

Test, beauty, cleanness

d'après le cours de
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Problem description

Nous aimerions construire une bibliothèque de graphiques à deux dimensions pour l'édition de dessins structurés

des *Widgets* comme le cercle et rectangle doivent être supportés

des *Opérations* telles que traduire, mettre à l'échelle doivent être offertes

What are the responsibilities?

Containing the widgets

Modeling the widgets

Applying the operations

Version 1

Créer un canvas qui contient les widgets

Testing the canvas

```
public class HotDrawTest {  
    @Test public void testEmptyCanvas() {  
        Canvas canvas = new Canvas ();  
        assertEquals(canvas.getNumberofElements(), 0);  
    }  
}
```

The class Canvas is not created yet!

Creating the class Canvas

```
public class Canvas {  
    public Object getNumberOfElements() {  
        return 0;  
    }  
}
```

Introducing the containment

We need to be able to add objects in a canvas!

```
@Test public void testCanvas() {  
    Canvas canvas = new Canvas ();  
  
    canvas.add(new Object());  
    assertEquals(1, canvas.getNumberOfElements());  
  
    canvas.add(new Object());  
    canvas.add(new Object());  
    assertEquals(3, canvas.getNumberOfElements());  
}
```

Revising the definition of Canvas

```
public class Canvas {
    private ArrayList<Object> elements =
        new ArrayList<Object>();

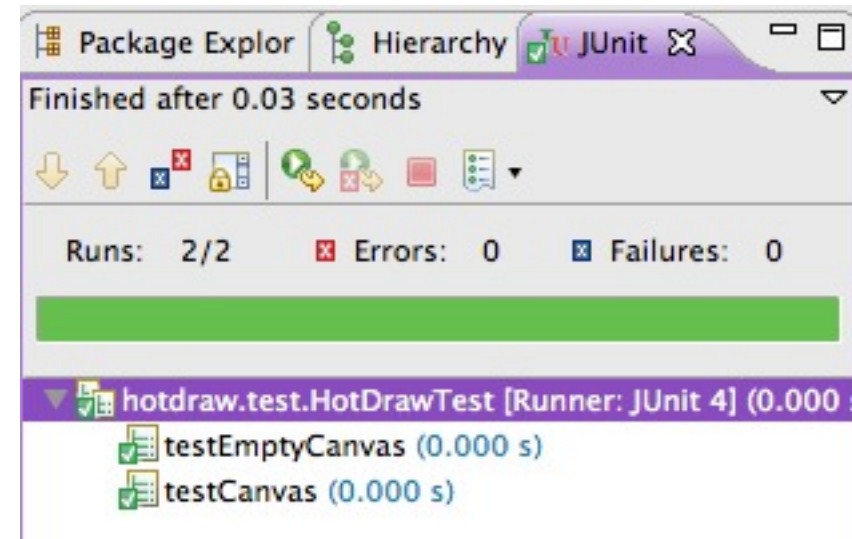
    public int getNumberOfElements() {
        return elements.size();
    }

    public void add(Object object) {
        elements.add(object);
    }
}
```


Revising the definition of Canvas

```
public class Canvas {  
    private ArrayList<Object> elements =  
        new ArrayList<Object>();  
  
    public int getNumberOfElements() {  
        return elements.size();  
    }  
  
    public void add(Object object) {  
        elements.add(object);  
    }  
}
```

Tests are green!



Version 2

Introducing some widgets

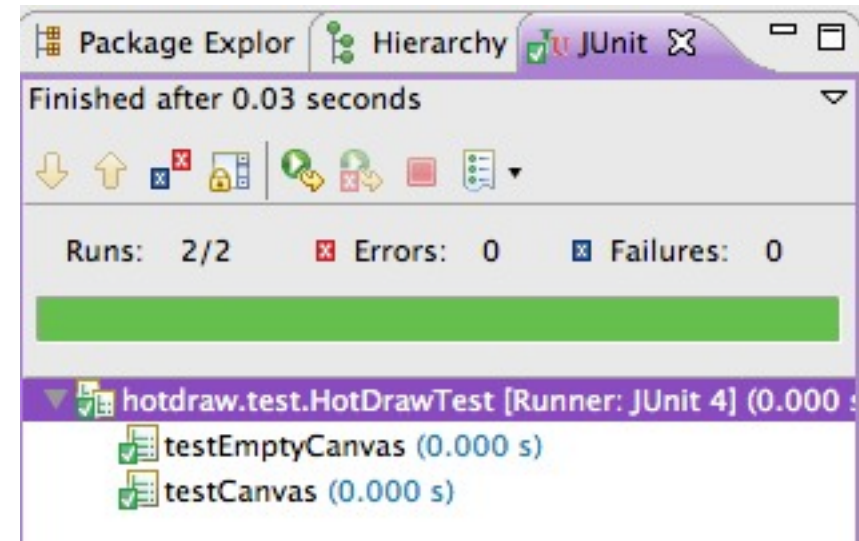
We revise our testCanvas

```
@Test public void testCanvas() {  
    Canvas canvas = new Canvas ();  
  
    canvas.add(new Circle());  
    assertEquals(1, canvas.getNumberofElements());  
  
    canvas.add(new Circle());  
    canvas.add(new Rectangle());  
    assertEquals(3, canvas.getNumberofElements());  
}
```

