# CS 635 Advanced Object-Oriented Design & Programming
Spring Semester, 2014
Doc 5 Assignment 1, Strategy
Feb 11, 2014

```
public class MinHeap {
    public Node root;
public class MinHeap {
    ~~public~~ Node root;
```

```
public class MinHeap {
    private Node root;

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

```
public class MinHeap {
    private Node root;

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

```
public class MinHeap {
    private Node root;

    public Node root() {
        return root;
    }

    public void insert(Node root, String element) {
        blah
    }
```

```
MinHeap test = new MinHeap();
Node root = test.root();
test.insert(root, "cat");
```

```
public class MinHeap {
    private Node root;

    public void insertNode(Node newElement) {
        blah, blah , etc
    }
```

```
MinHeap test = new MinHeap();
Node element = new Node("cat");
test.insertNode(element);
```

```
public class MinHeap {
    private Node root;

    public void insertNode(Node newElement) {
        blah, blah , etc
    }
```

```
MinHeap test = new MinHeap();
Node element = new Node("cat");
test.insertNode(element);
```

```
public class MinHeap {
    private Node root;

    public void insertNode(String element) {
        blah, blah , etc
    }
```

```
public class MinHeap {
     private Node root;

     public void insertNode(String element) {
          blah, blah , etc
     }
```

What is the name of the method used to add something to a collection in Java?

What does the method return?

```
public class MinHeap {

    public int sizeOfHeap() {
        blah
        return result;
    }
```

What name should the method have?

What type of collection is a heap?

Why does it only hold Strings?

```
public class MinHeap {
    private static Node root;
```

```
MinHeap first = new MinHeap();
MinHeap second = new MinHeap();
first.add("cat");
second.add("dog");
int wrong = second.size();
```

What value does wrong have?
What value should it be

```
public class MinHeap {
    private ~~static~~ Node root;
```

```
MinHeap first = new MinHeap();
MinHeap second = new MinHeap();
first.add("cat");
second.add("dog");
int wrong = second.size();
```

What value does wrong have?
What value should it be

```
public class MinHeap {

    public void display() {
        blah;
        System.out.println( currentNode.value);
        blah;
    }
```

```
public class MinHeap {

    public void display() {
        blah;
        System.out.println( currentNode.value);
        blah;
    }
```

```
public class MinHeap {

    public String display() {
        blah;
        blah;
        return result;
    }
```

How is this diplaying anything?

```
public class MinHeap {

    public String display() {
        blah;
        blah;
        return result;
    }
```

What do we call the method that returns a string representation of the object?

```
public class MinHeap {

     public String toString() {
          blah;
          blah;
          return result;
     }
```

```
public class MinHeap {

    public ArrayList display() {
        blah;
        blah;
        return result;
    }
```

More useful format

```
public class MinHeap {

    public <T> t[ ] toArray(T[ ] a) {
        blah;
        blah;
        return result;
    }
```

The Java collection standard

## Abstraction?

```
public class MinHeap {

      public void displayWord✗ndingInIng( ) {
            blah;
            blah;
      }
```

```
public class MinHeap {
    private Node root;
    private String ingWords                    Not part of class state

    public void display() {
        blah;
        ingWords = ingWords + currentNode.value;
        blah;
    }

    public String getIngWords() {
        return ingWords;
    }
```

```
public class MinHeap {

    public Iterator iterator( ) {
        blah;
        blah;
    }
```

```
MinHeap test = new MinHeap();
//add elements

for (Iterator elements = test.iterator; elements.hasNext();) {
    String item = elements.next();
    if (some condition on item) {

    }
}
```

## Duh Comments

```
public class MinHeap {

        //Declare fields
        private Node root;

        //constructor
        public MinHeap() { blah }

        // return the root
        public Node getRoot() { blah }
    }
```

## What have we lost?

```
public class MinHeap {

        private Node root;

        public MinHeap() { blah }

        public Node getRoot() { blah }
    }
```

## Data Class

```
public Node {
    public String value;
    public Node left;
    public Node right;
}
```

## Where are the Operations?

```
public Node {
    private String value;
    private Node left;
    private Node right;

    public String getValue() { return value;}
    public void setValue(String x) {value = x;}

    etc.
}
```

