CS 635 Advanced Object-Oriented Design & Programming
Spring Semester, 2007
Doc 5 Decorator & Command
Feb 13, 2007

References

Design Patterns: Elements of Resuable Object-Oriented Software,
Gamma, Helm, Johnson, Vlissides, Addison-Wesley, 1995, pp. 175-184, 233-242

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

Command Processor, Sommerlad in Pattern Languages of Program Design 2, Eds. Vlissides, Coplien, Kerth, Addison-Wesley, 1996, pp. 63-74

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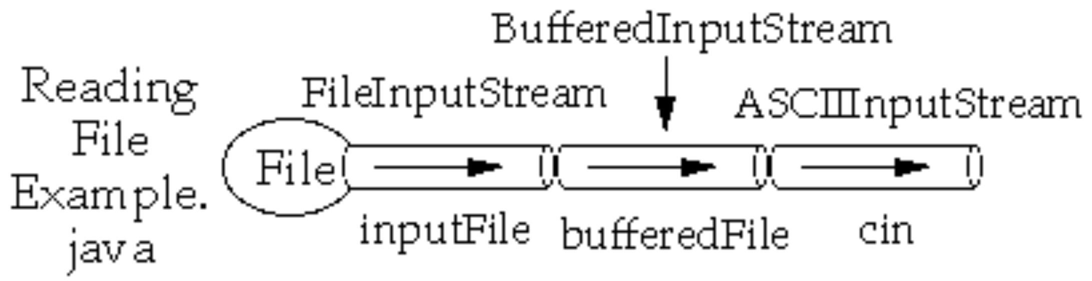
Prime Directive

Data + Operations

Decorator Pattern

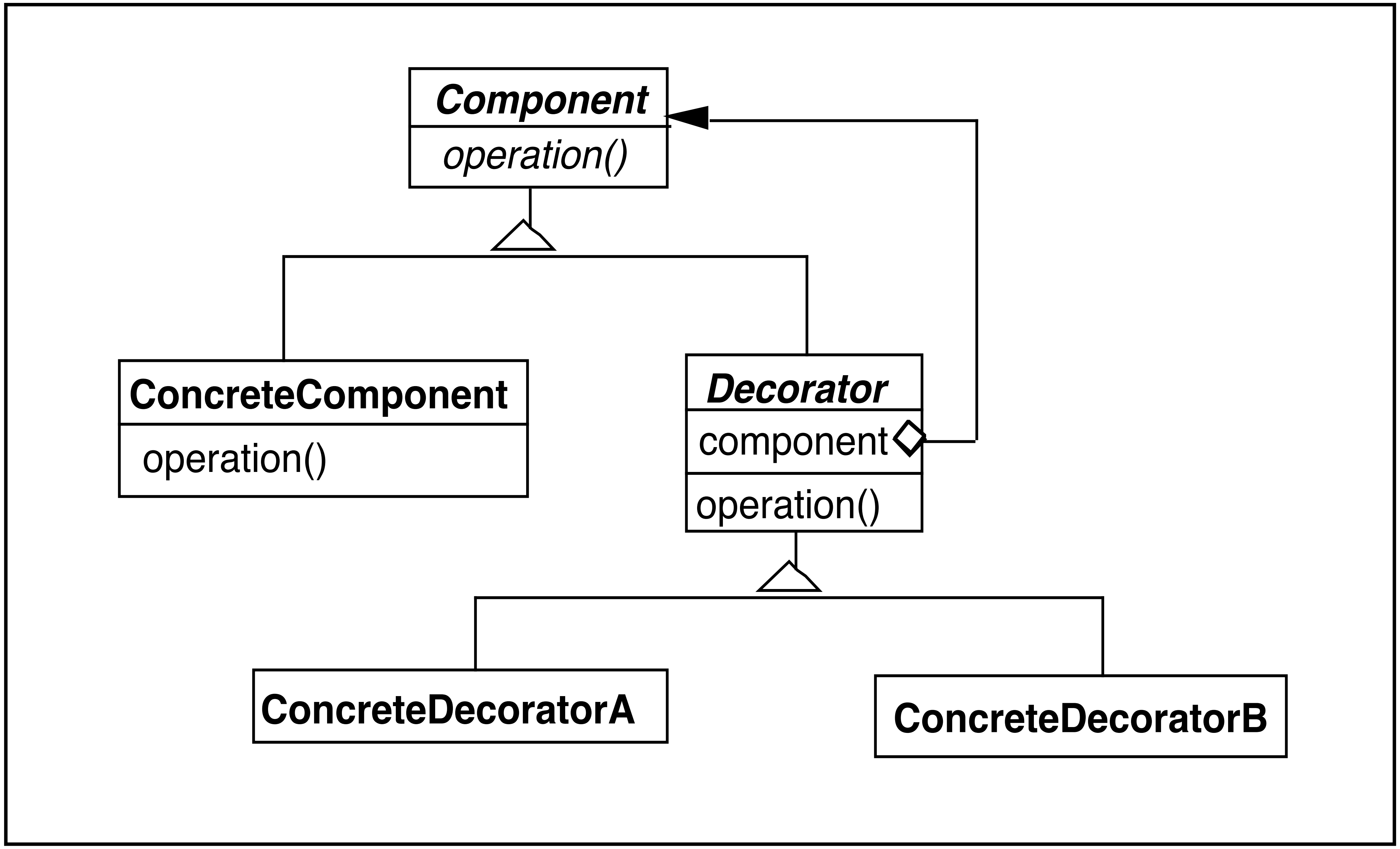
Adds responsibilities to individual objects

