CS 635 Advanced Object-Oriented Design & Programming
Spring Semester, 2014
Doc 7
Feb 18, 2014

References

“Null Object”, Woolf, in Pattern Languages of Program Design 3, Edited by Martin, Riehle, Buschmmann, Addison-Wesley, 1998, pp. 5-18

Special Case, Martin Fowler, http://martinfowler.com/eaaCatalog/specialCase.html

Patterns of Enterprise Application Architecture, Martin Fowler, Addision Wesley, 2003, pp. 496-498 Special Case

Principles of OO Design, or Everything I Know About Programming, I Learned from Dilbert, http://alanknightsblog.blogspot.com/2011/10/principles-of-oo-design-or-everything-i.html

Java 8

Java 8

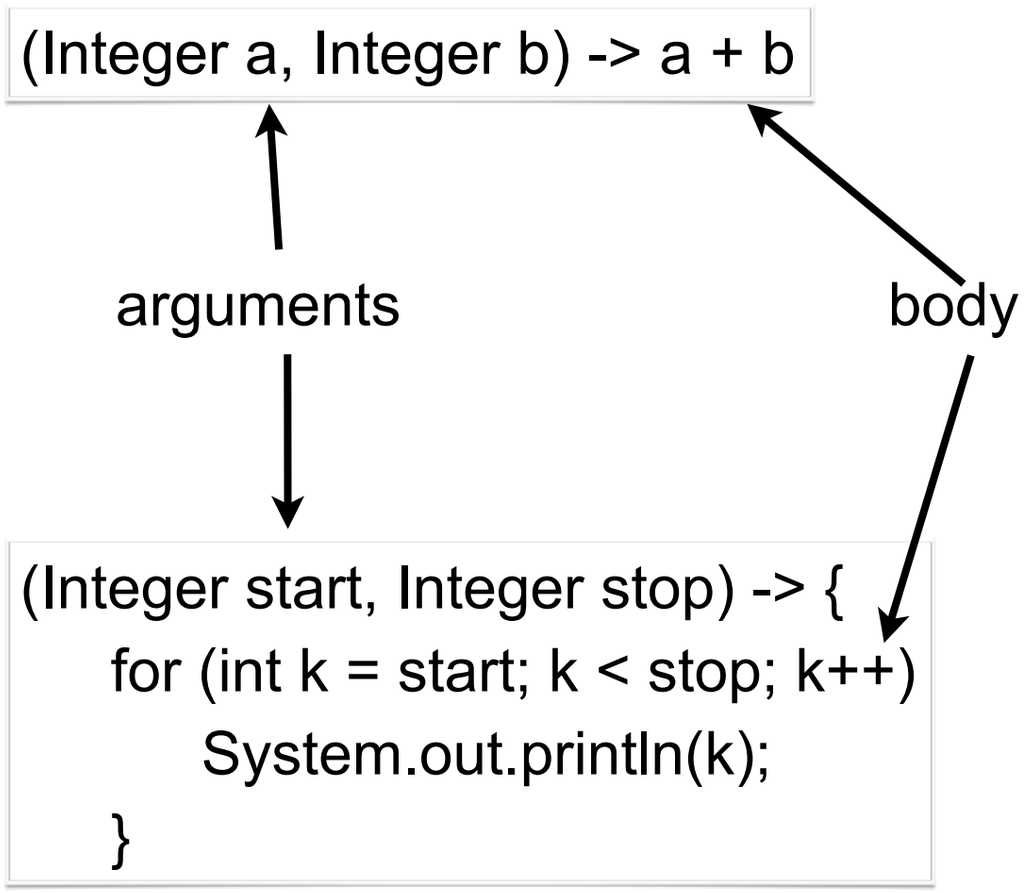
Target Release Date: March 18, 2014

New Features

- New Time, Date & Calendar classes
- Improvements to Cryptographic classes
- Nashorn JavaScript Engine
- Concurrency Improvements
  - Accumulators, Adders
- Default Methods
- Functional language Features
  - Lambda Expressions
  - Collection Streams (internal iterators)

Lambda Expression

Anonymous Function



Short Version of Lambda Syntax

(String text) -> text.length();

text -> text.length();

