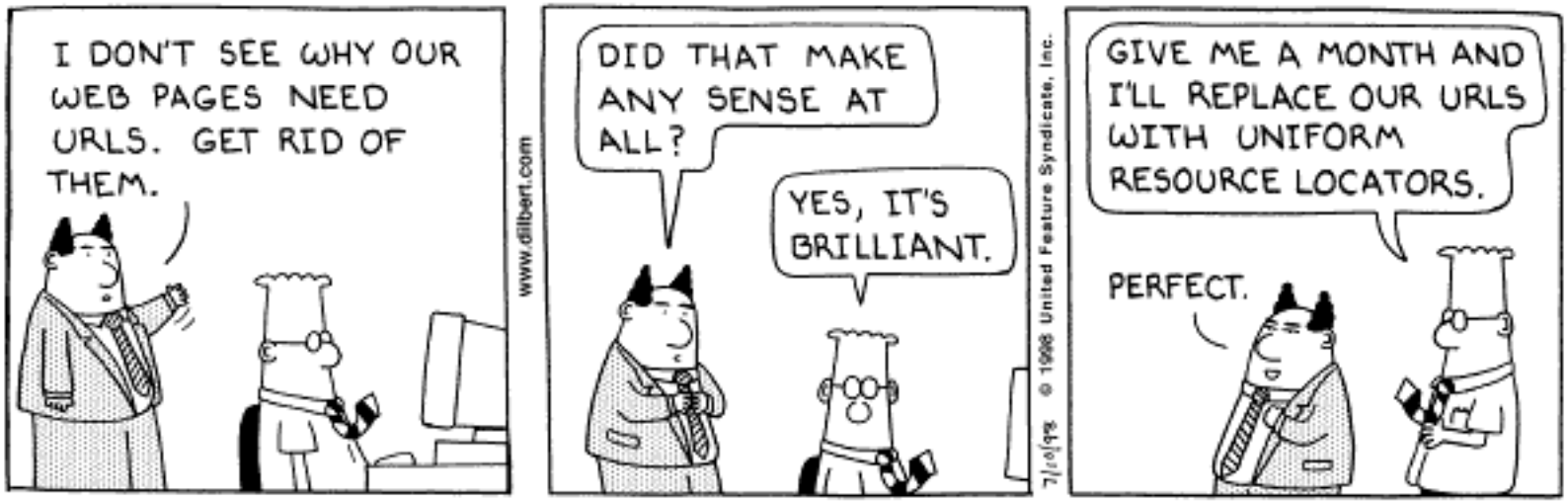
Object Interaction 1

Creating cooperating objects



This week:
Assignment 1 starts

A digital clock

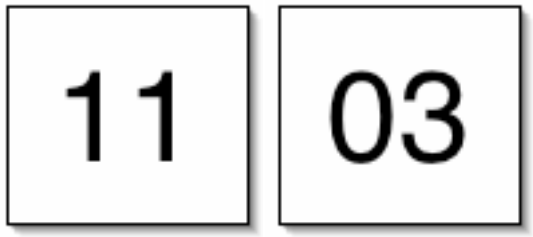
Abstraction and modularisation

- **Abstraction** is the ability to ignore details of parts to focus attention on a higher level of a problem.
- **Modularisation** is the process of dividing a whole into well-defined parts, which can be built and examined separately, and which interact in well-defined ways.

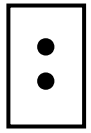
Modularising the clock display

One four-digit display?

Or two two-digit displays?



And a bit of glue ...