Circle and Rectangle

```
public class Circle {  
}
```

```
public class Rectangle {  
}
```



Adding position to circle and rectangle

```
@Test public void testCanvas() {
    Canvas canvas = new Canvas ();

    //(10, 20), radius 5
    canvas.add(new Circle(10,20, 5));
    assertEquals(1, canvas.getNumberOfElements());

    canvas.add(new Circle());

    //(5,6) -> (10,8)
    canvas.add(new Rectangle(5, 6, 10, 8));
    assertEquals(3, canvas.getNumberOfElements());
}
```

Generated template

```
public class Circle {  
  
    public Circle(int i, int j, int k) {  
        // TODO Auto-generated constructor stub  
    }  
}
```

Generated template

```
public class Rectangle {  
  
    public Rectangle(int i, int j, int k, int l) {  
        // TODO Auto-generated constructor stub  
    }  
}
```

Filling the template

```
public class Rectangle {
    private int x1, y1, x2, y2;

    public Rectangle() {
        this(2, 3, 5, 6);
    }

    public Rectangle(int x1, int y1, int x2, int y2) {
        this.x1 = x1;
        this.y1 = y1;
        this.x2 = x2;
        this.y2 = y2;
    }
}
```


Version 3

Before moving on, lets step back on what we wrote to see whether there are opportunities for *cleaning* a bit the code

HotDrawTest

```
public class HotDrawTest {  
    @Test public void testEmptyCanvas() {  
        Canvas canvas = new Canvas ();  
        ...  
    }  
  
    @Test public void testCanvas() {  
        Canvas canvas = new Canvas ();  
        ...  
    }  
}
```

HotDrawTest

```
public class HotDrawTest {  
  
    @Test public void testEmptyCanvas() {  
        Canvas canvas = new Canvas ();  
        ...  
    }  
  
    @Test public void testCanvas() {  
        Canvas canvas = new Canvas ();  
        ...  
    }  
}
```



Duplication!

Refactoring our test

```
public class HotDrawTest {
    private Canvas canvas;

    @Before public void initializingFixture() {
        canvas = new Canvas ();
    }

    @Test public void testEmptyCanvas() {
        assertEquals(canvas.getNumberOfElements(), 0);
    }

    @Test public void testCanvas() {
        //(10, 20), radius 5
        canvas.add(new Circle(10,20, 5));
        ...
    }
}
```

Giving a better name to the variable

```
public class HotDrawTest {  
    private Canvas canvas:
```

```
@Before public void  
    canvas = new Can  
}
```

```
@Test public void te  
    assertEquals(can  
}
```

```
@Test public void te  
    //(10, 20), radi  
    canvas.add(new C  
    assertEquals(1,  
  
    canvas.add(new C
```

- Undo Typing F9
- Revert File
- Save
- Open Declaration F3
- Open Type Hierarchy F4
- Open Call Hierarchy ^\H
- Show in Breadcrumb \#B
- Quick Outline #O
- Quick Type Hierarchy #T
- Show In \#W ▶
- Cut ^W
- Copy \W
- Copy Qualified Name
- Paste ^Y
- Quick Fix #1
- Source \#S ▶
- Refactor \#T ▶
- Surround With \#7 ▶

```
, 0);
```

```
s());
```

- Rename... \#R
- Move... \#V

canvas -> emptyCanvas

```
public class HotDrawTest {
    private Canvas emptyCanvas;

    @Before public void initializingFixture() {
        emptyCanvas = new Canvas ();
    }

    @Test public void testEmptyCanvas() {
        assertEquals(emptyCanvas.getNumberOfElements(), 0);
    }

    @Test public void testCanvas() {
        //(10, 20), radius 5
        emptyCanvas.add(new Circle(10,20, 5));
        ...
    }
}
```