(Integer a, Integer b) -> a + b

(a, b) -> a + b

Using Lambdas

```
Function<String,Integer> length =  text -> text.length();
int nameLength = length.apply("Roger Whitney");
```

```
BiFunction<Integer,Integer,Integer> adder = ( a, b) -> a + b;
int sum = adder.apply(1, 2);
```

Other Types of Lamdas

```
Predicate<Integer> isLarge =  value -> value > 100;
if (isLarge.test(59))
      System.out.println("large");
```

```
Consumer<String> print = text -> System.out.println(text);
print.accept("hello World");
```

```
int size = xxx;
      Supplier<List> listType = size > 100 ? (()-> new ArrayList()): (() -> new Vector());
      List elements = listType.get();
      System.out.println(elements.getClass().getName());
```

Lambda Types

New - See java.util.function Interfaces

Predicate<T> -- a boolean-valued property of an object
Consumer<T> -- an action to be performed on an object
Function<T,R> -- a function transforming a T to a R
Supplier<T> -- provide an instance of a T (such as a factory)
UnaryOperator<T> -- a function from T to T
BinaryOperator<T> -- a function from (T, T) to T

Pre-existing

java.lang.Runnable
java.util.concurrent.Callable
java.security.PrivilegedAction
java.util.Comparator
java.io.FileFilter
java.beans.PropertyChangeListener
etc.

Functional Interfaces

Interface with one method

Can be used to hold a lambda

java.lang.Runnable

```
void run()
```

Runnnable Example

```
Runnable test = () -> System.out.println("hello from thread");
Thread example = new Thread(test);
example.start();
```

OnClickListener Example

```
button.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View source) {
                makeToast();
        }
});
```

```
button.setOnClickListener( () -> makeToast());
```

Internal Iterator - forEach

```
String[] rawData = {"cat", "can", "bat", "rat"};

List<String> data = Arrays.asList(rawData);

data.forEach( word ->System.out.println(word) );
```

Stream java.util.stream.Stream

Sequence of values

Operations on the values

Operations are chained together into pipelines

Example

```
        String[] words = {"a", "ab", "abc", "abcd", "bat"};
        List<String> wordList = Arrays.asList(words);
        List<String> longWords
    longWords = wordList.stream()
                                        .filter( s -> s.length() >
2)
                                        .filter( s -> s.charAt(0)
== 'a')
                                            .map( s ->
  s.toUpperCase())

  .collect(Collectors.toList());
            System.out.println(longWords);
```

Lazy Evaluation

```
String[] words = {"a", "ab", "abc", "abcd", "bat"};
List<String> wordList = Arrays.asList(words);
List<String> longWords
longWords = wordList.stream()
                    .filter( s -> s.length() > 2)
                    .filter( s -> s.charAt(0) == 'a')
                    .map( s -> s.toUpperCase())
.collect(Collectors.toList());
System.out.println(longWords);
```

Only One pass of List to do all operations

ing Words

```
List<String> ingWords = heap.stream()
                                                .filter( s ->
        s.endsWith("ing"))

    .collect(Collectors.toList());
```