- Dynamically
- Transparently



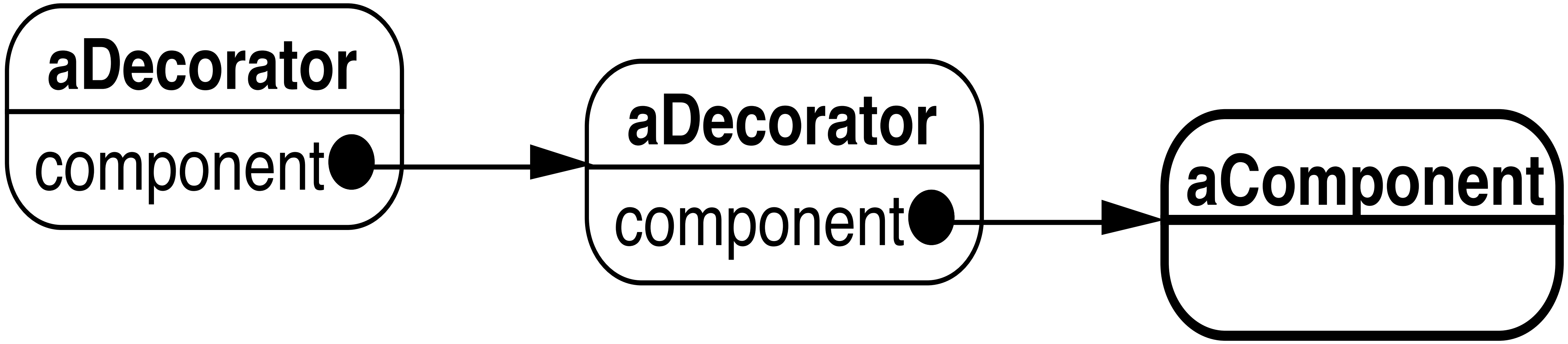
```
import java.io.*;
import sdsu.io.*;
class  ReadingFileExample
    {
    public  static  void  main( String  args[]  ) throws Exception
        {
        FileInputStream inputFile;
        BufferedInputStream bufferedFile;
        ASCIIInputStream  cin;

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


Component
operation()
ConcreteComponent
operation()
Decorator
component
operation()
ConcreteDecoratorA
ConcreteDecoratorB

POLICE LINE DO NOT CROSS

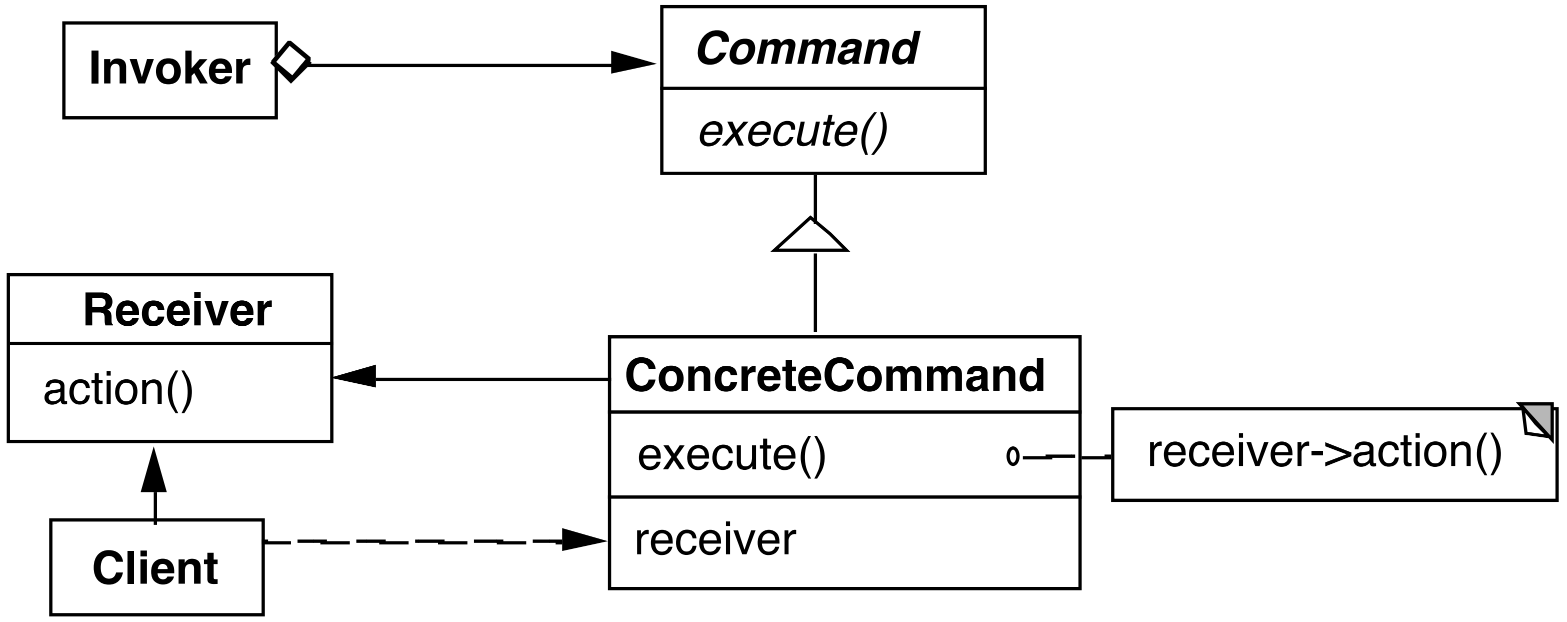
Decorator forwards all component operations



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/

Restaurant Example