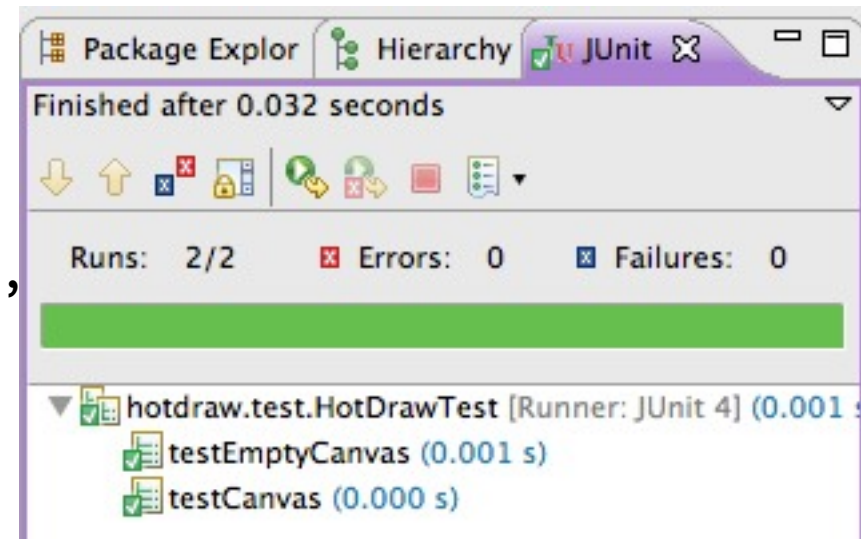
canvas -> emptyCanvas

```
public class HotDrawTest {
    private Canvas emptyCanvas;

    @Before public void initializingFixture() {
        emptyCanvas = new Canvas ();
    }

    @Test public void testEmptyCanvas() {
        assertEquals(emptyCanvas.getNumberOfElements(), 0);
    }

    @Test public void testCanvas() {
        //(10, 20), radius 5
        emptyCanvas.add(new Circle(10,
            ...
        }
    }
}
```



Version 4

Applying the operations on the widget

Note that at that point, *we have not seen the need* to have a *common superclass* for Circle and Rectangle

As well *we have not seen the need* to have a *common interface*

We should be test driven, else it is too easy to go wrong

The class canvas also contains *a list of objects*

Adding an operation

Let's translate our objects

Each widget should now understand the message
translate(deltaX, deltaY)

Let's write some test first

Testing circle first

```
@Test public void translatingCircle() {  
    Circle circle = new Circle();  
    int oldX = circle.getX();  
    int oldY = circle.getY();  
  
    circle.translate(2, 3);  
    assertEquals(circle.getX(), oldX + 2);  
    assertEquals(circle.getY(), oldY + 3);  
}
```

Generate Getters

```
public class (  
private int x
```

```
public Circle(  
    this(5, 5,  
})
```

```
public Circle(  
    this.x = x  
    this.y = y  
    this.radiu  
}  
}
```

The image shows a screenshot of an IDE's context menu. The menu is open over a code editor. The 'Source' menu item is selected, and its sub-menu is visible. In this sub-menu, the 'Generate Getters and Setters...' option is highlighted. Other options in the sub-menu include 'Toggle Comment', 'Remove Block Comment', 'Generate Element Comment', 'Correct Indentation', 'Format', 'Add Import', 'Organize Imports', 'Sort Members...', 'Clean Up...', 'Override/Implement Methods...', 'Generate Delegate Methods...', 'Generate hashCode() and equals()...', 'Generate Constructor using Fields...', and 'Generate Constructors from Superclass...'. The main menu also includes options like 'Open Type Hierarchy', 'Cut', 'Copy', 'Paste', 'Quick Fix', 'Refactor', 'Local History', 'References', 'Run As', 'Debug As', 'Mark as Entry Point', 'Auto-Consult', 'Team', 'Compare With', 'Replace With', 'Topcased', 'KerMeta', and 'Preferences...'. The code in the background is partially visible, showing a class definition with a constructor and a method.

Modifying Circle

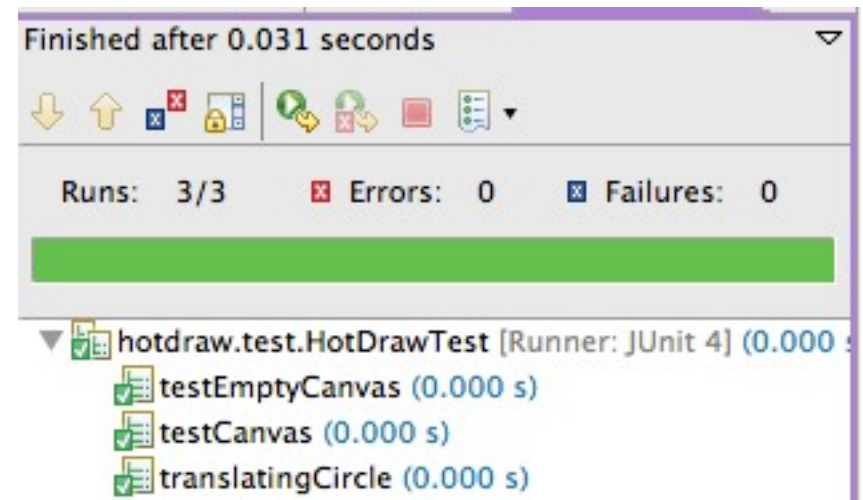
```
public class Circle {  
    private int x, y, radius;  
  
    public int getX() {  
        return x;  
    }  
  
    public int getY() {  
        return y;  
    }  
    ...  
}  
// Note that there is no accessor for radius, we have not  
seen the need of it!
```