For More Information

State of the Lambda: Libraries Edition

http://cr.openjdk.java.net/~briangoetz/lambda/lambda-libraries-final.html

http://tinyurl.com/mshjfkj

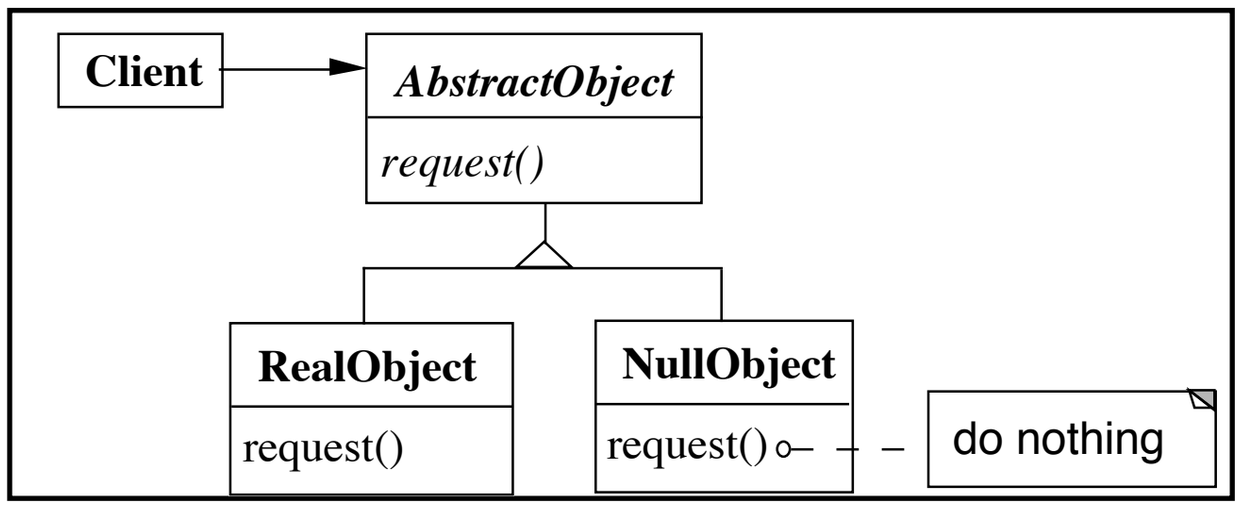
State of the Lambda

http://cr.openjdk.java.net/~briangoetz/lambda/lambda-state-final.html

http://tinyurl.com/kg5m9zu

Null Object

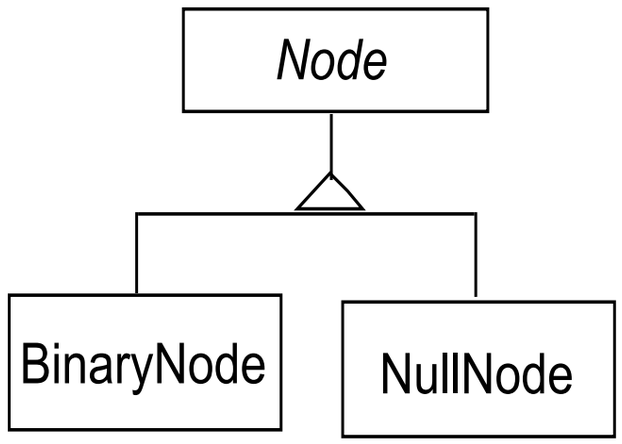
Null Object

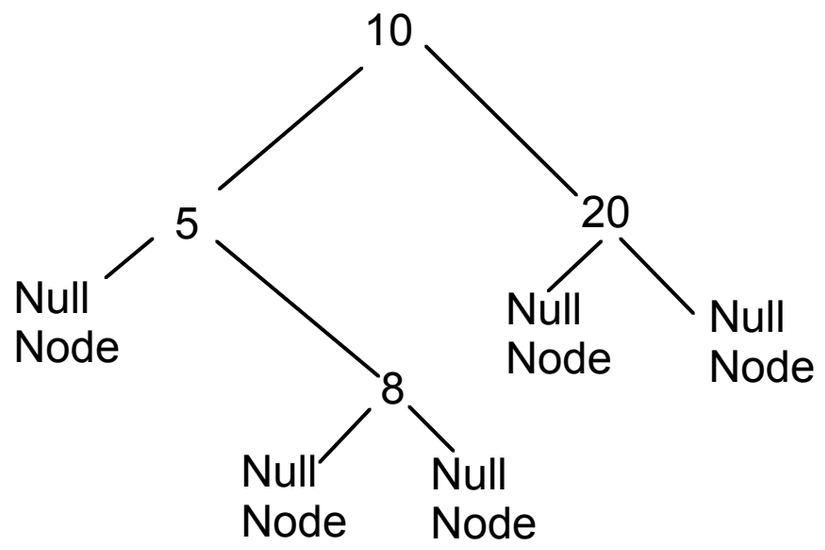


NullObject implements all the operations of the real object,

These operations do nothing or the correct thing for nothing

Null Object & Binary Search Tree





Comparing Normal Tree vs Tree with Null Nodes

Normal BST

```
public class BinaryNode {
        Node left
        Node right;
        int key;

        public boolean includes( int value ) {
                if (key == value)
                        return true;
                else if ((value < key) & left == null) )
                        return false;
                else if (value < key)
                        return left.includes( value );
                else if (right == null)
                        return false;
                else
                        return right.includes(value);
        }
etc.
}
```

With Null Nodes

```
public class BinaryNode extends Node {
        Node left = new NullNode();
        Node right = new NullNode();
        int key;

        public boolean includes( int value ) {
                if (key == value)
                        return true;
                else if (value < key )
                        return left.includes( value );
                else
                        return right.includes(value);
        }
etc.
}

public class NullNode extends Node {
        public boolean includes( int value ) {
                return false;
        }
etc.
}
```

