CS 635 Advanced Object-Oriented Design & Programming
Spring Semester, 2015
Doc 2 OO, Ternary Tree, Big Ball of Mud
Jan 27, 2014

Terms

Class

- A blueprint to create objects
- Includes attributes and methods that the created objects all share

Object

- Allocated region of storage
- Both the data and the instructions that operate on that data

From Wikipedia

Example

```
class Point
    def initialize(x, y)
        @x = x
        @y = y
    end

    def to_s
        "Point( #@x,#@y)"
    end
end
```

```
example = Point.new(10,5)

example.to_s
```


Ruby code. Yes I know most people don't know Ruby. There are lots of variation of syntax and semantics for classes in OO languages.

Alternative Definition

Object

first-class, dynamically dispatched behavior

Behavior

Collection of named operations

Operations can be invoked by clients

Operations may share additional hidden details

Dynamic dispatch

Different objects can implement the same operation name(s) in different ways

First class

Objects have the same capabilities as other kinds of values

Passed to operations

Returned as the result of an operation

William Cook at http://wcook.blogspot.com/2012/07/proposal-for-simplified-modern.html

Abstraction

“Extracting the essential details about an item or group of items, while ignoring the unessential details.”

Edward Berard

“The process of identifying common patterns that have systematic variations; an abstraction represents the common pattern and provides a means for specifying which variation to use.”

Richard Gabriel

Encapsulation

Enclosing all parts of an abstraction within a container

Information Hiding

Hiding of design decisions in a computer program

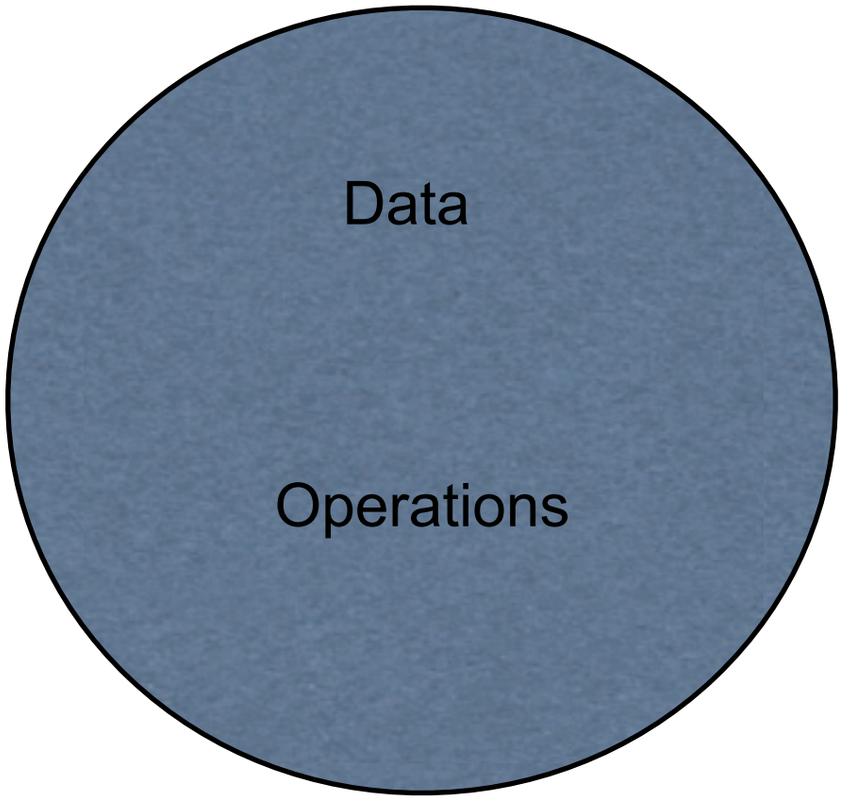
Hide decisions are most likely to change,
To protect other parts of the program

Class

Represents an abstraction

Encapsulates data and operations of the abstraction

Hide design decisions/details



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Not so much a definition of a class as a goal how we should use a class.

Heuristics

2.1 All data should be hidden within it class

2.8 A class should capture one and only one key abstraction

2.9 Keep related data and behavior in one place

Numbers of the heuristics are from the text Object-Oriented Design Heuristics by Riel

Non-OO items

Utility methods

Data classes

Utility method

Method in class that

- Does not access any field (data member, instance variables)
- Just uses parameters

Utility Method - Example

```
class CrosswordPuzzle {
    public void someMethodThatDoesStuff {
        bunch of stuff not shown
        count = vowelCount(aString);
        blah
    }

    private int vowelCount(String word) {
        int vowelCount = 0;
        for (int k = 0; k< word.length(); k++ ) {
            char current = word.charAt(k);
            if ( (current == 'a') || (current == 'e' ) || (current == 'i') || (current == "o" )
                || (current == "u") )
                vowelCount++;
        }
        return vowelCount;
    }
```