```
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;
	}
}
```

First Run

```
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
```

Second Run

```
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

Java Example of Pluggable Command

```
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 );
		}
	}
```

Using the Pluggable Command

```
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));
        }
    }
```

Output

```
cat
```

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
```

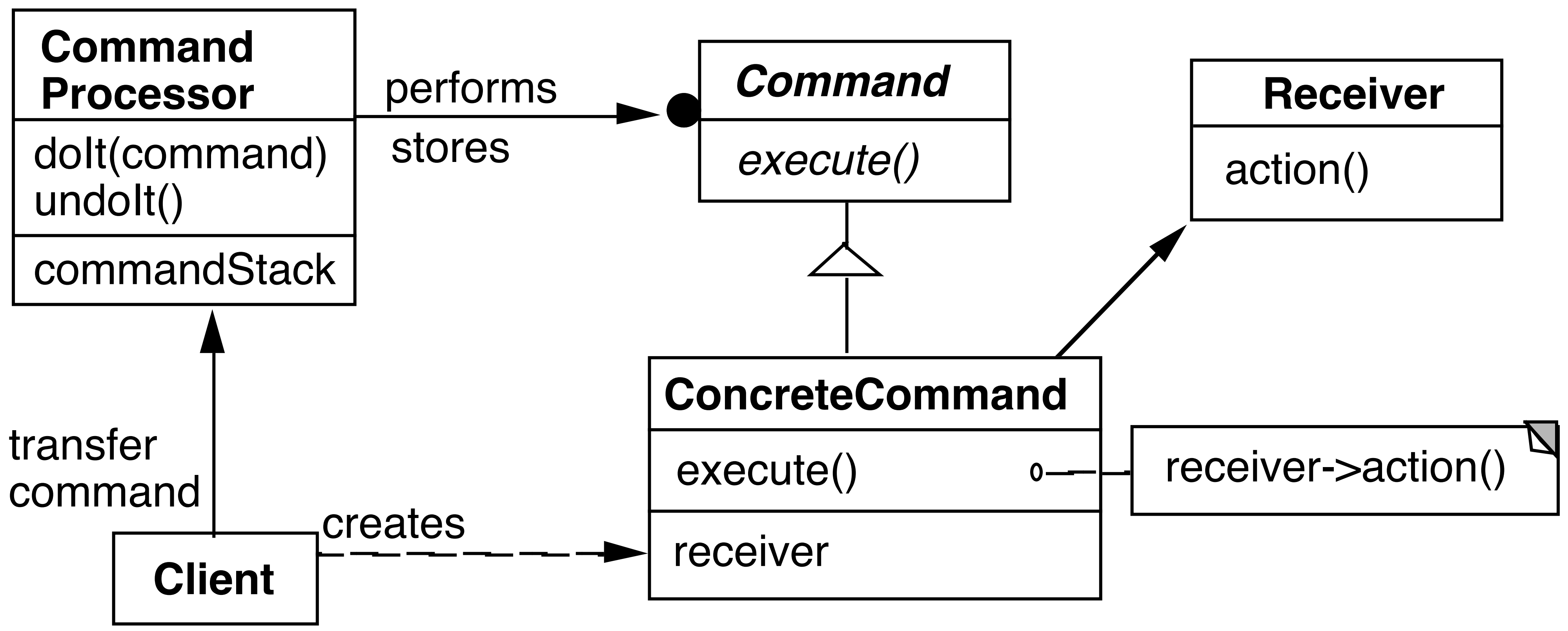
Command Processor Pattern