Applicability - When to use Null Objects

Some collaborator instances should do nothing

You want clients to ignore the difference between a collaborator that does something and one that does nothing

Client does not have to explicitly check for null or some other special value

You want to be able to reuse the do-nothing behavior so that various clients that need this behavior will consistently work in the same way

Applicability -When not to use Null Objects

Very little code actually uses the variable directly

The code that does use the variable is well encapsulated

The code that uses the variable can easily decide how to handle the null case and will always handle it the same way

Consequences

Advantages

Uses polymorphic classes

Simplifies client code

Encapsulates do nothing behavior

Makes do nothing behavior reusable

Disadvantages

Forces encapsulation

Makes it difficult to distribute or mix into the behavior of several collaborating objects

May cause class explosion

Forces uniformity

Is non-mutable

Implementation

Too Many classes

Multiple Do-nothing meanings

Try Adapter pattern

Transformation to RealObject

Try Proxy pattern

Refactoring: Introduce Null Object

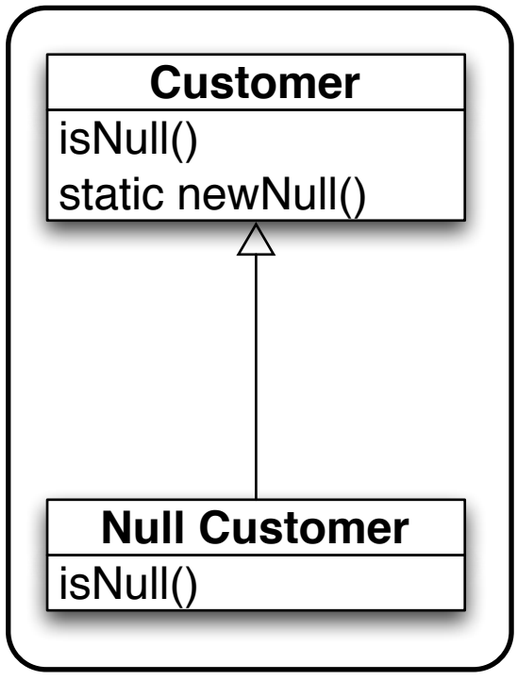
You have repeated checks for a null value

Replace the null value with a null object

```
if (customer == null)
    plan = BillingPlan.basic();
else
    plan = customer.getPlan();
```

```
plan = customer.getPlan();
```

Create Null Subclass



public boolean isNull() { return false;}
public static Customer newNull() { return new NullCustomer();}

boolean isNull() { return true;}

Compile

Replace all nulls with null object

```
class SomeClassThatReturnCustomers {

    public Customer getCustomer() {
        if (_customer == null )
            return Customer.newNull();
        else
            return _customer;
    }
        etc.
}
```

Compile

Replace all null checks with isNull()

```
if (customer == null)
    plan = BillingPlan.basic();
else
    plan = customer.getPlan();
```

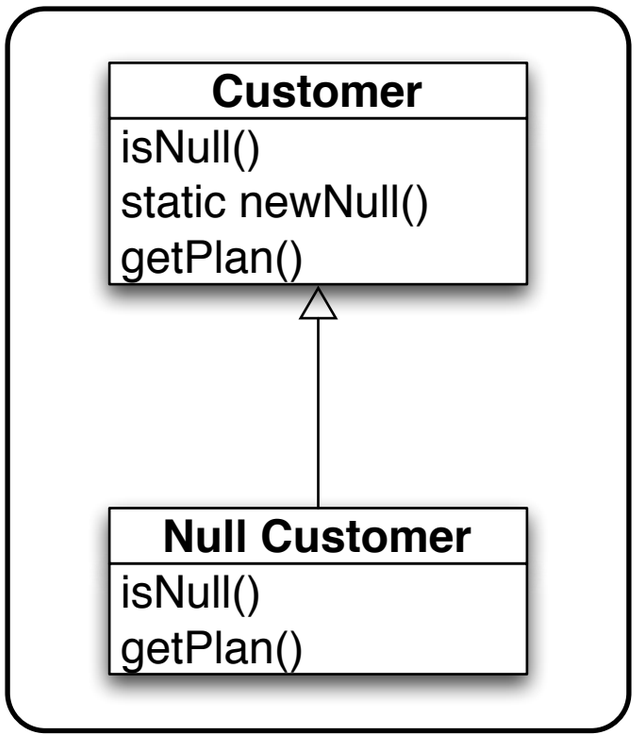
```
if (customer.isNull())
    plan = BillingPlan.basic();
else
    plan = customer.getPlan();
```

Compile and test

What is the point of this step?