## Find all the Helper methods in MinHeap

```
public class MinHeap {

        private int getHeight(Node aNode) {
            if (aNode.left == null & aNode.right == null)
                return 1;
            if (aNode.left == null)
                return 1;
            return 1 + Math.max(getHeight(aNode.left(), getHeight(aNode.right());
        }
```

## Why not put it in Node class?

```
public class Node {

        public int height() {
            if (left == null & right == null)
                return 1;
            if (left == null)
                return 1;
            return 1 + Math.max(left.height(), right.height());
        }
```

## Store the value

```
public class Node {
        private int height;

        public int height() {
            return height()
        }
```

## Cache the value

```
public class Node {
        private static final NOT_SET = -1;
        private int height;

        public boolean add(String value) {
            height = NO_SET; //adding may change height
            blah blah
        }

        public int height() {
            if (height == NOT_SET)
                height = computeHeight();
            return height;
        }

        private int computeHeight() { blah blah }
```

## Strategy Pattern

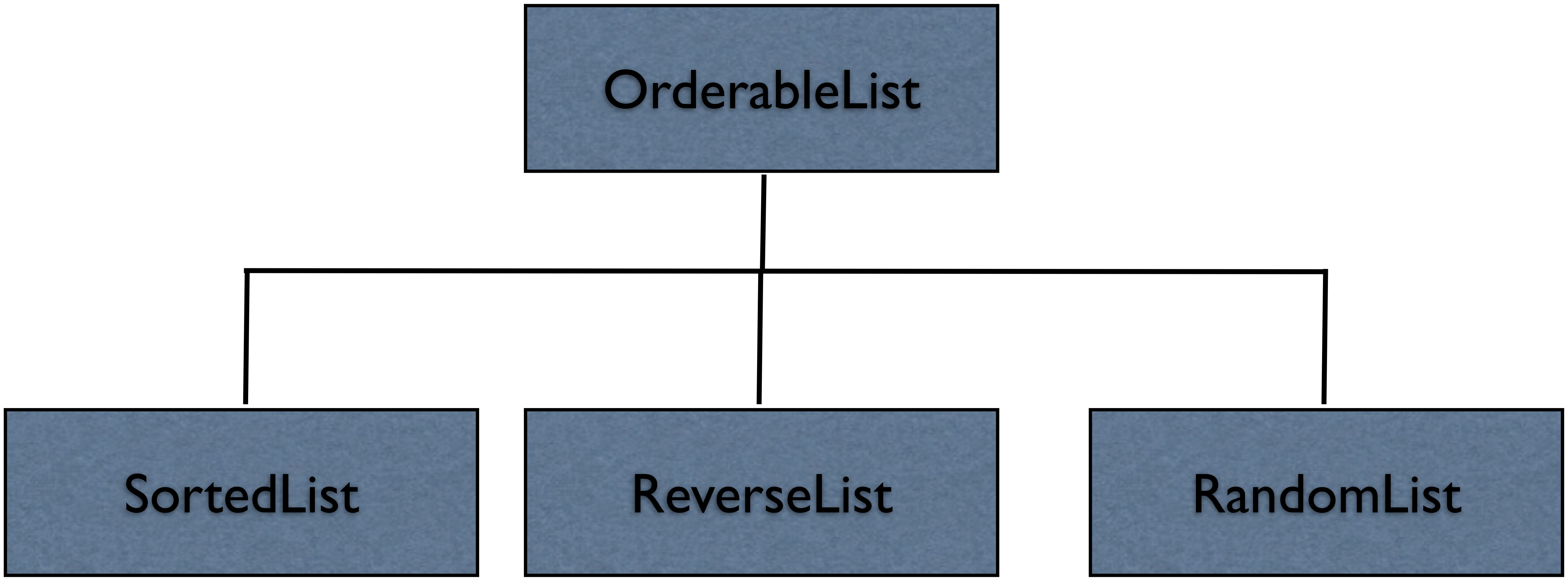
## Favor
## Composition
## over
## Inheritance

