Lecture 4: Graphics and Lists

CS 62

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Graphics

- Create objects you want to draw:
  - **`Rectangle2D.Double`**, **`Line.Double`**, etc.
  - Constructors take x,y coords and dimensions, but don't actually draw items.

- All drawing takes place in **`paint`** method using a "graphics context"
  - an object you can use to draw graphics primitives

- Triggered implicitly by uncovering window or explicitly by calling **`repaint`** method.
  - Adds **`repaint`** event to event queue – eventually draws it

Graphics context

- All drawing is done in `paint` method of component
- `public void paint(Graphics g)`
  - `g` is a Graphics context provided by system
  - "pen" that does the drawing
  - Programmer calls `repaint()`, not `paint()`!!
- Need to import classes from **`java.awt.*`**, **`java.geom.*`**, **`javax.swing.*`**
- See **`MyGraphicsDemo`**

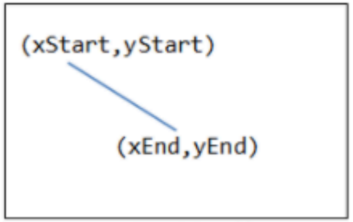
General Graphics Applications

- Create an extension of component (either `JPanel`, `JFrame`, or `JApplet`) and implement `paint` method in the subclass.
  - See main method of demo to get window to show
  - At start of paint method cast `g` to `Graphics2D` to get access to new methods

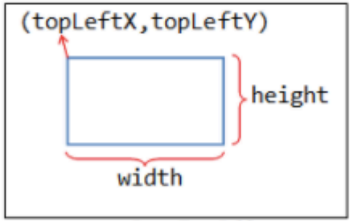
- Call `repaint()` on component every time you make a change.
    - Causes OS to schedule call of paint in event queue
    - Called automatically if window obscured and revealed

Geometric Objects

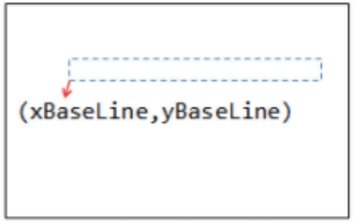
- Objects from classes **`Rectangle2D.Double`**, **`Line2D.Double`**, etc. from **`java.awt.geom`**
  - There are also float versions
  - Constructors take params x, y, width, height, but don't draw object
- **`Rectangle2D.Double`**
- **`RoundRectangle2D.Double`**
- **`Ellipse2D.Double`**
- **`Arc2D.Double`**
- **`Line2D.Double`**, …



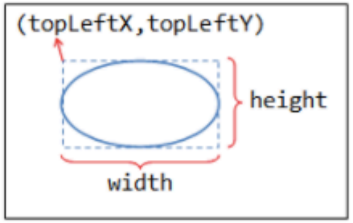
drawLine()



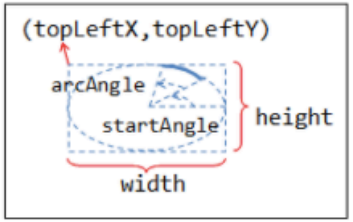
drawRect()



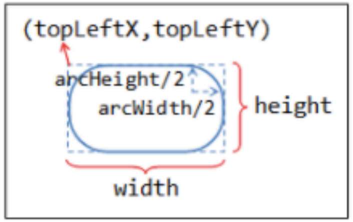
drawString()



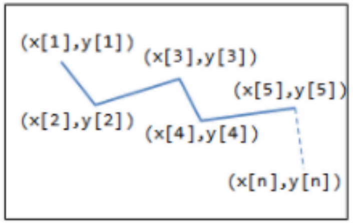
drawOval()



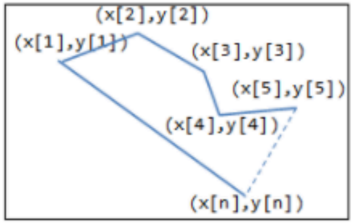
drawArc()