Find an operation clients invoke if not null
Add Operation to Null class

```
if (customer.isNull())
    plan = BillingPlan.basic();
else
    plan = customer.getPlan();
```




```
class NullCustomer {
    public BillingPlan getPlan() {
        return BillingPlan.basic();
    }
```

Remove the Condition Check

```
if (customer.isNull())
    plan = BillingPlan.basic();
else
    plan = customer.getPlan();
```

```
plan = customer.getPlan();
```

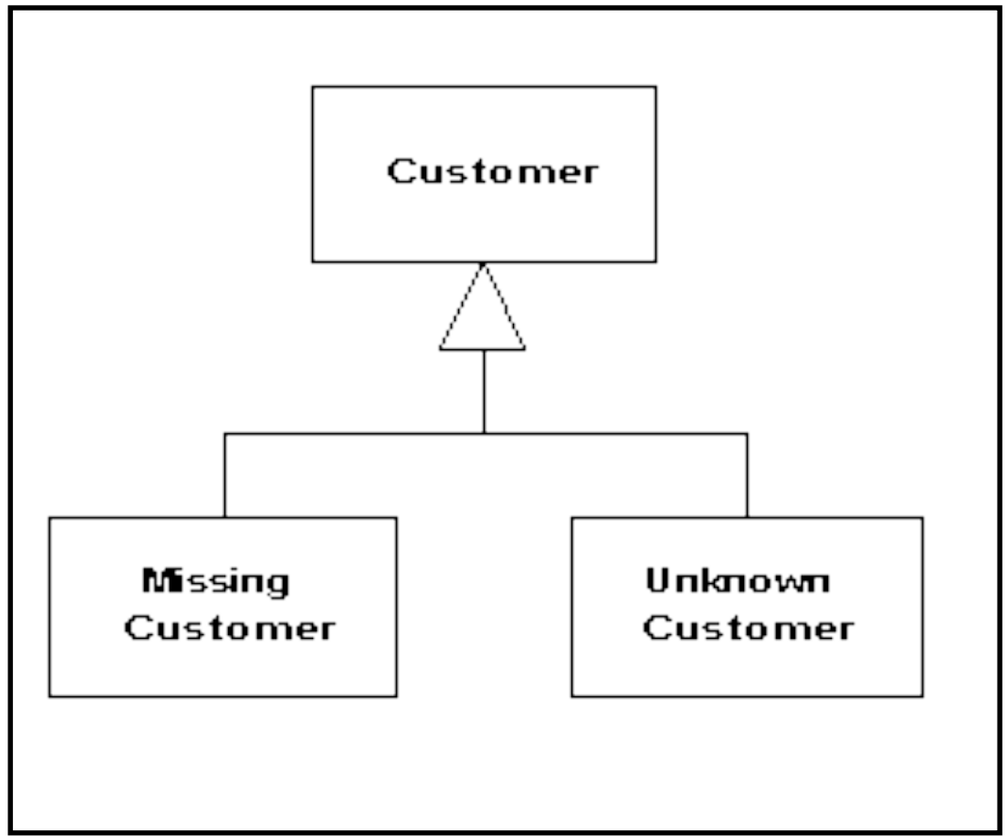
Compile & Test

Repeat last two slides for each operation
clients check if null

Special Case

Special Case

Represent special cases by a subclass



Use when multiple places that have same behavior

After conditional check for particular class instance

Or same behavior after a null check

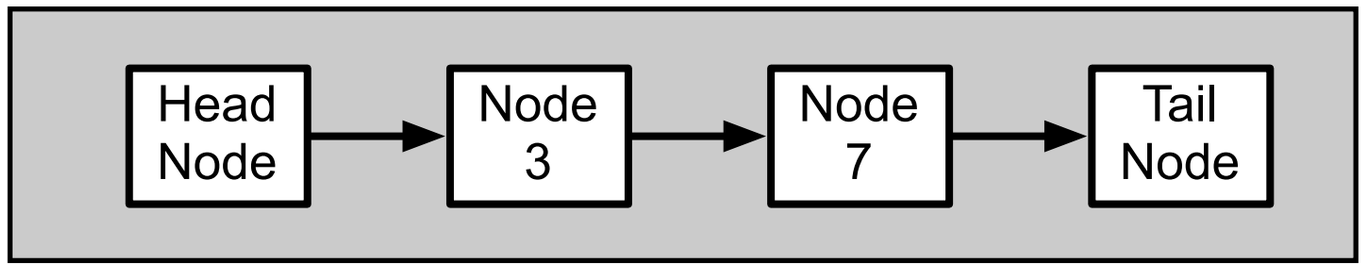
Object-Oriented Recursion

Source:

A method polymorphically sends its message to a different receiver

Eventually a method is called that performs the task

The recursion then unwinds back to the original message send



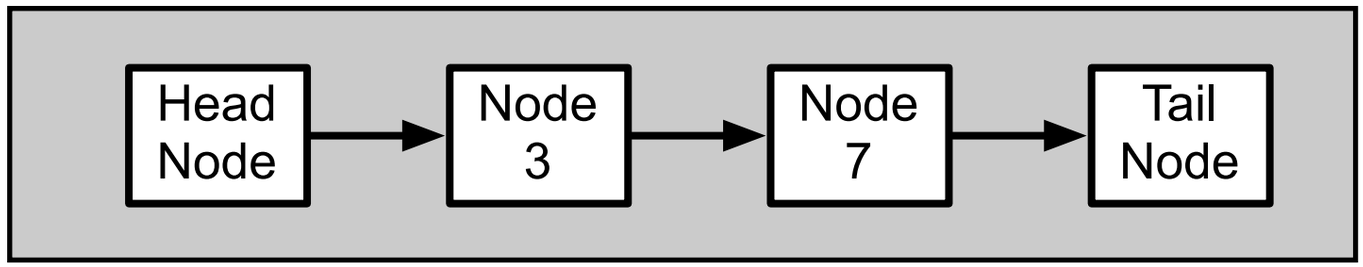
(3 7)

```
class HeadNode {
        public String toString() {
                return "(" + next.toString();
        }
}
```

```
class TailNode {
        public String toString() {
                return " )";
        }
}
```

```
class Node {
        public String toString() {
                return " " + element + next.toString();
        }
}
```


Without tail recursion doing this on a long linked list could cause a stack overflow. So while it may not be a good idea to do this on a linked list it does provide a simple example to explain the idea.




```
class HeadNode {
        public void add(int value) {
                next.add(value);
        }
}
```

```
class TailNode {
        public void add(int value) {
                prependNode(value);
        }
}
```

```
class Node {
