CS 535 Object-Oriented Programming & Design
Fall Semester, 2013
Doc 2 More OO Introduction
Aug 29, 2013

References

Object-Oriented Design Heuristics, Chapter 2

Why is OO Good?

For discussion in class

Does your code achieve those properties of goodness?

```
 struct Stack {
     float[] elements
     int topOfStack
 }


void push(stack *Stack,float elementToAdd) {
    stack.elements[topOfStack++] = elementToAdd;
}
```

```
 public class Stack {
     public float[] elements
     public int topOfStack
 }


public class StackStuff
    public void push(stack Stack,float elementToAdd) {
        stack.elements[topOfStack++] = elementToAdd;
    }
}
```

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

Instance of a class

From Wikipedia

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

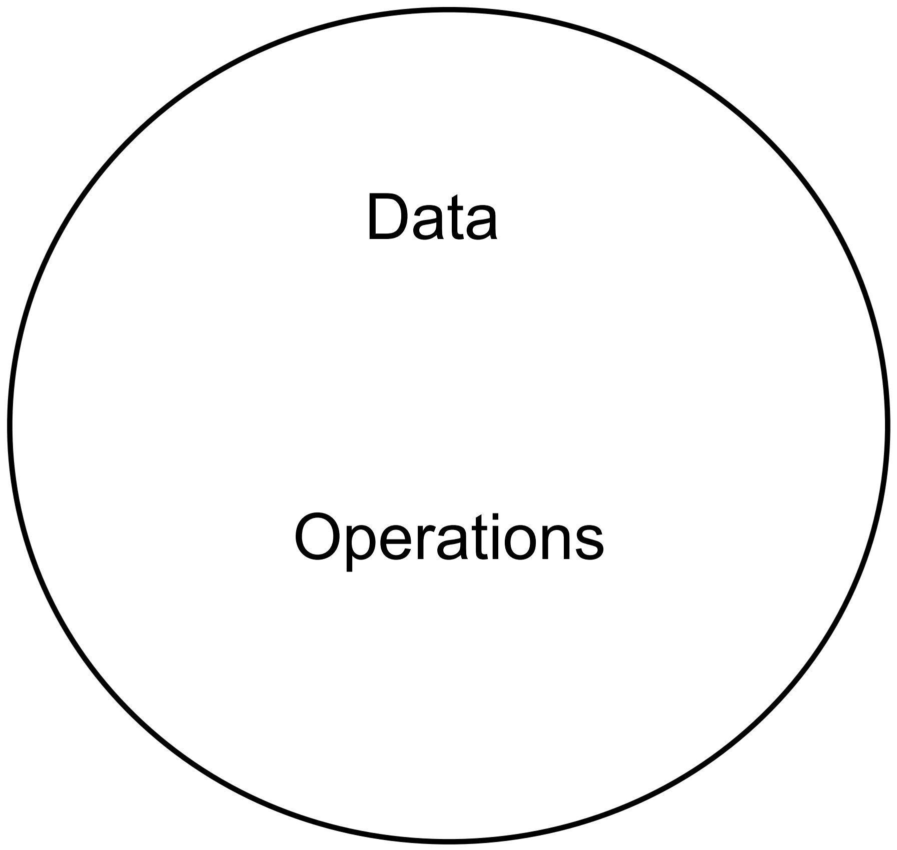
Hide decisions are most likely to change,
To protect other parts of the program

Class

Represents an abstraction

Encapsulates data and operations of the abstraction

Hide design decisions/details



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

Alan Kay - 2003

OOP to me means only

messaging,

local retention and

protection and hiding of state-process, and

extreme LateBinding of all things

Alan Kay

I'm sorry that I long ago coined the term "objects" for this topic because it gets many people to focus on the lesser idea.

Alan Kay

I'm sorry that I long ago coined the term "objects" for this topic because it gets many people to focus on the lesser idea.

The big idea is "messaging"

Alan Kay

I'm sorry that I long ago coined the term "objects" for this topic because it gets many people to focus on the lesser idea.

The big idea is "messaging"

I thought of objects being like biological cells and/or individual computers on a network, only able to communicate with messages

Alan Kay

I'm sorry that I long ago coined the term "objects" for this topic because it gets many people to focus on the lesser idea.

The big idea is "messaging"

I thought of objects being like biological cells and/or individual computers on a network, only able to communicate with messages

I wanted to get rid of data

Alan Kay

I'm sorry that I long ago coined the term "objects" for this topic because it gets many people to focus on the lesser idea.

The big idea is "messaging"

I thought of objects being like biological cells and/or individual computers on a network, only able to communicate with messages

I wanted to get rid of data

The key in making great and growable systems is much more to design how its modules communicate rather than what their internal properties and behaviors should be

Alan Kay

Perspective is worth 80 IQ points.

