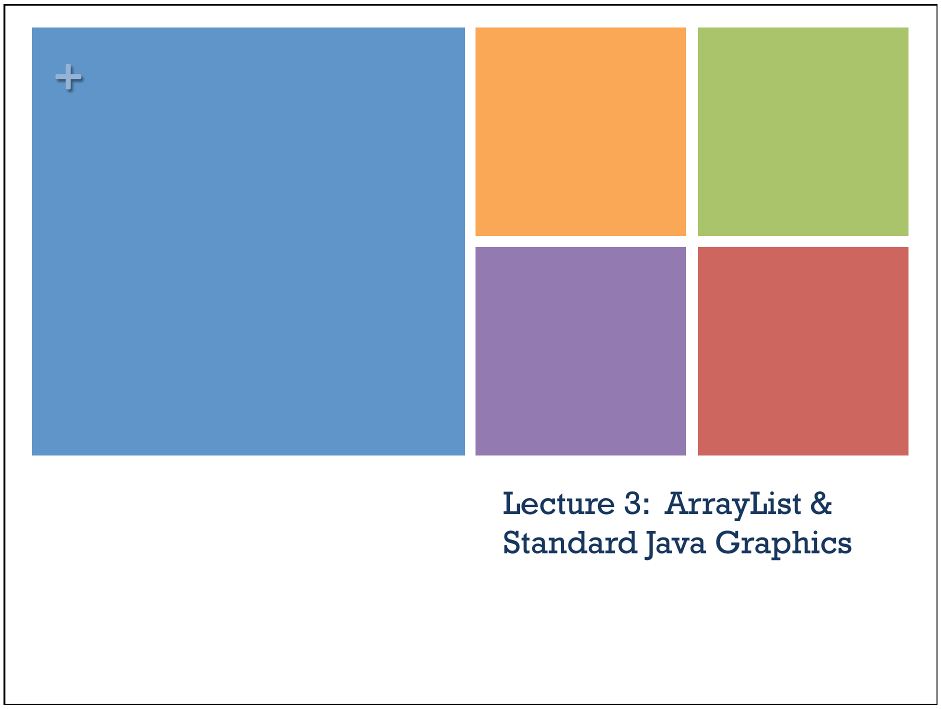

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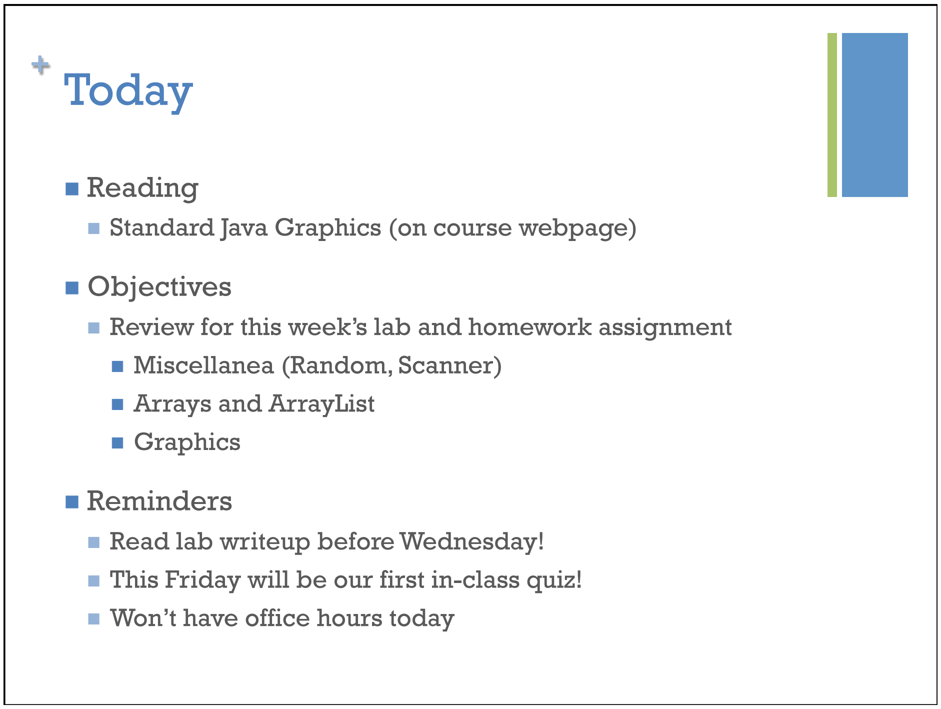
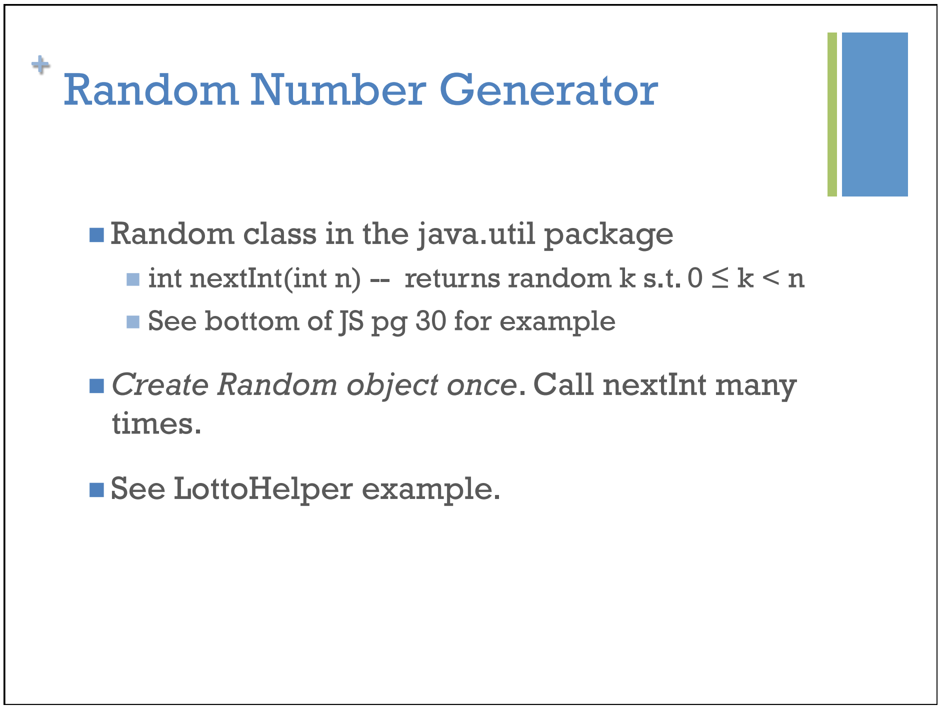
Lecture 3: ArrayList & Standard Java Graphics