        public void add(int value) {
                if (element > value)
                        prependNode(value);
                else
                        next.add(value);
        }
}
```

Principles of OO Design, or Everything I Know About Programming, I Learned from Dilbert

Alan Knight

1. Never do any work that you can get someone else to do for you

Example 1 Total of bills that have been paid this quarter for a factory

```
total = 0;
Vector billings = aFactory.billings();
 for (Bill billing : billings)
    if ((billing.status() == "paid") && (billing.date() > startDate))
        total = total + billing.amount();
```

versus

```
total = aFactory.totalBillingsPaidSince(startDate).
```

1. Never do any work that you can get someone else to do for you

Excuse me Smithers. I need to know the total bills that have been paid so far this quarter. No, don't trouble yourself. If you'll just lend me the key to your filing cabinet I'll go through the records myself. I'm not that familiar with your filing system, but how complicated can it be? I'll try not to make too much of a mess.

Verses

SMITHERS! I need the total bills that have been paid since the beginning of the quarter. No, I'm not interested in the petty details of your filing system. I want that total, and I'll expect it on my desk within the next half millisecond.

1. Never do any work that you can get someone else to do for you

somebody.clients().add(new Client());

Less work

somebody just returns collection

verses

somebody.addClient(new Client());

Needs

addClient:
removeClient:
more?

Encapsulation & Responsibility

Encapsulation is about responsibility

Who does the work

Who should do the work

2. Avoid Responsibility

If you must accept a responsibility, keep it as vague as possible.

For any responsibility you accept, try to pass the real work off to somebody else.