        return 2 * this.pi * this.r;
}
Circle.prototype.circumference = Circle_circumference;

function Circle(x, y, r) {
        this.x = x;
        this.y = y;
        this.r = r
}

var center = new Circle(0.0, 0.0, 1.0);
print(center.circumference());

Circle.prototype.area = function() {return this.pi * this.r * this.r; }
print(center.area());

center.color = "red";
```