OO Version

```
class String {

    public int vowelCount {
        int count = 0;
        for (char current in this)
            if (current.isVowel()) count++;
        return count;
    }
```

Is this better? Why

```
class CrosswordPuzzle {
    public void someMethodThatDoesStuff {
        bunch of stuff not shown
        count = aString.vowelCount();
        blah
    }
```

```
class Character {

    public boolean isVowel() {
        return (this == 'a') || (this == 'e' ) || (this == 'i') || (this == "o" )|| (this == "u");
    }
```

Kent Beck's Properties of Good Style

Kent Beck's Properties of Good Code Stype

Once and only once

Lots of little pieces

Replacing objects

Moving Objects

Rates of change

Once and Only Once

"In a program written with good style, everything is said once and only once"

If have

- several methods with same logic
- several objects with same methods

then rule is not satisfied

Lots of little pieces

"Good code invariably has small methods and small objects"

Small pieces allow you to satisfy "once and only once"

Data Class

```
class Point {
    private int x;
    private int y;

    public void setX(int newX) {
        x = newX;
    }

    public int getX() {
        return x;
    }

    public void setY(int newY) {
        y = newY;
    }

    public int getY() {
        return y;
    }
```

Class with

- get/set methods
- constructor
- No or very few other methods

How is Bar Better than Foo

```
public class Foo {
    public int x;
    public int y;
}
```

```
public class Bar {
    private int x;
    private int y;

    public int getX() {return x;}
    public int getY() {return y;}

    public void setX(int newX){
        x = newX
    }

    public void setY(int newY){
        y = newY
    }
}
```

Ternary Search Tree - TSTNode

```
/** class TSTNode **/
class TSTNode
{
    char data;
    boolean isEnd;
    TSTNode left, middle, right;

    /** Constructor **/
    public TSTNode(char data)
    {
        this.data = data;
        this.isEnd = false;
        this.left = null;
        this.middle = null;
        this.right = null;
    }
}
```


Source http://www.sanfoundry.com/java-program-ternary-search-tree/

Ternary Search Tree - The Tree

```
/** class TernarySearchTree **/
class TernarySearchTree
{
    private TSTNode root;
    private ArrayList<String> al;

    /** Constructor **/
    public TernarySearchTree()
    {
        root = null;
    }
```

Ternary Search Tree - The Tree

```
/** function to check if empty **/
public boolean isEmpty()
{
    return root == null;
}

/** function to clear **/
public void makeEmpty()
{
    root = null;
}
```

Ternary Search Tree - insert

```
/** function to insert for a word **/
public void insert(String word)
{
    root = insert(root, word.toCharArray(), 0);
}
```

Ternary Search Tree - insert

```
/** function to insert for a word **/
public TSTNode insert(TSTNode r, char[] word, int ptr)
{
    if (r == null)
        r = new TSTNode(word[ptr]);

    if (word[ptr] < r.data)
        r.left = insert(r.left, word, ptr);
    else if (word[ptr] > r.data)
        r.right = insert(r.right, word, ptr);
    else
    {
        if (ptr + 1 < word.length)
            r.middle = insert(r.middle, word, ptr + 1);
        else
            r.isEnd = true;
    }
    return r;
}
```

Assume StringIterator

```
public class StringIterator
    public char next();
    public char current();
    public boolean hasNext();
```

Ternary Search Tree - insert

```
public TSTNode insert(TSTNode r, StringIterator charsToInsert)
{
    if (r == null)
        r = new TSTNode(word[ptr]);

    if (charsToInsert.current()< r.data)
        r.left = insert(r.left, charsToInsert);
    else if (charsToInsert.current() > r.data)
        r.right = insert(r.right, charsToInsert);
    else
    {
        if (charsToInsert.hasNext()) {
            charsToInsert.next()
            r.middle = insert(r.middle, charsToInsert);
        else
            r.isEnd = true;
    }
    return r;
}
```

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

Alan Knight


I'M ALREADY USELESS, BUT I'M THINKING ABOUT BECOMING TOXIC AS WELL.


DilbertCartoonist@gmail.com
THAT SEEMS AMBITIOUS FOR YOU.
THINK IT THROUGH.


AS A USELESS PERSON, I STILL GET INVITED TO MEETINGS BECAUSE I DON'T CAUSE MUCH TROUBLE.


©2015 Scott Adams, Inc. /Dist. by Universal Uclick
BUT IF I GO FULL— TOXIC, NO ONE WILL INVITE ME TO MEETINGS IN THE FIRST PLACE.


I CAN AVOID A LOT OF WORK BY NIPPING IT IN THE BUD.