Translating Circle

```
public class Circle {  
    ...  
    public void translate(int dx, int dy) {  
        x = x + dx;  
        y = y + dy;  
    }  
    ...  
}
```

Translating Circle

```
public class Circle {  
    ...  
    public void translate(int dx, int dy) {  
        x = x + dx;  
        y = y + dy;  
    }  
    ...  
}
```



Translating the rectangle

```
@Test public void translatingRectangle() {  
    Rectangle rectangle = new Rectangle();  
    int oldX1 = rectangle.getX1();  
    int oldY1 = rectangle.getY1();  
    int oldX2 = rectangle.getX2();  
    int oldY2 = rectangle.getY2();  
  
    rectangle.translate(2, 3);  
    assertEquals(rectangle.getX1(), oldX1 + 2);  
    assertEquals(rectangle.getX2(), oldX2 + 2);  
    assertEquals(rectangle.getY1(), oldY1 + 3);  
    assertEquals(rectangle.getY2(), oldY2 + 3);  
}
```

Updating Rectangle

```
public class Rectangle {  
    ...  
    public int getX1() {...}  
    public int getY1() {...}  
    public int getX2() {...}  
    public int getY2() {  
        return y2;  
    }  
  
    public void translate(int dx, int dy) {  
        x1 = x1 + dx;  
        x2 = x2 + dx;  
        y1 = y1 + dy;  
        y2 = y2 + dy;  
    }  
}
```


Important

Note that we have not still see the need to have a common interface and a common superclass

If you doing it upfront, when *your design will look like what you want it to be, and not what it has to be*

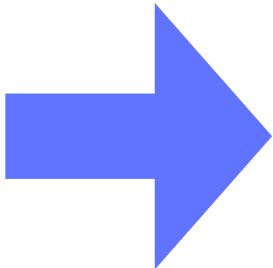
Version 5

It is a bit cumbersome to have to translate each element one by one

Let's ask the canvas to translate all the nodes

Translating the canvas

```
@Test public void translatingTheCanvas() {  
  
    Rectangle rectangle = new Rectangle();  
    int rectangleOldX1 = rectangle.getX1();  
    int rectangleOldY1 = rectangle.getY1();  
    int rectangleOldX2 = rectangle.getX2();  
    int rectangleOldY2 = rectangle.getY2();  
  
    Circle circle = new Circle();  
    int circleOldX = circle.getX();  
    int circleOldY = circle.getY();  
  
    emptyCanvas.add(rectangle);  
    emptyCanvas.add(circle);  
    emptyCanvas.translate(2, 3);  
    ...  
}
```



Translating the canvas

...

```
assertEquals(rectangle.getX1(), rectangleOldX1 + 2);  
assertEquals(rectangle.getX2(), rectangleOldX2 + 2);  
assertEquals(rectangle.getY1(), rectangleOldY1 + 3);  
assertEquals(rectangle.getY2(), rectangleOldY2 + 3);  
assertEquals(circle.getX(), circleOldX + 2);  
assertEquals(circle.getY(), circleOldY + 3);  
}
```

Updating Canvas - what we would like to do

```
public class Canvas {  
  
    private ArrayList<Object> elements =  
        new ArrayList<Object>();  
  
    public void add(Object object) {  
        elements.add(object);  
    }  
  
    public void translate(int dx, int dy) {  
        for(Object o : elements)  
            o.translate(dx, dy);  
    }  
    ...  
}
```

Updating Canvas - what we would like to do

```
public class Canvas {  
    private ArrayList<Object> elements =  
        new ArrayList<Object>();  
  
    public void add(Object object) {  
        elements.add(object);  
    }  
  
    public void translate(int dx, int dy) {  
        for(Object o : elements)  
            o.translate(dx, dy);  
    }  
    ...  
}
```



The compiler will not be happy with this

What is happening?

