References

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Pattern-Oriented Software Architecture: A System of Patterns, Buschman, Meunier, Rohnert, Sommerlad, Stal, 1996, pp. 277-290, Command Processor

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Prime Directive
Data + Operations
Decorator Pattern
Adds responsibilities to individual objects

Dynamically
Transparently
import java.io.*;
import sdsu.io.*;
class ReadingFileExample
{
    public static void main( String args[] ) throws Exception
    {
        FileInputStream inputFile;
        BufferedInputStream bufferedFile;
        ASCIIInputStream cin;

        inputFile = new FileInputStream( "ReadingFileExample.java" );
        bufferedFile = new BufferedInputStream( inputFile );
        cin = new ASCIIInputStream( bufferedFile );

        inputFile = new FileInputStream( "ReadingFileExample.java" );
        bufferedFile = new BufferedInputStream( inputFile );
        cin = new ASCIIInputStream( bufferedFile );
    }
}
ConcreteDecoratorB

Component
operation()

ConcreteComponent
operation()

Decorator
operation()

ConcreteDecoratorA

ConcreteDecoratorB
Decorator forwards all component operations
Favor Composition over Inheritance
Command

Encapsulates a request as an object

Example
Invoker be a menu
Client be a word processing program
Receiver a document
Action be save
When to Use the Command Pattern

- Need action as a parameter (replaces callback functions)
- Specify, queue, and execute requests at different times
- Undo
- Logging changes
- High-level operations built on primitive operations
  - A transaction encapsulates a set of changes to data
  - Systems that use transaction often can use the command pattern
- Macro language
Callback Function vs Command

Command contains reference to object that it acts on
Consequences

Command decouples the object that invokes the operation from the one that knows how to perform it

It is easy to add new commands, because you do not have to change existing classes

You can assemble commands into a composite object
Prevayler

http://www.prevayler.org/wiki.jsp

Prevalence layer for Java

Database that
  Serializes object to save them to disk
  Uses commands when modifying objects
  Keeps log of commands

Ruby Version
  http://madeleine.sourceforge.net/
```java
import java.util.*;
import org.prevayler.implementation.AbstractPrevalentSystem;

public class Restaurant extends AbstractPrevalentSystem {
    private String name;
    ArrayList ratings = new ArrayList();

    public Restaurant(String newName) { name = newName; }

    public String name() {return name;}

    public void addRating( int newRating) {
        ratings.add( new Integer(newRating));
    }

    public float getRating() {
        if (ratings.size() == 0 )
            return -1;
        int total = 0;
        for (int k =0; k < ratings.size();k++)
            total = total + ((Integer)ratings.get(k)).intValue();
        return total/ ratings.size();
    }
}
```
Command

import java.io.Serializable;

import org.prevayler.Command;
import org.prevayler.PrevalentSystem;

public class AddRatingCommand implements Command {
    private final int newRating;

    public AddRatingCommand(int rating) {
        newRating = rating;
    }

    public Serializable execute(PrevalentSystem system) {
        ((Restaurant) system).addRating(newRating);
        return null;
    }
}
import java.util.*;
import org.prevayler.implementation.SnapshotPrevayler;

public class PrevaylerExample {

    public static void main(String args[]) throws Exception {
        SnapshotPrevayler samsDinerData =
                new SnapshotPrevayler(new Restaurant("Sams Diner"), "food");

        System.out.println("Start");
        Restaurant samsDiner = (Restaurant) samsDinerData.system();
        System.out.println(samsDiner.getRating());
        samsDinerData.executeCommand(new AddRatingCommand(5));
        System.out.println(samsDiner.getRating());
    }
}

Output
Recovering system state...
Start
-1.0
5.0
public class PrevaylerExample {

    public static void main (String args[]) throws Exception {
        SnapshotPrevayler samsDinerData = 
                new SnapshotPrevayler(new Restaurant("Sams Diner"), "food");

        System.out.println( "Start");
        Restaurant samsDiner = (Restaurant) samsDinerData.system();
        System.out.println( samsDiner.getRating() );
        samsDinerData.executeCommand( new AddRatingCommand( 10));
        System.out.println( samsDiner.getRating() );
    }
}

Output
Recovering system state...
Reading food/000000000000000000001.commandLog...
Start
5.0
7.0
Pluggable Commands

Can create one general Command using reflection

Don’t hard code the method called in the command

Pass the method to call an argument
import java.util.*;
import java.lang.reflect.*;

public class Command {
    private Object receiver;
    private Method command;
    private Object[] arguments;

    public Command(Object receiver, Method command, Object[] arguments) {
        this.receiver = receiver;
        this.command = command;
        this.arguments = arguments;
    }

    public void execute() throws InvocationTargetException, IllegalAccessException {
        command.invoke(receiver, arguments);
    }
}
public class Test {
    public static void main(String[] args) throws Exception {
        Vector sample = new Vector();
        Class[] argumentTypes = { Object.class };
        Method add =
                Vector.class.getMethod( "addElement", argumentTypes);
        Object[] arguments = { "cat" };

        Command test = new Command(sample, add, arguments );
        test.execute();
        System.out.println( sample.elementAt( 0));
    }
}
Smalltalk Pluggable Command

Object subclass: #PluggableCommand
  instanceVariableNames: 'receiver selector arguments '

Class Methods
receiver: anObject selector: aSymbol arguments: anArrayOrNil
  ^super new
    setReceiver: anObject
    selector: aSymbol
    arguments: anArrayOrNil

Instance Methods
setReceiver: anObject selector: aSymbol arguments: anArrayOrNil
  receiver := anObject.
  selector := aSymbol.
  arguments := anArrayOrNil isNil
    ifTrue:[#( )]
    ifFalse: [anArrayOrNil]

execute
  ^receiver
    perform: selector
    withArguments: arguments
Using the Pluggable Command

| sample command |
sample := OrderedCollection new.
command := PluggableCommand
    receiver: sample
    selector: #add:
    arguments: #( 5 ).
command execute.
^sample at: 1
Command Processor Pattern

Command Processor manages the command objects

The command processor:

- Contains all command objects
- Schedules the execution of commands
- May store the commands for later unto
- May log the sequence of commands for testing purposes
- Uses singleton to insure only one instance
Structure

Command Processor
- dolt(command)
- undolt()
- commandStack

Command
- execute()

Receiver
- action()

ConcreteCommand
- execute()
- receiver

Client
- creates

Command Processor
- performs
- stores

Client
- transfer command

Command Processor
- creates

ConcreteCommand
- receiver->action()
Dynamics

Client

Command Processor

Document

request

create()

doit()

makeBold command

undo request

undoit()

undo()

delete()

getSelection()

makeBold()

restoreText()

do()
Benefits

Flexibility in the way requests are activated

- Different user interface elements can generate the same kind of command object
- Allows the user to configure commands performed by a user interface element

Flexibility in the number and functionality of requests

- Adding new commands and providing for a macro language comes easy

Programming execution-related services

- Commands can be stored for later replay
- Commands can be logged
- Commands can be rolled back

Testability at application level

Concurrency

- Allows for the execution of commands in separate threads
Liabilities

Efficiency loss

Potential for an excessive number of command classes

Try reducing the number of command classes by:

- Grouping commands around abstractions
- Unifying simple commands classes by passing the receiver object as a parameter

Complexity

How do commands get additional parameters they need?