## Orderable List

Sorted

Reverse Sorted

Random


OrderableList
SortedList
ReverseList
RandomList

## One size does not fit all

## Issue 1 - Orthogonal Features

Order

Sorted

Reverse Sorted

Random

Threads

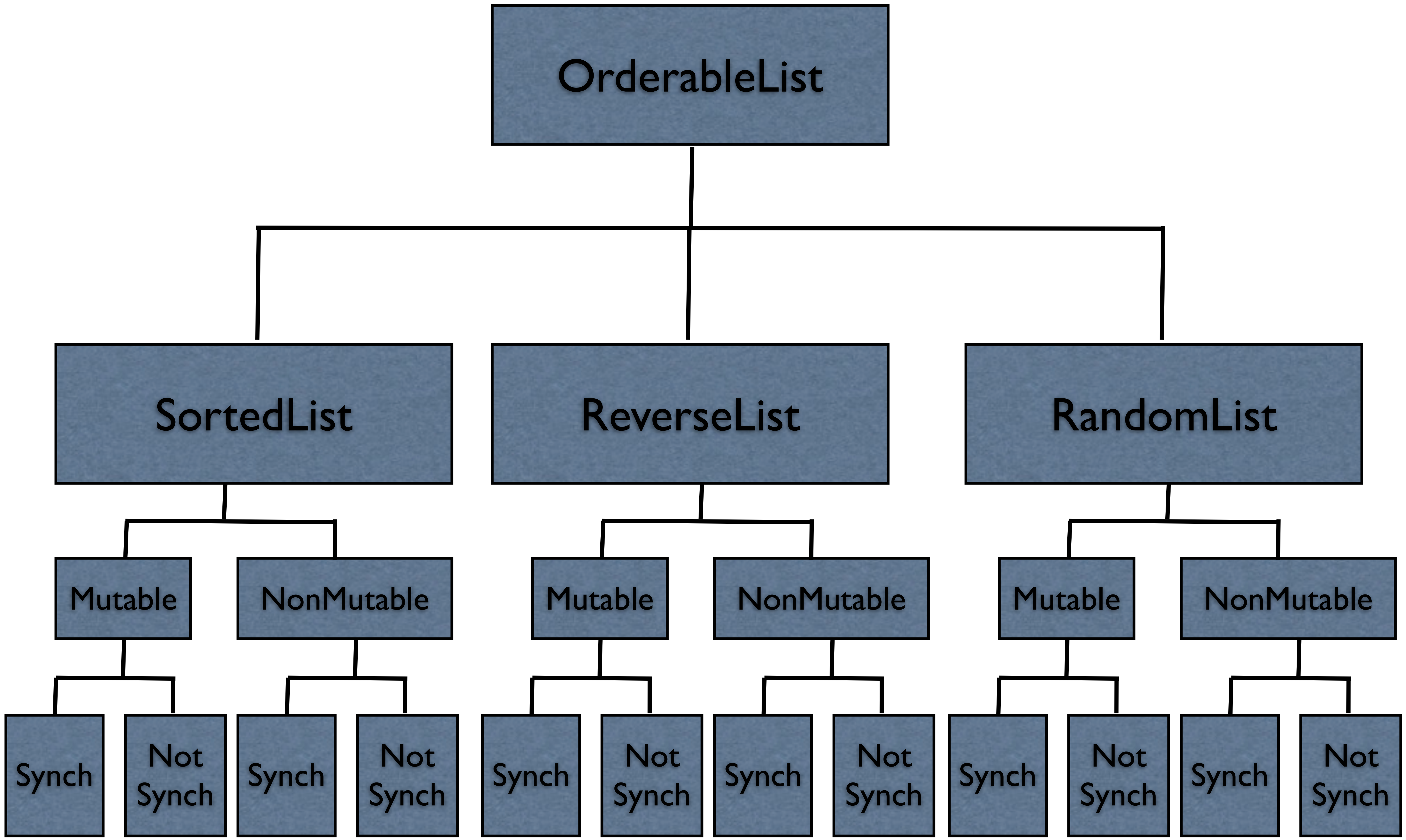
Synchronized

Unsynchronized

Mutability

Mutable

Non-mutable


OrderableList
SortedList
ReverseList
RandomList
Mutable
NonMutable
Mutable
NonMutable
Mutable
NonMutable
Synch
Not Synch
Synch
Not Synch
Synch
Not Synch
Synch
Not Synch
Synch
Not Synch
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Not Synch