Only now we see the *need* to introduce a *common interface* that the object have to fulfill

This interface will only be aware of the `translate(dx,dy)` method

Let's introduce the Widget interface

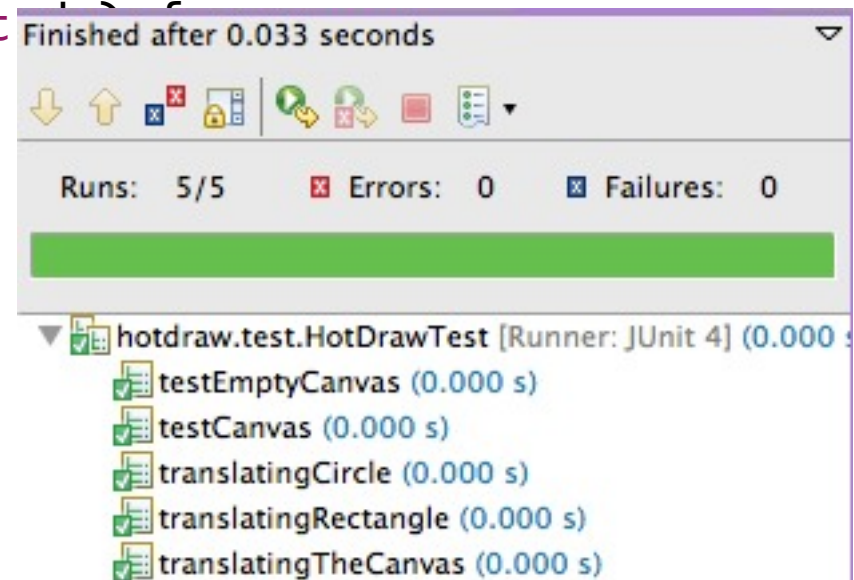
```
public interface Widget {  
    public void translate(int dx, int dy);  
}  
  
public class Rectangle implements Widget {  
    ...  
}  
  
public class Circle implements Widget {  
    ...  
}
```


Updating Canvas

```
public class Canvas {  
    private ArrayList<Widget> elements =  
        new ArrayList<Widget>();  
  
    public void add(Widget widget) {  
        elements.add(widget);  
    }  
  
    public void translate(int dx, int dy) {  
        for(Widget o : elements)  
            o.translate(dx, dy);  
    }  
    ...  
}
```

Updating Canvas

```
public class Canvas {  
    private ArrayList<Widget> elements =  
        new ArrayList<Widget>();  
  
    public void add(Widget widget) {  
        elements.add(widget);  
    }  
  
    public void translate(int dx, int dy) {  
        for(Widget o : elements)  
            o.translate(dx, dy);  
    }  
    ...  
}
```



Version 6

We are doing a pretty good job so far

Let's add a group of widgets that can be commonly manipulated

Testing Group

```
@Test public void groupingWidgets() {  
    Group group = new Group();  
    assertEquals(group.getNumberOfElements(), 0);  
  
    group.add(new Circle());  
    group.add(new Rectangle());  
    assertEquals(group.getNumberOfElements(), 2);  
}
```

Defining Group

```
public class Group {  
    private ArrayList<Object> elements =  
        new ArrayList<Object>();  
  
    public void add(Object w) {  
        elements.add(w);  
    }  
  
    public int getNumberOfElements() {  
        return elements.size();  
    }  
}
```

Defining Group

```
public class Group {  
    private ArrayList<Object> elements =  
        new ArrayList<Object>();  
  
    public void add(Object w) {  
        elements.add(w);  
    }  
  
    public int getNumber() {  
        return elements.size();  
    }  
}
```



Yes! We haven't seen the need to have Widget here

Defining Group

Finished after 0.103 seconds

Runs: 6/6 Errors: 0 Failures: 0

- hotdraw.test.HotDrawTest [Runner: JUnit 4] (0.040 s)
 - testEmptyCanvas (0.000 s)
 - testCanvas (0.000 s)
 - translatingCircle (0.000 s)
 - translatingRectangle (0.000 s)
 - translatingTheCanvas (0.000 s)
 - groupingWidgets (0.039 s)

```
ject> elements =  
.ist<Object>();
```

```
ct w) {
```

```
}
```

```
public int getNumb  
return elements.
```

```
?
```

Yes! We haven't seen the need to have Widget here

This is the proof that we do not need it!