IS IT HARD TO BE TOXIC? HOW DO YOU DO IT?
IT'S EASY.


ALL YOU DO IS PROVIDE INCOMPLETE INFORMATION THAT MAKES PEOPLE ANXIOUS AND HATEFUL.


www.dilbert.com
1-25-15
I CAN'T TELL YOU WHAT WAS SAID IN THAT LAST MEETING, BUT I DEFENDED YOU.

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.

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.

```
class TernarySearchTree {

    public void insert(String word) {
        root.insert(new StringIterator(word));
    }
```

Have the Node do the work

Ternary Search Tree - toString

```
public String toString()
   {
      al = new ArrayList<String>();
      traverse(root, "");
      return "\nTernary Search Tree : "+ al;
   }
```

al

A field used to replace an argument to traverse

Ternary Search Tree - toString

```
/** function to traverse tree **/
private void traverse(TSTNode r, String str)
{
    if (r != null)
    {
        traverse(r.left, str);

        str = str + r.data;
        if (r.isEnd)
            al.add(str);

        traverse(r.middle, str);
        str = str.substring(0, str.length() - 1);

        traverse(r.right, str);
    }
  }
}
```

Using a local variable

```
/** class TernarySearchTree **/
class TernarySearchTree
{
    private TSTNode root;


    public String toString()
      {
          ArrayList words = new ArrayList<String>();
          String collectedWord = "";
          traverse(root, collectedWord, words);
          return words.toString();
    }
```

What Compsci textbooks don't tell you

What don't they tell you?

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nearly every sample program in every textbook is a perfect and well-thought-out specimen, virtually no software out in the wild is, and this is rarely acknowledged

What are the causes of bad Software?

bad programmers, too good programmers, bad laziness, time

What is the simple fix?

Comments

What is a Big Ball of Mud?

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How many have worked on a Big ball of mud?
What caused it?
What was the impact of the Big ball of mud?

What Forces Lead to Big Ball of Mud

Time, Cost, Experience, Skill, Visibility, Complexity, Change, Scale

Patterns

Big Ball of Mud
Throwaway Code
Piecemeal Growth
Keep it Working
Shearing Layers
Sweeping it Under the Rug
Reconstruction

Big Ball of Mud

You need to deliver quality software on time, and under budget.

Therefore, focus first on features and functionality, then focus on architecture and performance.

Enemy of Big Ball of Mud

Top down design

Hire good architects

Problems

Variable and function names
- uninformative

Functions themselves may make extensive use of
- global variables,
- long lists of poorly defined parameters.

The function themselves are
- lengthy and convoluted,
- perform several unrelated tasks.

The programmer’s intent is next to impossible to discern.

We built the most complicated system that can possible work

Three ways to deal with BIG BALLS OF MUD

Keep it healthy - expansion then refactoring
Throw it away
Live with it

Extreme Programming Practices

Pair programming
Planning game
Test driven development
Customer part of development team
Continuous integration
Refactoring or design improvement
Small releases
Coding standards
Collective code ownership
Simple design
System metaphor
Sustainable pace

Throwaway Code

You need an immediate fix for a small problem, or a quick prototype or proof of concept.

Therefore, produce, by any means available, simple, expedient, disposable code that adequately addresses just the problem at-hand.

Why do we need throwaway code?

What the main problem with throwaway code?

Piecemeal Growth

Users' needs change with time.

Therefore, incrementally address forces that encourage change and growth.

Allow opportunities for growth to be exploited locally, as they occur.

Refactor unrelentingly.

What is the main problem with Piecemeal Growth?

Keep it Working

Maintenance needs have accumulated, but an overhaul is unwise, since you might break the system.

Therefore, do what it takes to maintain the software and keep it going. Keep it working.

How do Piecemeal Growth and Keep it Working lead to a ball of mud?

How can we use Piecemeal Growth and Keep it Working and avoid the ball of mud?

Is it advisable to use Piecemeal Growth and Keep it Working?

Shearing Layers

Different artifacts change at different rates

Therefor

Factor your system so that artifacts that change at similar rates are together

Why?

Put things that change at different rates in different places?

Example?

Sweep it Under the Rug

Overgrown, tangled, haphazard spaghetti code is hard to comprehend, repair, or extend, and tends to grow even worse if it is not somehow brought under control.

Therefore, if you can’t easily make a mess go away, at least cordon it off.

This restricts the disorder to a fixed area, keeps it out of sight, and can set the stage for additional refactoring.

Reconstruction

Your code has declined to the point where it is beyond repair, or even comprehension.

Therefore, throw it away and start over.

"Plan to throw one away, you will anyway"

Fred Brooks

Problems with Starting Over

Cost

Time

Reintroduce bugs

Few features