## Issue 2 - Flexibility

## Change behavior at runtime

```
OrderableList x = new OrderableList();
x.makeSorted();
x.add(foo);
x.add(bar):
x.makeRandom();
```

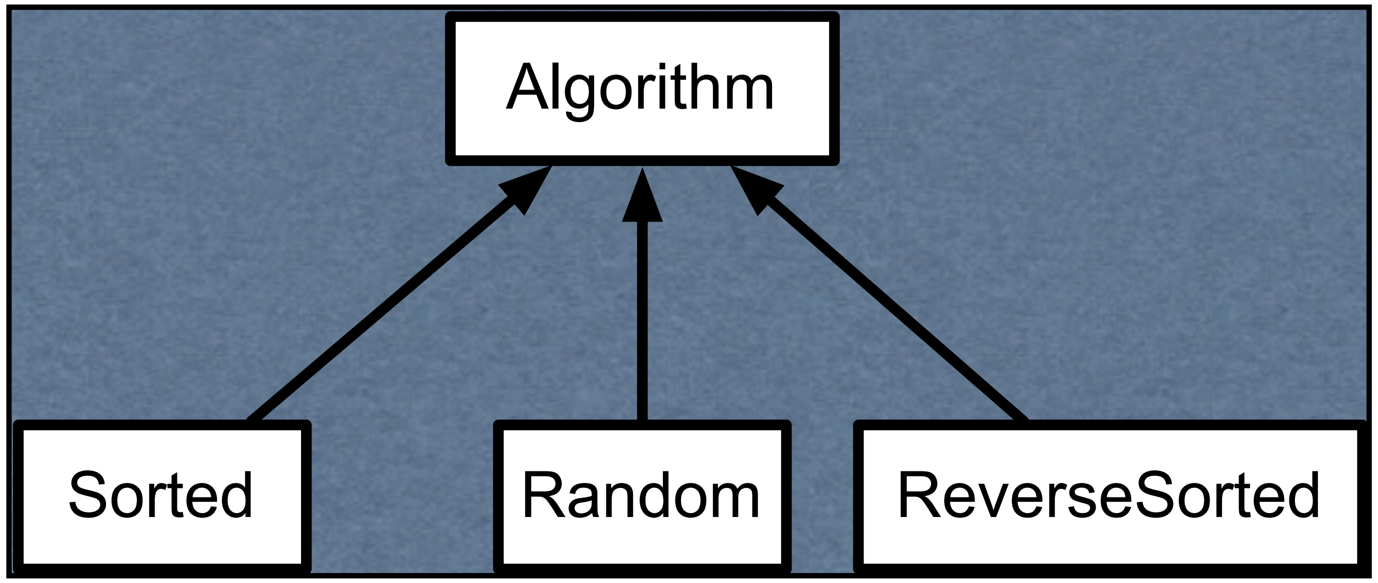
## Configure objects behavior at runtime

