

Object interactions

Lecture 6

Waterford Institute of Technology

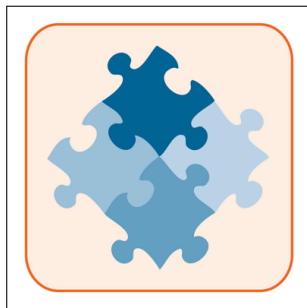
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Abstraction revisited

BlueJ Clock

- demonstrates **abstraction**
- Application decomposed into modules
- Implementation details hidden
- Public interface only exposed
- Development separable by both
 - Location
 - Time

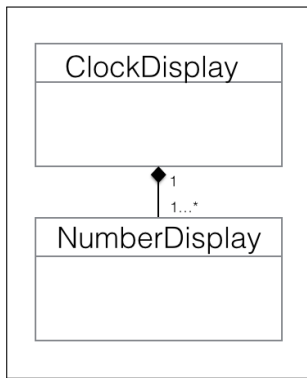


Class diagram

BlueJ Clock Example

Class diagram

- *Static* view
- Represents class design
- Arrow means *ClockDisplay* **has a** *NumberDisplay*
- One *ClockDisplay* has one or many *NumberDisplay* fields

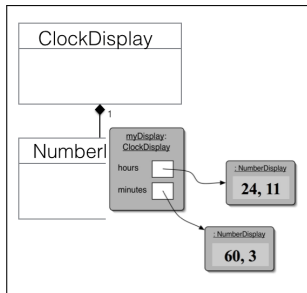


Object composition

BlueJ ClockDisplay

Both Object & Class diagrams reveal

- ClockDisplay has 2 NumberDisplay fields
- ClockDisplay exclusive owner fields
- *Object Composition* example



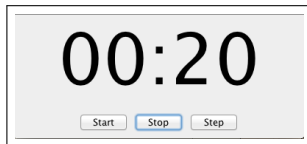
NumberDisplay class

NumberDisplay

- Represents digital number display
- Fields
 - `int limit`
 - `int value`
- *value* range 0 to *limit-1*
- *value* resumes at 0 when limit reached
- *modular* or *clock* arithmetic

```
public class NumberDisplay
{
    private int limit;
    private int value;
    public NumberDisplay(int limit)
    {
        this.limit = limit;
        value = 0;
    }
}
```

NumberDisplay class



NumberDisplay

- Updating *value* attribute
- Accepts parameter only if in valid range
- Otherwise no action

```
public void setValue(int value)
{
    if(value >= 0 && value < limit)
    {
        this.value = value;
    }
}
```

Conditional and Unary Operators

Conditional operators

- Logical **AND** &&
- Logical **OR** ||

Unary operator

- Logical complement !
- Also called **NOT** operator
- Inverts value of boolean

```
boolean a = false;  
boolean b = true;  
/* !a is true  
 * !b is false  
 * a && b is false  
 * a || b is true  
 */
```

Truth table for logical operations

Table 1 : Using **booleans**

a	b	a&&b	a b
false	false	false	false
false	true	false	true
true	false	false	true
true	true	true	true

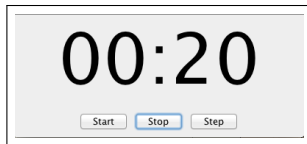
Table 2 : Alternative representation

a	b	a&&b	a b
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	1

NumberDisplay class

NumberDisplay

- Return time to display
- String concatenation used
- Leading zero inserted

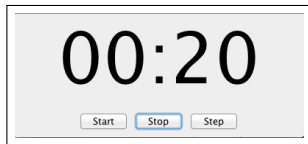


```
public String getDisplayValue()
{
    if(value < 10) {
        return "0" + value;
    }
    else {
        return "" + value;
    }
}
```

NumberDisplay class

NumberDisplay

- Increment time
- Use modulus operator %
- Forces a roll-over to zero at limit

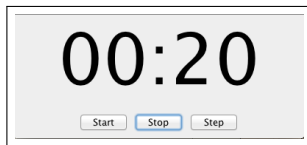


```
public void increment()
{
    value = (value + 1) % limit;
}
```

NumberDisplay class

NumberDisplay

- Increment time
- Use modulus operator %
- Forces a roll-over to zero at limit



Time Start	Time +1	Check limit	End Time
57	58	58%60	58
58	59	59%60	59
59	60	60%60	00
00	01	01%60	01

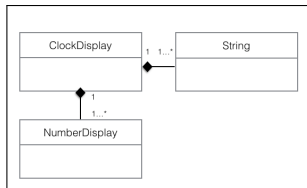
Table 3 : Increment clock minutes display

ClockDisplay class

ClockDisplay composition

Has fields

- *NumberDisplay*
- *String*



```
public class ClockDisplay
{
    private NumberDisplay hours;
    private NumberDisplay minutes;
    private String displayString;
    ...
}
```

ClockDisplay class

ClockDisplay instantiation

Default constructor

- Two new *NumberDisplay* objects
 - Minute display
 - Hour display
- Initializes *limit* attributes
- Sets clock display 00.00

```
public ClockDisplay()
{
    hours = new NumberDisplay(24);
    minutes = new NumberDisplay(60);
    updateDisplay();
}
```