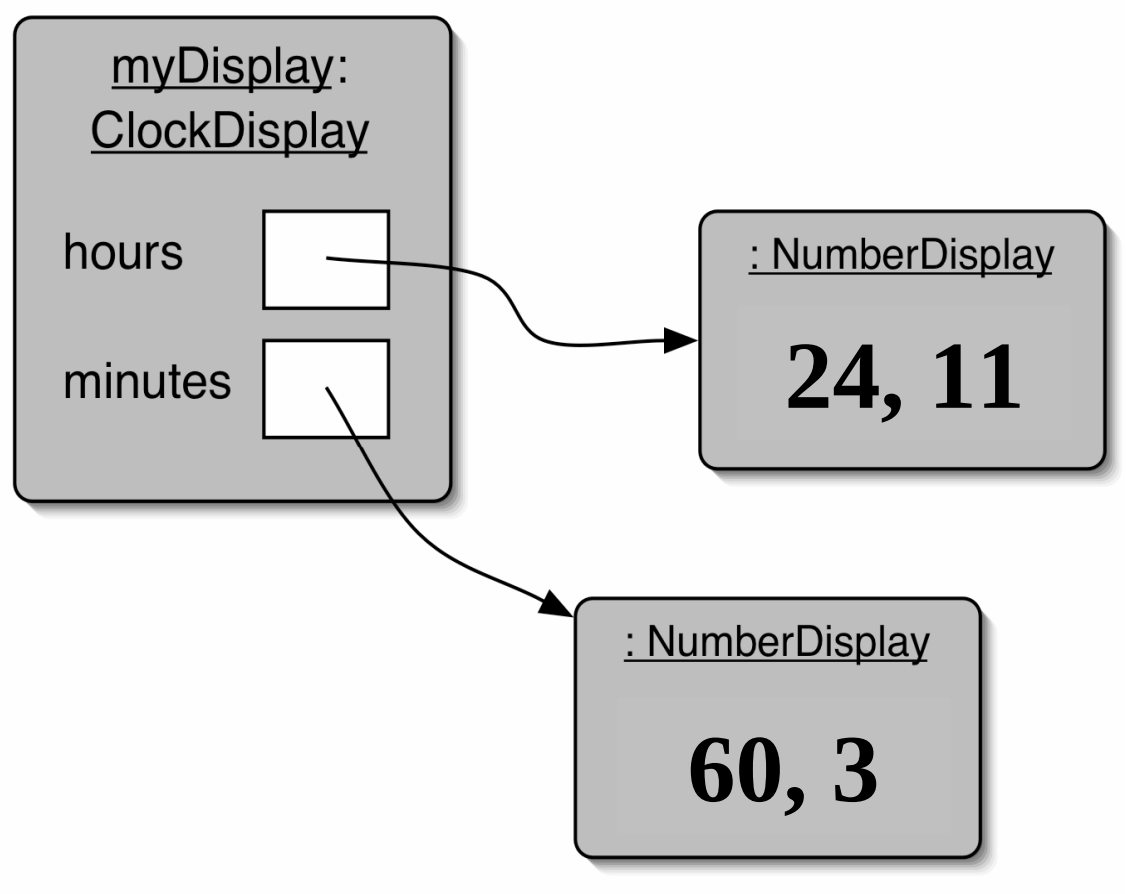
Implementation - NumberDisplay

```
public class NumberDisplay
{
    private int limit;
    private int value;

    ... constructor omitted
    ... methods omitted
}
```

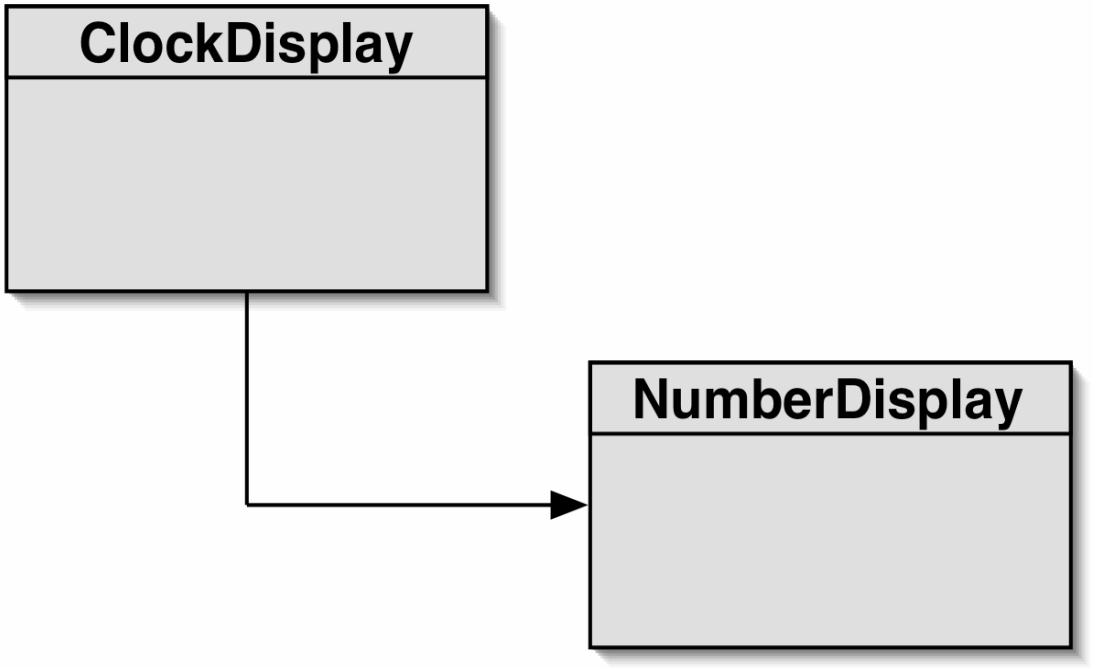
Implementation - ClockDisplay

```
public class ClockDisplay
{
    private NumberDisplay hours;
    private NumberDisplay minutes;

    ... constructor omitted
    ... methods omitted
}
```

