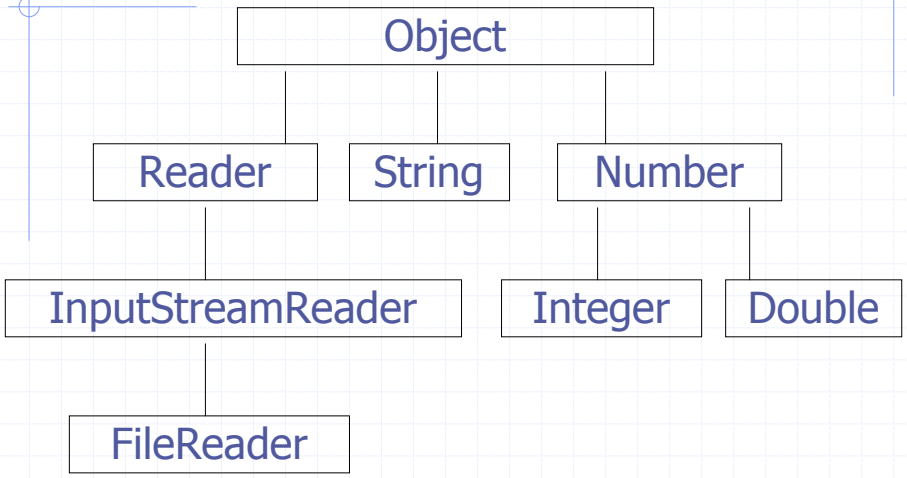
Object-Oriented Design

Object Oriented Design

- Goals
  - Robustness
  - Adaptability
  - Flexible code reuse
- Principles
  - Abstraction
  - Encapsulation
  - Modularity

Class Hierarchy



Inheritance & Polymorphism

- subclass extends superclass
- the subclass "specialises", and "inherits" from, the superclass
- field or method in subclass can override field or method in superclass
- the appropriate method is found by means of dynamic dispatch
- keywords: this & super

Example: Progression class

```
public class Progression {
    protected long first, cur;
    Progression() { cur = first = 0; }
    protected long firstValue() { cur = first; return cur; }
    protected long nextValue() { return ++cur; }
    public void printProgression( int n ) {
        System.out.println( firstValue());
        for( int i = 2; i <= n; i++ )  {
            System.out.print( " " + nextValue()); }
        System.out.println();
    }
```


ArithProgression subclass

```
class ArithProgression extends Progression {
    protected long inc;  //  increment
    // parameter inc masks or overrides field inc
    ArithProgression( long inc ) {this.inc = inc; }
    ArithProgression() {this( 1 );} // calls other constructor
     // this method overrides Progression.nextValue()
    protected long nextValue() {
        cur += inc;
        return cur;
    }
// inherits methods firstValue() and printProgression()
}
```


FibonacciProgression

```
class FibonacciProgression extends Progression {
    long prev;
    FibonacciProgression( long value1, long value2 ) {
        first = value1;  prev = value2 - value1; }
    FibonacciProgression() { this( 0, 1 ); }
    protected long nextValue() {
        long temp = prev;
        prev = cur;
        cur += temp;
        return cur;
    }
```


Test Progression

```
class Tester {
    public static void main( String[] args ) {
        Progression prog;
        prog = new ArithProgression();//default increment
        prog.printProgression( 10 );
        prog = new ArithProgression( 5 );// increment 5
        prog.printProgression( 10 );
        prog = new FibonacciProgression(); // default
        prog.printProgression( 10 );
        prog = new FibonacciProgression( 4, 6 );
        prog.printProgression( 10 );
    }
```

Test Progression

ArithProgression(); //default increment

0 1 2 3 4 5 6 7 8 9

ArithProgression(5);// increment 5

0 5 10 15 20 25 30 35 40 45

FibonacciProgression(); // default

0 1 1 2 3 5 8 13 21 34

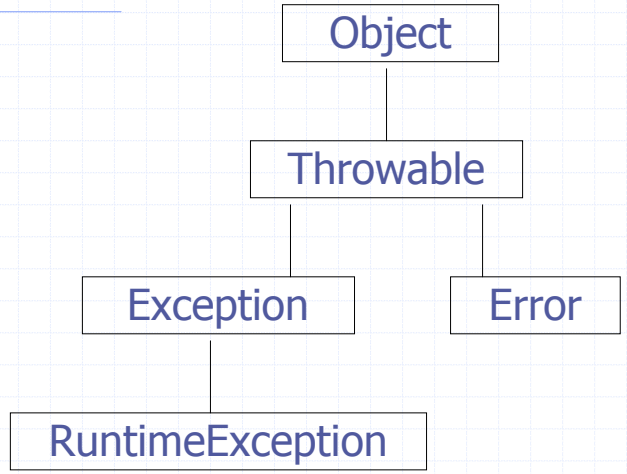
FibonacciProgression(4, 6);

4 6 10 16 26 42 68 110 178 288

Exceptions

- when code encounters unexpected conditions, it throws an exception
- other code must then catch the exception
- when an exception is thrown in a method, the method may either catch the exception or throw it to the calling method
- Exceptions are in a hierarchy (and you can define your own)
- Exceptions other than RuntimeExceptions must be caught

Exception Hierarchy



Copy.java

```
try {
   fileIn  = new BufferedReader(new FileReader(source));
   fileOut = new PrintWriter( new FileWriter( dest ));
   String oneLine;
   while(( oneLine = fileIn.readLine()) != null ) {
         fileOut.println( oneLine );  }
   fileIn.close();  fileOut.close();
}
catch( IOException e ) {
   System.out.print( "Exception: " + e );
   System.exit( 1 );
}
```

Interfaces

- An interface is a collection of method declarations with no data and no code
- When a class implements an interface, it must implement all methods declared in the interface
- Each class extends (directly) only one other class, but may implement more than one interface

Abstract Classes

- an abstract class is a class containing empty method declarations
- abstract class cannot be instantiated
- subclass of an abstract class must provide implementations for all the abstract methods of the superclass

Casting and instanceof

```
void printProgression( Progression prog ) {
      ……
   if( prog instanceof ArithProgression ) {
       System.out.println( “int = ’’ +
           ((ArithProgression)  prog ).int );
   }
   if( prog instanceof FibonacciProgression ) {
       System.out.println( “prev = ’’ +
           ((FibonacciProgression)  prog ).prev );
   }
```


Javadoc

```
/**
 *  Compute the sigmoid function of a given input
 *
 * @param  x  Any real number
 * @return  y  The sigmoid function of x
 */
Public double sigmoid( double x ) {
   if( x >= 0.0 )
        return 1.0 / ( 1.0 + Math.exp( -x ));
   else
        return 1.0 - sigmoid( -x );
}
```

Design Patterns

- Position
- Iterator
- Template method
- Composition
- Comparator
- Locator
- Decorator