Classes and Objects

Abstraction

Hide data

Hide design decisions

Messages

Relevant Heuristics

2.8 A class should capture one and only one key abstraction

2.9 Keep related data and behavior in one place

Signs of Poor OO Design

Data Classes

Helper functions

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

Helper method

Method in class that

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

Sign that Data and Operations are not being kept together

Assignment Results

Classes	
Data Classes	

Class	Accessor	Helper	Other

Helper 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

Is this better? Why

```
class String {

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


class Character {

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

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

Linked List Example

```
class LinkedList {
    private head;
    private tail;

    public LinkedList() {//some code}

    public boolean add(int index, Object element) {//blah}

    public Object get(int index) {//some code}

    public Object remove(int index) {//some code}

    public boolean remove(Object element) {//some code}

    public boolean removeLastOccurrence(Object element) {}
```

```
class Node {
    Object value;
    Node previous;
    Node next;
}
```

Node Class

Data Class

What are the operations?

```
class Node {
    Object value;
    Node previous;
    Node next;
}
```

Heuristic

A method to help solve a problem, commonly informal

"rules of thumb"

2.1 All data should be hidden within its class

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

```
public class Foo {
    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
    }
}
```

How is the version on the right better than the version on the left?

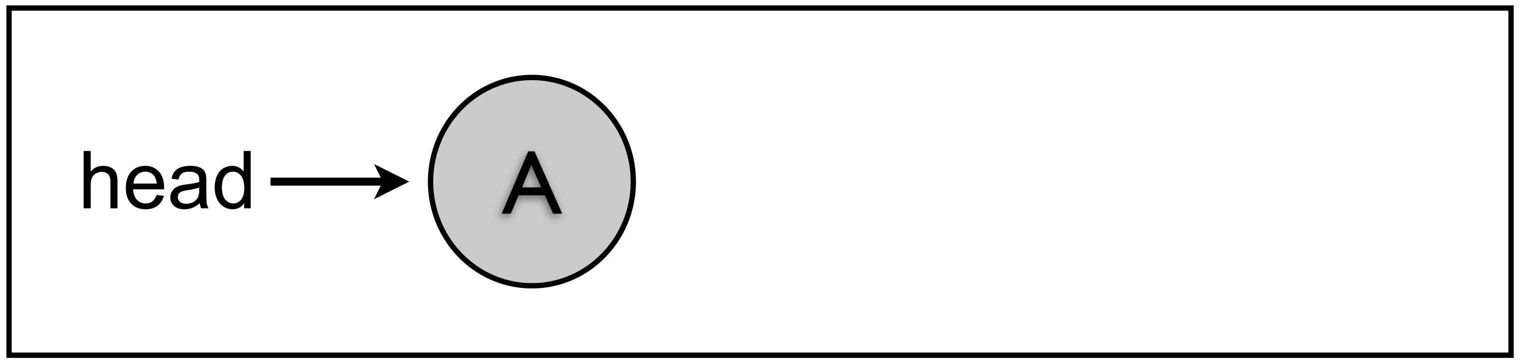
Information Hiding

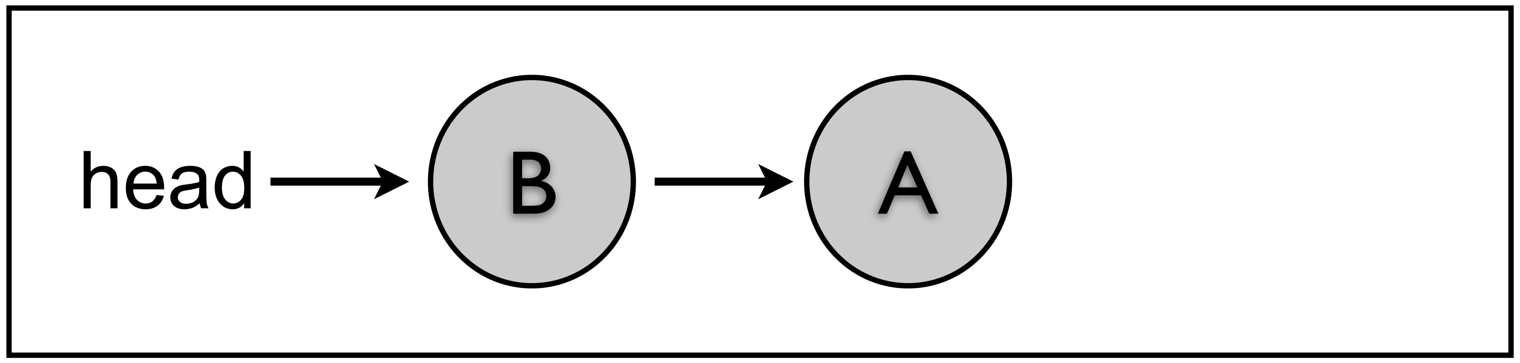
```
class LinkedList {
    private int size;
    private Node head;