Object diagram



Class diagram

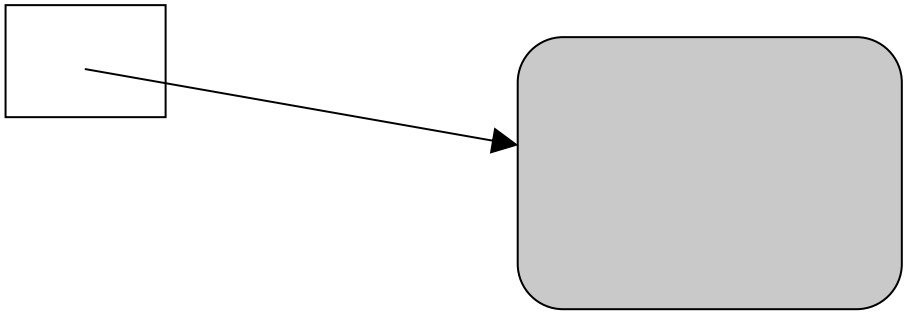


Primitive types vs. Object types

```
int i;
```

primitive type

```
SomeObject obj;
```



object type

Quiz: What is the output?

```
int a;
int b;
a = 42;
b = a;
a = a + 1;                          // has b changed?
System.out.println(b);
```

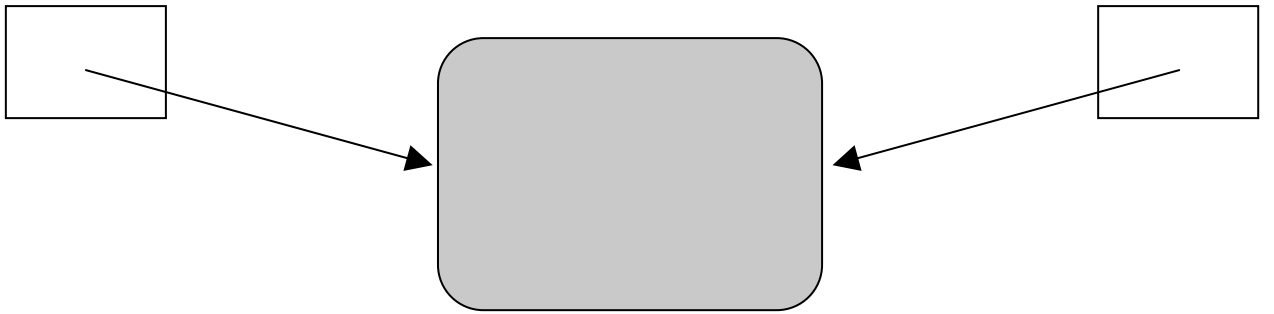
```
Person a;
Person b;
a = new Person("Everett");
b = a;
a.changeName("Delmar");     // has b changed?
System.out.println(b.getName());
```

Primitive types vs. Object types

```
b = a;
```

```
ObjectType a;
```

```
ObjectType b;
```



```
int a;
```

```
int b;
```

Quiz: What is the output?

- ```
  int a;
  int b;
  a = 42;
  b = a;
  a = a + 1;                    // has b changed?
  System.out.println(b);
  ```


- ```
  Person a;
  Person b;
  a = new Person("Everett");
  b = a;
  a.changeName("Delmar");     // has b changed?
  System.out.println(b.getName());
  ```

Source code: NumberDisplay

```
public NumberDisplay(int rollOverLimit)
{
    limit = rollOverLimit;
    value = 0;
}


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

The modulo operator

- The *'division'* operator (*/*), when applied to int operands, returns the *integer result* of an *integer division*.
- The 'modulo' operator (%) returns the *integer remainder* of an *integer division*.
- Example:

  17 / 5 = result 3, remainder 2
- In Java:

  17 / 5 = 3

  17 % 5 = 2

Quiz

- What is the result of the expression `(8 % 3)`
- What are all possible results of the expression `(n % 5)`?

Source code: NumberDisplay

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

Concepts

- abstraction
- modularisation
- primitive types
- object types
- class diagram
- object diagram
- object references