

Object Oriented Programming with Java

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Lecture 12 -- Graphics

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Overview of Lecture

- Java 1.0 and Java 1.2 (Java 2D) graphics models
- Basic 2D line graphics
- 2D Coordinates
- Using float and double with coordinates and shapes
- Some Java 2D classes: points, rectangles, ellipses, lines
- Example application which draws some 2D shapes

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1 Graphics in 2D

Basic graphics from Java 1.0:

- draw text and lines (only 1 pixel wide)
- set fonts and colours
- display images from a file

Java 1.2 adds *Java 2D* library which has a richer model

- draw lines of any width
- fill shapes with gradients and textures
- move, rotate, scale and shear text and images
- overlay text and images

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2 Drawing in Java 2D

To use Java 2D classes we must cast the graphics object that methods like `paintComponent` receive into a `Graphics2D` object:

```
public void paintComponent(Graphics g) {  
    Graphics2D g2 = (Graphics2D) g;  
    ...  
}
```

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2 Drawing Shapes

Java 2D provides many shapes

To draw a shape:

1. Create an object which implements `Shape` interface (Java provides lines, rectangles, ellipses...)
2. Pass object to `draw` method of `Graphics2D`

```
Rectangle2D rect = ...; // details later  
g2.draw(rect);
```

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3 Coordinates

Upper left corner has coordinate(0,0)

Positive coordinates are (horizontal, vertical) (also called (x,y)) offsets from upper left corner
i.e. coordinates measure how far down and right you are

(0,0) is hidden by window title bar - use a big enough y-value to be visible

Container has a `getInsets()` method which returns an `Insets` object telling you what the visible area is

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4 Coordinates and Types

In Java 1.0 the units are *pixels* and coded as ints

In Java 2D coordinates are floats

```
float f = 1.2; // error: 1.2 is a double
float f = 1.2F;

Rectangle2D r = ...
float f = r.getWidth(); // error: getWidth
                        // returns double
float f = (float) r.getWidth();
```

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4 Shapes and Types

Java 2D provides 2 versions of each shape class:

- one with float coordinates - e.g. Rectangle2D.Float
- one with double coordinates - e.g. Rectangle2D.Double

These are both static inner classes of Rectangle2D

We can store both types in Rectangle2D objects:

```
Rectangle2D floatRect = new Rectangle2D.Float(10.0F,
25.0F, 5.0F, 5.0F);
Rectangle2D doubleRect = new Rectangle2D.Double(10.0,
25.0, 5, 5);
```

So only use inner classes when creating shapes

Float version saves a little memory

But using double version is easier

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5 Some Java 2D Classes

Point2D is very useful for working with coordinates

```
Point2D p = new Point2D.Double(10,20);
```

Some shapes:

```
Rectangle2D.Double(double x, double y, double
width, double height)
```

```
Ellipse2D.Double(double x, double y, double
width, double height)
```

```
Line2D.Double(Point2D start, Point2D end)
```

```
Line2D.Double(double startX, double startY,
double endX, double endY)
```

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5 Rectangular Shapes

Ellipse2D and Rectangle2D both inherit from
java.awt.geom.RectangularShape

return values of enclosing rectangle

```
double getCenterX()
double getCenterY()
double getMinX()
double getMinY()
double getMaxX()
double getMaxY()
double getWidth()
double getHeight()
```

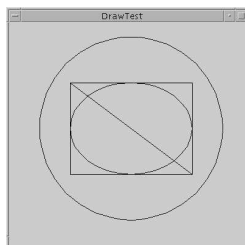
return x/y coordinate of top-left corner of enclosing rectangle

```
double getX()
double getY()
```

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6 Example: DrawTest.java

See web for full code of
DrawTest.java



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6 Part listing of DrawTest.java (1/2)

```
/**
 * A panel that displays rectangles and ellipses.
 */
class DrawPanel extends JPanel
{
    public void paintComponent(Graphics g)
    {
        super.paintComponent(g);
        Graphics2D g2 = (Graphics2D)g;

        // draw a rectangle

        double leftX = 100;
        double topY = 100;
        double width = 200;
        double height = 150;

        Rectangle2D rect = new Rectangle2D.Double(leftX, topY,
            width, height);
        g2.draw(rect);
    }
}
```

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6 Part listing of DrawTest.java (2/2)

```
// draw the enclosed ellipse

Ellipse2D ellipse = new Ellipse2D.Double();
ellipse setFrame(rect);
g2.draw(ellipse);

// draw a diagonal line
g2.draw(new Line2D.Double(leftX, topY,
    leftX + width, topY + height));

// draw a circle with the same center
double centerX = rect.getCenterX();
double centerY = rect.getCenterY();
double radius = 150;

Ellipse2D circle = new Ellipse2D.Double();
circle.setFrameFromCenter(centerX, centerY,
    centerX + radius, centerY + radius);
g2.draw(circle);
}
}
```

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Further Reading

Core Java Vol. 1 chapter 7

- Colours
- Text and fonts
- Images

Core Java Vol. 2 chapter 7

- Areas
- Coordinate transformations
- Clipping
- Reading/writing/manipulating images
- Printing
- Clipboard
- Drag and Drop
- ... and more

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Further Reading

See

<http://java.sun.com/docs/books/tutorial/2d/index.html>

for a tutorial

Test yourself

- Java 2D Library
- Insets object
- Pixel

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