}
```

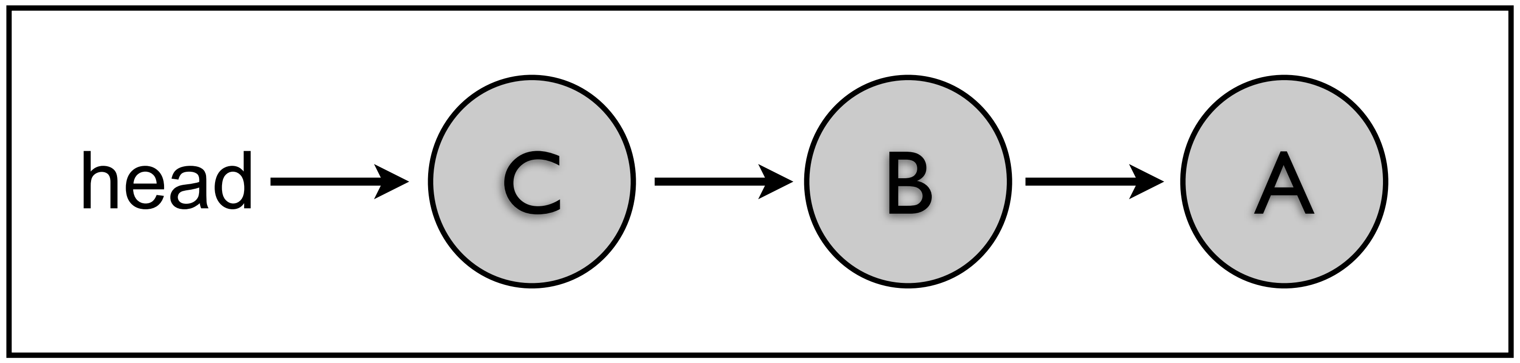
Information Hiding - Copies verses Reference

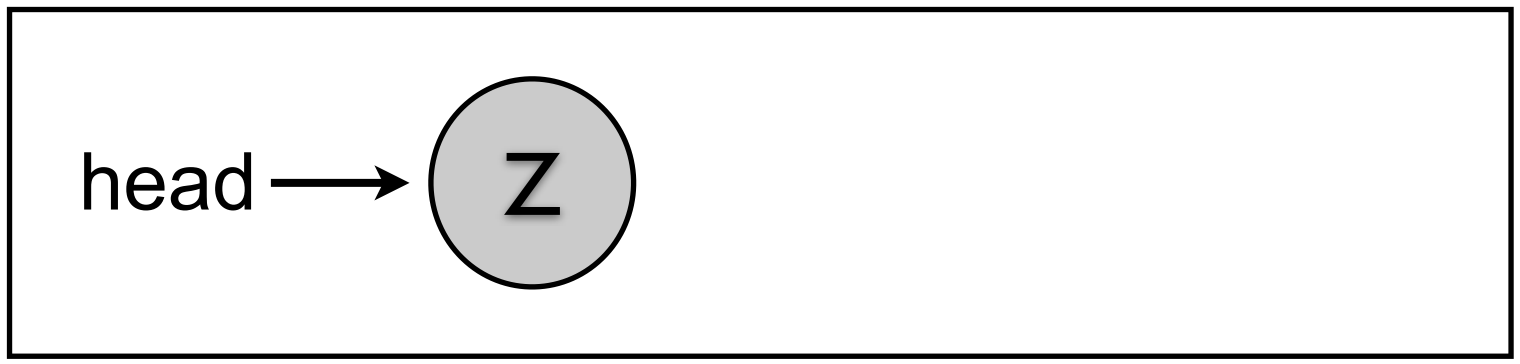
```
class LinkedList {
    private int size;
    private Node head;

    public int size() {
        return size;
    }

    public Node head() {
        return head;
    }
}
```

head


head
A


head
B
A


head
C
B
A


head
z

Information Hiding - Copies verses Reference

```
class LinkedList {
    private int size;
    private Node head;

    public int size() {
        return size;
    }

✗   public Node head() {
        return head;
    }
}
```

Information Hiding

```
class LinkedList {
    private int size;
    private Node head;

    public void addFirst(Node newData) {
        newData.next(head);
        head = newData;
    }
```

Information Hiding

```
class LinkedList {
    private int size;
    private Node head;

    public void addFirst(Object data) {
        head = new Node(data, head);
    }

    public Node getFirst() {      ✗
        return head;
    }
```