Translating a group - what we could write, but it contains a lot of duplication

```
@Test public void translatingGroup() {  
    Group group = new Group();  
    group.add(new Circle());  
    group.add(new Rectangle());  
    group.translate(...)  
}
```


But let's refactor first

```
public class HotDrawTest {
    private Canvas emptyCanvas;
    private Group emptyGroup, group;
    private Circle circle;
    private Rectangle rectangle;

    @Before public void initializingFixture() {
        emptyCanvas = new Canvas ();
        emptyGroup = new Group();
        group = new Group();
        group.add(circle = new Circle());
        group.add(rectangle = new Rectangle());
    }
}
```

But let's refactor first

```
@Test public void groupingWidgets() {  
    assertEquals(emptyGroup.getNumberofElements(), 0);  
    assertEquals(group.getNumberofElements(), 2);  
}
```

Translating a group

```
@Test public void translatingGroup() {  
    int circleOldX = circle.getX();  
    int circleOldY = circle.getY();  
    int rOldX1 = rectangle.getX1();  
    int rOldY1 = rectangle.getY1();  
  
    group.translate(2, 3);  
  
    assertEquals(rectangle.getX1(), rOldX1 + 2);  
    assertEquals(rectangle.getY1(), rOldY1 + 3);  
    assertEquals(circle.getX(), circleOldX + 2);  
    assertEquals(circle.getY(), circleOldY + 3);  
}
```

Translating a group

```
public class Group {
    private ArrayList<Widget> elements =
        new ArrayList<Widget>();

    public void add(Widget w) {
        elements.add(w);
    }

    public int getNumberOfElements() {
        return elements.size();
    }

    public void translate(int i, int j) {
        for(Widget w : elements)
            w.translate(i, j);
    }
}
```

Translating a group

```
public class Group {  
    private ArrayList<Widget> elements =  
        new ArrayList<Widget>();  
  
    public void add(Widget w) {  
        elements.add(w);  
    }  
  
    public int getNumberOfElements() {  
        return elements.size();  
    }  
  
    public void translate(int i, int j) {  
        for(Widget w : elements)  
            w.translate(i, j);  
    }  
}
```



Yes, we need an array
of Widgets

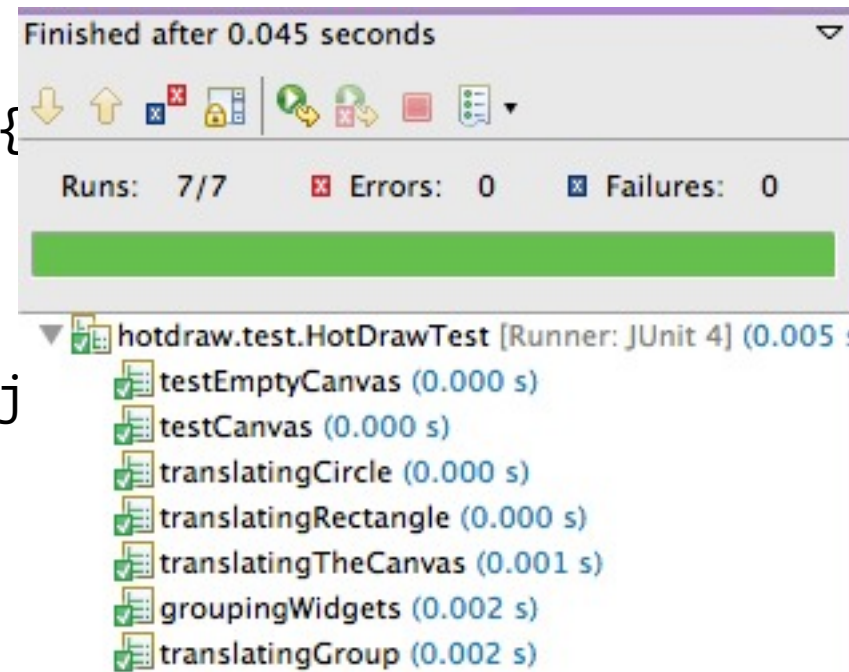
Translating a group

```
public class Group {
    private ArrayList<Widget> elements =
        new ArrayList<Widget>();

    public void add(Widget w) {
        elements.add(w);
    }

    public int getNumberOfElements() {
        return elements.size();
    }

    public void translate(int i, int j
        for(Widget w : elements)
            w.translate(i, j);
    }
}
```