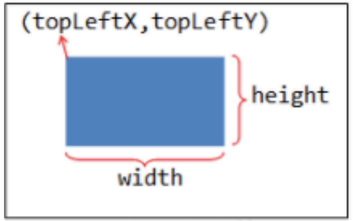
drawRoundRect()



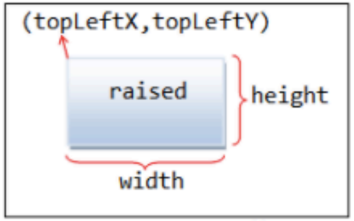
drawPolyline()



drawPolygon()

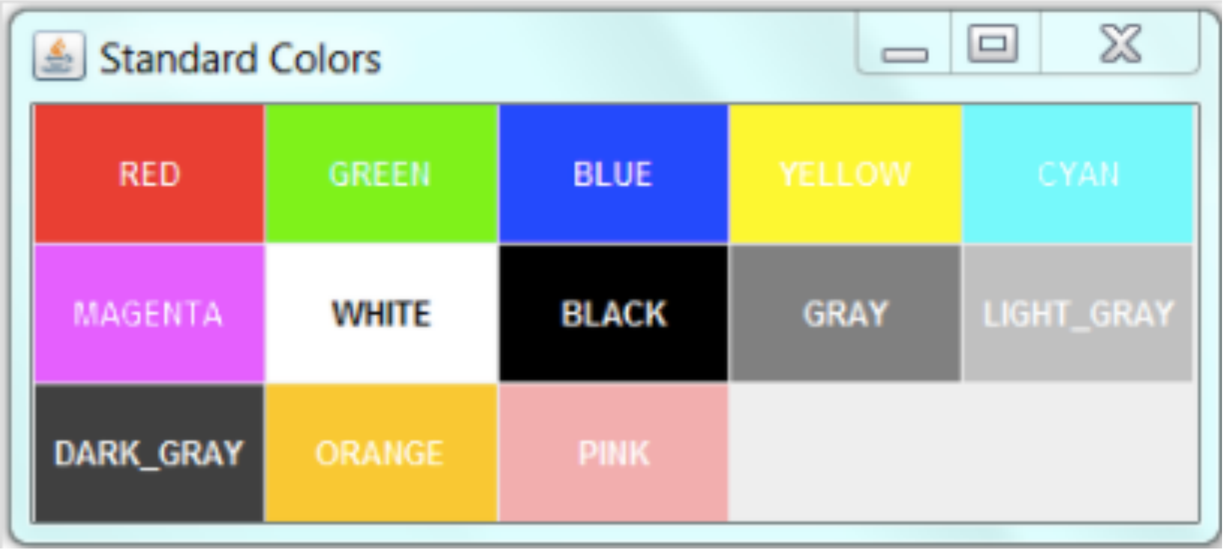


fillRect()



fill3DRect()