## Strategy Pattern

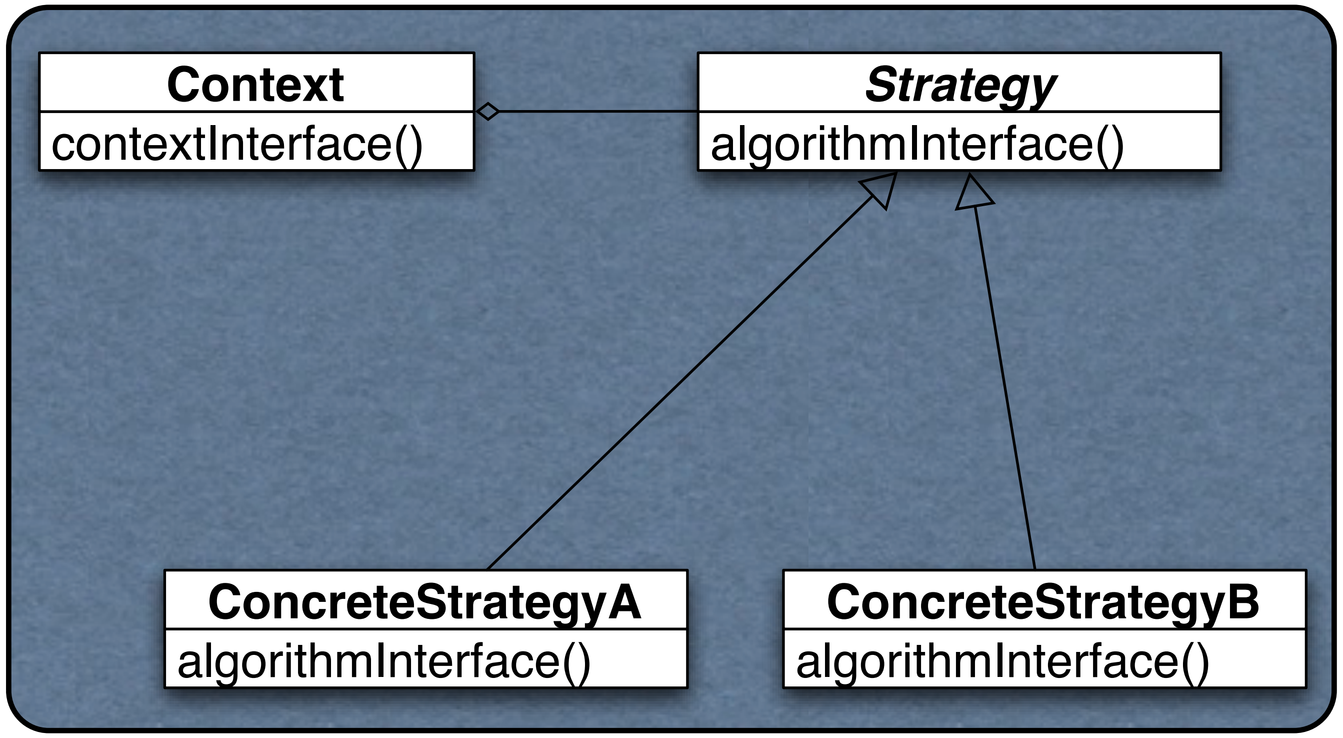
```
class OrderableList {
      private Object[ ] elements;
      private Algorithm orderer;

      public OrderableList(Algorithm x) {
            orderer = x;
      }

   public void add(Object element) {
      elements = ordered.add(elements,element);
   }
```



## Structure


Context
contextInterface()
Strategy
algorithmInterface()
ConcreteStrategyA
algorithmInterface()
ConcreteStrategyB
algorithmInterface()

The algorithm is the operation

Context contains the data

How does this work?

## Prime Directive

Data + Operations

## How does Strategy Get the Data?

Pass needed data as parameters in strategy method

Give strategy object reference to context
Strategy extracts needed data from context

## Example - Java Layout Manager

```
import java.awt.*;
class  FlowExample  extends Frame  {

    public FlowExample( int  width, int height ) {
        setTitle( "Flow Example" );
        setSize( width, height );
        setLayout( new FlowLayout( FlowLayout.LEFT) );

        for ( int label = 1; label < 10; label++ )
            add( new Button( String.valueOf( label ) ) );
        show();
    }

    public  static  void  main( String  args[] ) {
        new  FlowExample( 175, 100 );
        new  FlowExample( 175, 100 );
    }
}
```

## Example - Smalltalk Sort blocks

```
| list |
list := #( 1 6 2 3 9 5 ) asSortedCollection.
Transcript
    print: list;
    cr.
list sortBlock: [:x :y | x > y].
Transcript
    print: list;
    cr;
    flush.
```

## Costs

Clients must be aware of different Strategies

Communication overhead between Strategy and Context

Increase number of objects

## Benefits

Alternative to subclassing of Context

Eliminates conditional statements

Replace in Context code like:

```
switch  ( flag ) {
        case A: doA(); break;
        case B: doB(); break;
        case C: doC(); break;
}
```

With code like:

```
strategy.do();
```

Gives a choice of implementations

## Refactoring: Replace Conditional Logic with Strategy

Conditional logic in a method controls which of several variants of a calculation are executed

so

Create a Strategy for each variant and make the method delegate the calculation to a Strategy instance

## Replace Conditional Logic with Strategy

```
class Foo {
    public void bar() {
        switch  ( flag ) {
            case A: doA(); break;
            case B: doB(); break;
            case C: doC(); break;
        }
    }
}
```

$\longrightarrow$

```
class Foo {
    private strategy;
    public void bar() {
        strategy.do(data);
    }
}
```