Version 7

Let's refactor Canvas

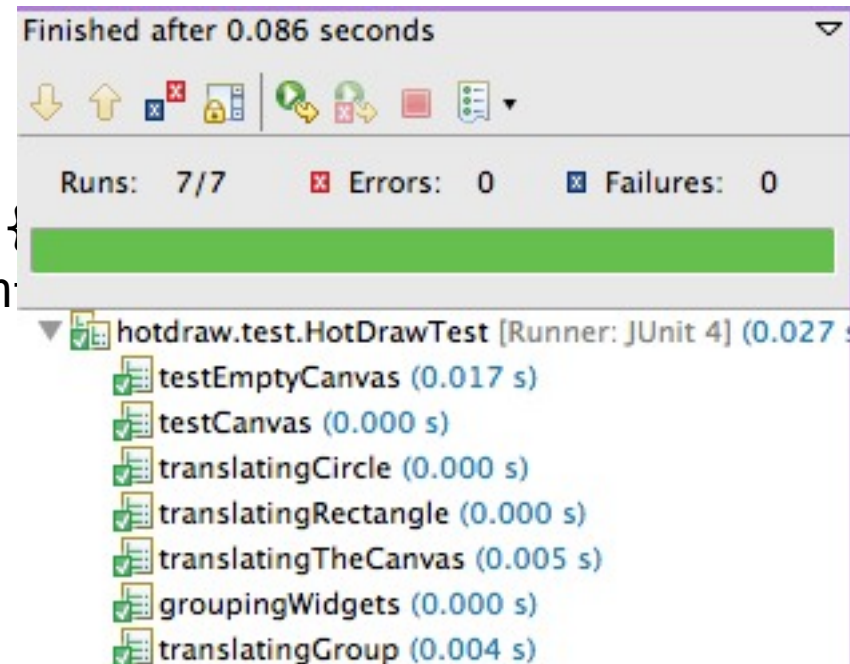
instead of containing a list of elements, it will solely contain a group

Canvas is getting simpler

```
public class Canvas {  
    private Group group = new Group();  
  
    public void add(Widget widget) {  
        group.add(widget);  
    }  
  
    public void translate(int dx, int dy) {  
        group.translate(dx, dy);  
    }  
  
    public int getNumberOfElements() {  
        return group.getNumberOfElements();  
    }  
}
```


Canvas is getting simpler

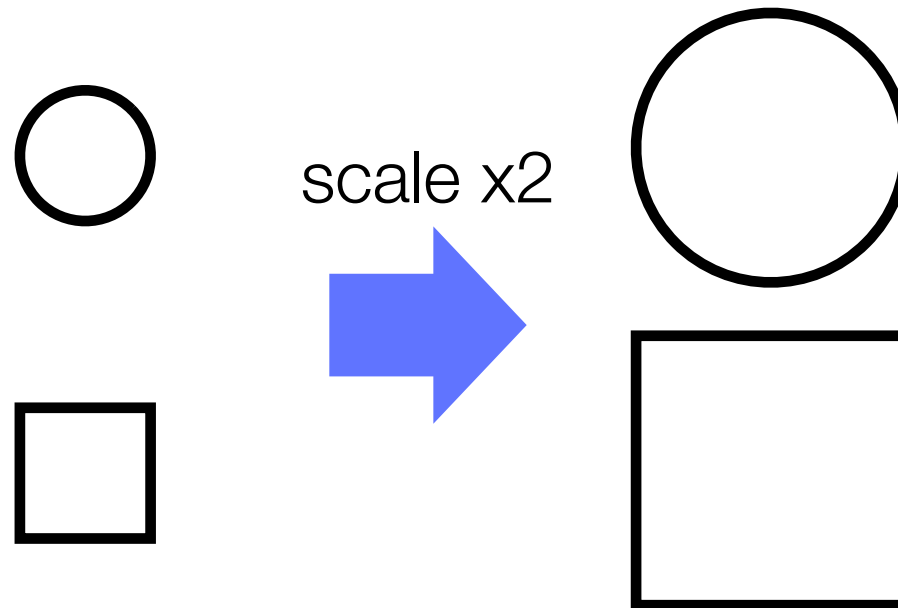
```
public class Canvas {  
    private Group group = new Group();  
  
    public void add(Widget widget) {  
        group.add(widget);  
    }  
  
    public void translate(int dx, int dy) {  
        group.translate(dx, dy);  
    }  
  
    public int getNumberOfElements() {  
        return group.getNumberOfElements();  
    }  
}
```



Version 8

Adding a new operation

We will now scale objects



Adding a test for scalability

```
@Test public void scalingGroup() {  
    int oldRadius = circle.radius();  
    int rectangleWidth = rectangle.width();  
    int rectangleHeight = rectangle.height();  
  
    group.scale(2);  
  
    assertEquals(circle.radius(), 2 * oldRadius);  
    assertEquals(rectangle.width(), 2 * rectangleWidth);  
    assertEquals(rectangle.height(), 2 * rectangleHeight);  
}
```

Adding a test for scalability

Accessing
radius

```
@Test public void scalingGroup() {  
    int oldRadius = circle.radius();  
    int rectangleWidth = rectangle.width();  
    int rectangleHeight = rectangle.height();  
  
    group.scale(2);  
  
    assertEquals(circle.radius(), 2 * oldRadius);  
    assertEquals(rectangle.width(), 2 * rectangleWidth);  
    assertEquals(rectangle.height(), 2 * rectangleHeight);  
}
```