Command Processor manages the command objects

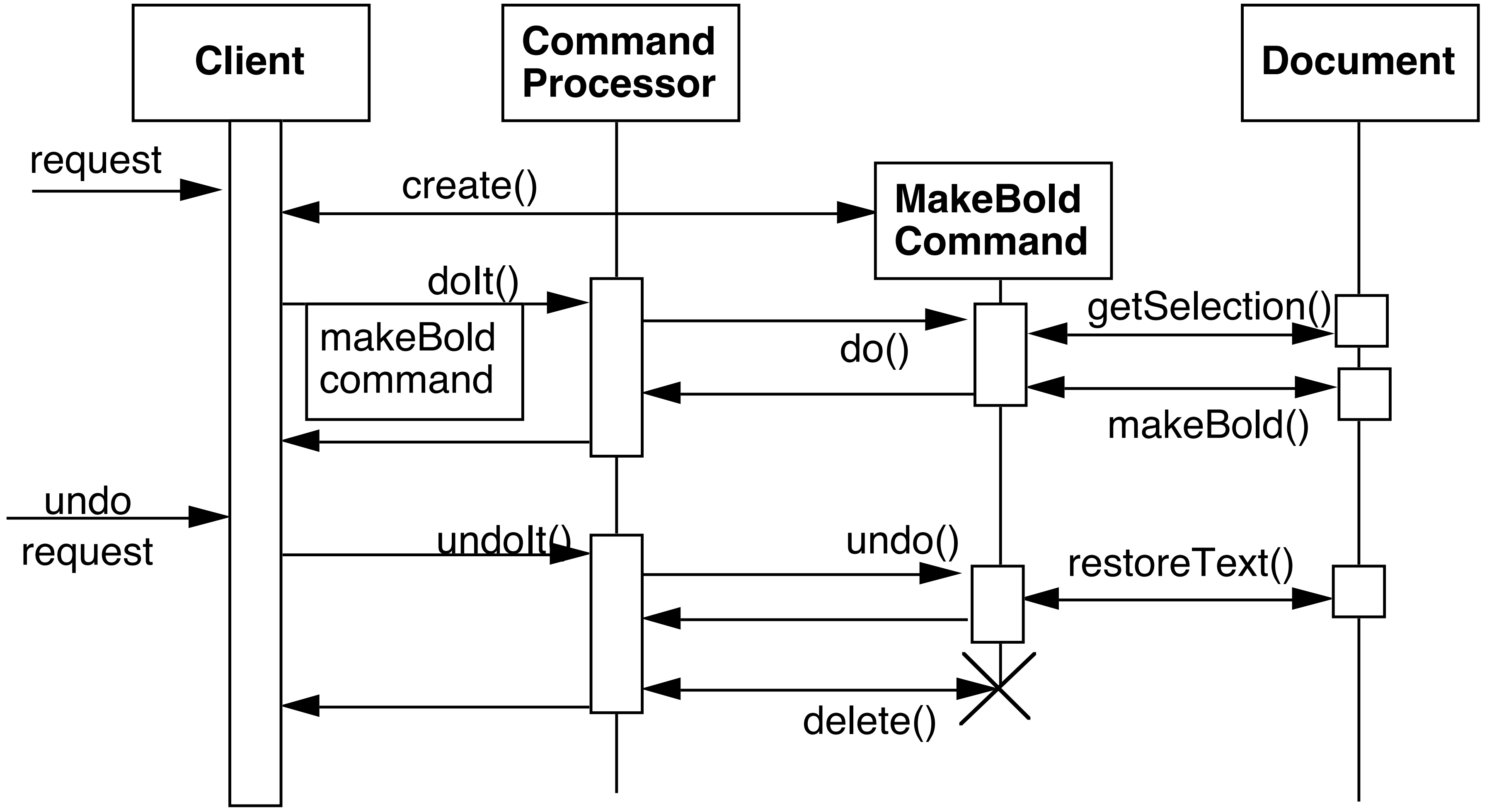
The command processor:

- 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
doIt(command)
undoIt()
commandStack
performs
stores
Command
execute()
Receiver
action()
ConcreteCommand
execute()
receiver
receiver->action()
transfer command
creates
Client

Dynamics



Client
Command Processor
Document
request
create()
MakeBold Command
doIt()
makeBold command
do()
getSelection()
makeBold()
undo
request
undoIt()
undo()
restoreText()
delete()

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?