ClockDisplay class

ClockDisplay instantiation

Overloaded constructor

- Two new *NumberDisplay* objects
 - Minute display
 - Hour display
- Initializes *limit* attributes
- Updates clock display

```
public ClockDisplay(int hour, int minute)
{
    hours = new NumberDisplay(24);
    minutes = new NumberDisplay(60);
    setTime(hour, minute);
}
```

ClockDisplay class

Simulate ticking clock

- Advance one minute
- Check minute elapsed
- Then increment hour

```
public void timeTick()
{
    minutes.increment();
    //if minute display zero
    //time to advance an hour
    if(minutes.getValue() == 0) {
        hours.increment();
    }
    updateDisplay(); }
}
```

ClockDisplay class

Update clock display

- Get hour value
- Get minute value
- Concatenate values
- Example display 00:20

```
private void updateDisplay()
{
    displayString = hours.getDisplayValue()
                    + ":"
                    + minutes.getDisplayValue();
}
```


Object reference

this keyword

this: a reference to the current object.

```
public class Circle {  
    public Circle() {  
        System.out.println("this : " + this);  
    }  
}
```

```
public class TestCircle {  
    public TestCircle() {  
        Circle circle = new Circle();  
        System.out.println("circle : " + circle);  
    }  
}
```

```
this : Circle@2f67d81  
circle : Circle@2f67d81
```

Strings

String class

```
String greeting = "Hello ICTSkills group: the future is bright";
```

- Java String class widely used
- Java *Strings* are objects
 - Comprise series of characters
- Direct creation
 - `String s = "this is a string"`
 - "this is a string" is a String literal
- Creation using *new* operator
 - `String s = new String("this is a string")`

Strings

String methods

Extensive set of methods available

- String length
 - `String s = "this is a string";`
 - `int length = s.length;`
 - length is 16
- String concatenation method 1
 - `String s1 = "Hello ";`
 - `String s2 = "ICTSkills group";`
 - `String s3 = s1.concat(s2);`
 - `s3` : *Hello ICTSkills group*
- String concatenation method 2
 - `String s1 = "Hello ";`
 - `String s2 = "ICTSkills group";`
 - `String s3 = s1 + s2;`
 - Result: *Hello ICTSkills group*

Strings

Converting String to number

- `String s = "100.45";`
 - `double d = Double.parseDouble(s);`
 - `System.out.println("d is " + d);`
 - Output: d is 100.45
- `String s = "100";`
 - `int number = Integer.parseInt(s);`
 - `System.out.println("number is " + number);`
 - Output: number is 100

Two members of the **Number** family:

- **Integer** class contains a single field whose type is *int*.
- **Double** class contains a single field whose type is *double*.

Strings

Converting number to String

Method 1 : Concatenate with empty string

- ```
int num = 100;
String s1 = "" + num;
```

### Method 2: Invoke String method *valueOf*

- ```
int num = 100;  
String s1 = String.valueOf(num);
```

Method 3: Use one of *Number* family

- ```
int num = 100;
double dnum = 100.35;
String s1 = Integer.toString(num);
String s2 = Double.toString(dnum);
```

Other *Number* family members are Byte, Float, Long, Short

# Strings

## Comparing String objects

Using *String equals* and *equalsIgnoreCase* methods

- ```
String s0 = "ICTSkills Group";  
String s1 = "ICTSkills group";  
boolean b1 = s0.equals(s1);  
boolean b2 = s0.equalsIgnoreCase(s1);
```
- b1 is *false*
- b2 is *true*

Some other methods are

```
boolean endsWith(String suffix); //true if string ends with suffix  
boolean startsWith(String prefix) //true if string begins with prefix
```

Primitive type conversion

Explicit conversion & explicit cast

Table 4 : **Explicit conversion**

Expression	Type	Value
Math.round(3.14)	long	3
Math.round(2.71)	long	3

Table 5 : **Explicit cast**

Expression	Type	Value
(int)Math.round(3.14)	int	3
(int)3.14	int	3
(int)2.71	int	2

Primitive type conversion

Automatic promotion - no loss of data

Java automatically converts data to type with larger range

- No need for explicit cast

```
double val = 0.3*11; //11 transparently promoted to 11.0
```

```
int b = 10;  
int c = 10;  
int d = b*b - 4*c;  
double e = b*b - 4.0*c;
```


Primitive type conversion

Explicit cast required where loss of data

```
public class Circle {  
    double radius;  
    ...  
    //this will not compile  
    public int getRadius() {return radius;}  
}
```

```
public class Circle {  
    double radius;  
    ...  
    //this will compile  
    public int getRadius() {return (int)radius;}  
}
```

Summary

- Abstraction: focussing on bigger picture at expense of details
- Modularization : decomposing system into components
- Boolean algebra, truth tables, conditional & unary operators
- Primitive type : fundamental variable types such as *int*, *double*
- Class diagram : shows classes of application
- Object diagram : instantaneous view of objects & relationships
- Object instantiation : class constructor invocation
- Overloading : method with same name but various parameters
- Internal method call : method invokes other method same class
- External method call : method calls method other object using dot operator

Referenced material

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