Accessing
width and height

Updating Circle

```
public class Circle implements Widget {  
    private int x, y, radius;  
  
    public int radius() {  
        return radius;  
    }  
    ...  
}
```

Updating Rectangle

```
public class Rectangle implements Widget {  
    public int width() {  
        return Math.abs(x2 - x1);  
    }  
  
    public int height() {  
        return Math.abs(y2 - y1);  
    }  
    ...  
}
```

Scalability

```
public class Group {  
    public void scale(double s) {  
        for(Widget w : elements)  
            w.scale(s);  
    }  
    ... }  
}
```

```
public interface Widget {  
    ...  
    public void scale(double s); }  
}
```

```
public class Circle implements Widget {  
    public void scale(double s) {  
        radius *= s;  
    }  
}
```

```
public class Rectangle implements Widget {  
    public void scale(double s) {  
        x1 *= s; y1 *= s; x2 *= s; y2 *= s;  
    }  
}
```

Scalability

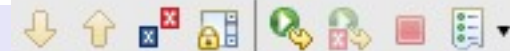
```
public class Group {  
    public void scale(double s) {  
        for(Widget w : elements)  
            w.scale(s);  
    }  
    ... }  
}
```

```
public interface Widget {  
    ...  
    public void scale(double s); }  
}
```

```
public class Circle implements Widget {  
    public void scale(double s) {  
        radius *= s;  
    }  
}
```

```
public class Rectangle implements Widget {  
    public void scale(double s) {  
        x1 *= s; y1 *= s; x2 *= s; y2 *= s;  
    }  
}
```

Finished after 0.032 seconds



Runs: 8/8 Errors: 0 Failures: 0

hotdraw.test.HotDrawTest [Runner: JUnit 4] (0.001 s)

- testEmptyCanvas (0.001 s)
- testCanvas (0.000 s)
- translatingCircle (0.000 s)
- translatingRectangle (0.000 s)
- translatingTheCanvas (0.000 s)
- groupingWidgets (0.000 s)
- translatingGroup (0.000 s)
- scalingGroup (0.000 s)

Version 10

Making group recursive

A group can now contain a group

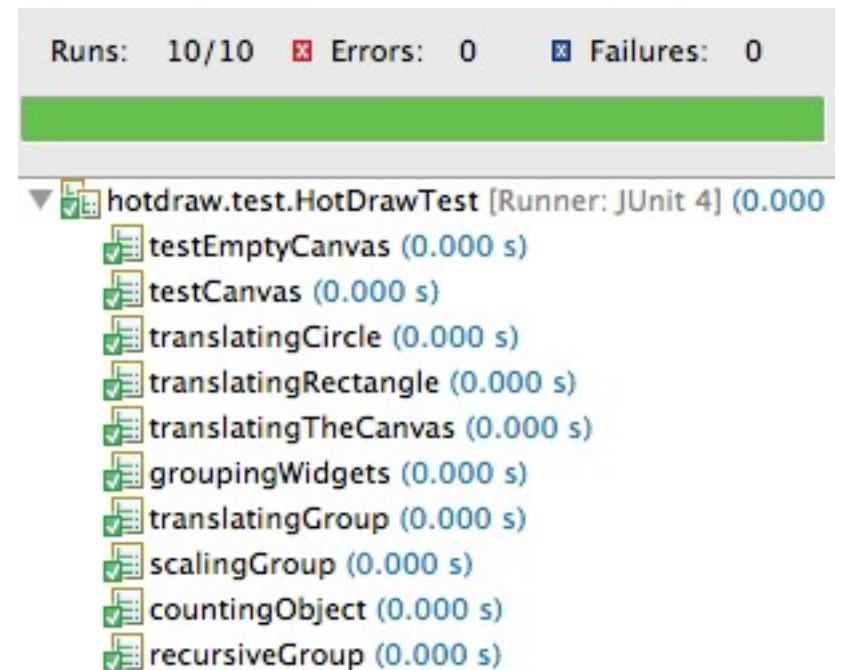
Recursive group

```
@Test public void recursiveGroup() {  
    Group unGroup = new Group();  
    unGroup.add(emptyGroup);  
    group.add(unGroup);  
    assertEquals(emptyGroup.getNumberofElements(), 0);  
    assertEquals(unGroup.getNumberofElements(), 1);  
    assertEquals(group.getNumberofElements(), 3);  
}
```

```
group = new Group();  
group.add(circle = new Circle());  
group.add(rectangle = new Rectangle());
```

Group implement Widget

```
public class Group implements Widget {  
    ...  
}
```





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- to copy, distribute, display, and perform the work
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