java.awt.Color



Standard Colors

RED	GREEN	BLUE	YELLOW	CYAN
MAGENTA	WHITE	BLACK	GRAY	LIGHT_GRAY
DARK_GRAY	ORANGE	PINK		

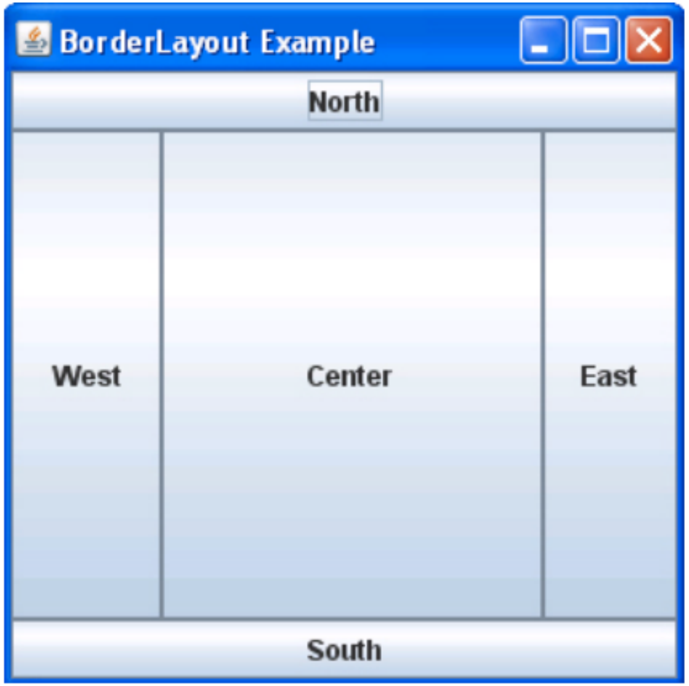
Methods

- `myObj.setFrame(x,y,width,height)` : can move object
- `g2.draw(myObj)` : gives outline
- `g2.fill(myObj)` : gives filled version
- `g2.drawString(“a string”,x,y)` : draws string

`MyGraphicsDemo`

- Class extends **`JFrame`**, which creates window.
- Constructor calls **`super`** with title of window.
- **`main`** method creates object, sets size, visibility, and enables go-away box.
- **`paint`** method creates and draws objects.

BorderLayout



PostItApplication

- More sophisticated.
- **JFrame** contains two **JPanels**.
- **JFrame** uses **BorderLayout**, so add controls to **Jpanel** in **SOUTH**, drawing canvas in **CENTER** of the **JFrame**.
- **DrawingCanvas** extends **JPanel** -- contains **paint** method
  - Note use of **ArrayList** to hold **PostIts**.

`PostIt`

- Represents the rectangles being dragged:
  - Contains getter(accessor) and setter(mutator) methods to allow it to be manipulated by drawing program.
  - Could add features (title bar, go-away box) without affecting **`PostItApplication`** code.

PostItApplication

- **PostItApplication** class responsible for
  - setting up the GUI
  - Responding to button pressed and menu selections
  - Sets up **ArrayList** of items on canvas.
- Class has 3 inner classes
  - **DrawingCanvas**
  - **DrawingMouseListener**
  - **DrawingMouseMotionListener**
  - *Inner classes have access to private features of containing class*

`List` Operations

- Review list operations from library interface **`List`** in Java 8 documentation.
  - Bailey's List is slightly different.

- Think about how to implement with array.

- **`size`**, **`isEmpty`**, **`get`**, **`set`** functions

ArrayList

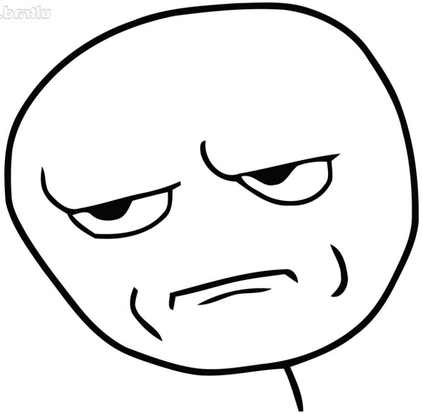
- See Bailey's **ArrayIndexList**
  - Similar to Java 8's **ArrayList**
  - Instance variables:
    - **elts**: array instance variable,
    - **eltsFilled**: number of slots filled.
- Some operations very cheap:
  - **size**, **isEmpty**, **get**, **set** take constant time (no search)
- Others more expensive

Lab and Assignment 1

- Strip with 12 squares and 5 silver dollars placed randomly on the board.
- Move silver dollars to fill 5 leftmost squares
- Coins move only to the left.
- No coin may pass another.
- No square may hold more than one coin.
- Last person to move wins.
- Complete description in textbook.

Arrays

- `int arr[] = new int[10]`
- Hold a sequence of primitives or objects.
- Public instance variable `length`
- Fixed length
- Don’t play nice with generics



`ArrayList`

- `import java.util.ArrayList`
- `class ArrayList<E> implements List<E>`
- Important methods:
  - `add, get, set, indexOf, isEmpty, remove, size, contains, clear`

  - `size, isEmpty, get, set` → constant time
  - `add(E e)` → "amortized constant" time

- See javadoc at: https://docs.oracle.com/javase/8/docs/api/
- Text uses `Vector` instead of `ArrayList`.
  - `ArrayList` more efficient if no concurrency