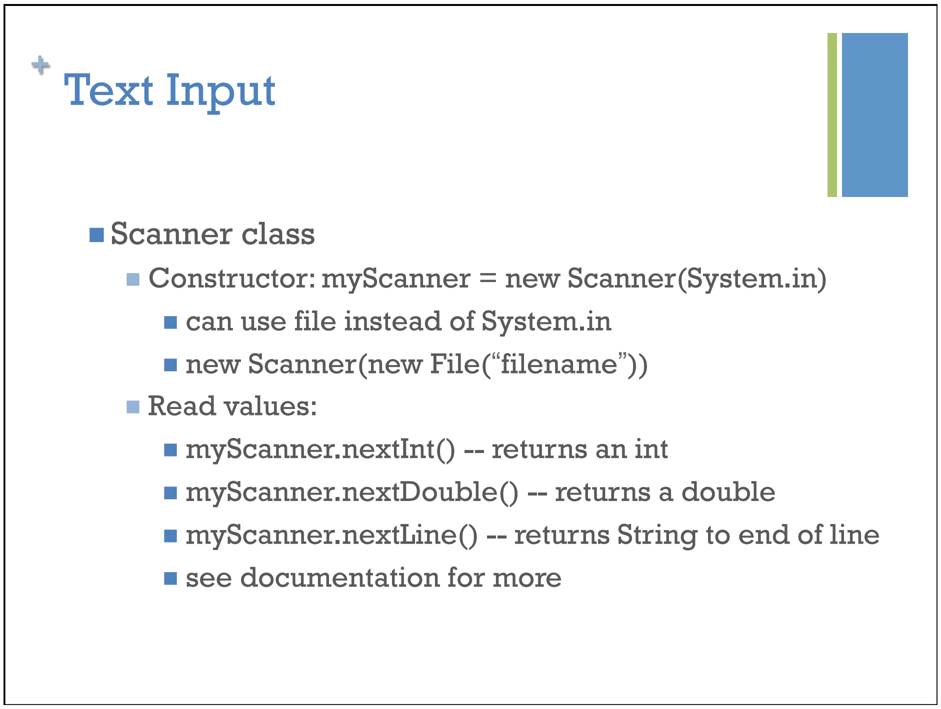
+ Today

- Reading
  - Standard Java Graphics (on course webpage)
- Objectives
  - Review for this week's lab and homework assignment
    - Miscellanea (Random, Scanner)
    - Arrays and ArrayList
    - Graphics
- Reminders
  - Read lab writeup before Wednesday!
  - This Friday will be our first in-class quiz!
  - Won't have office hours today



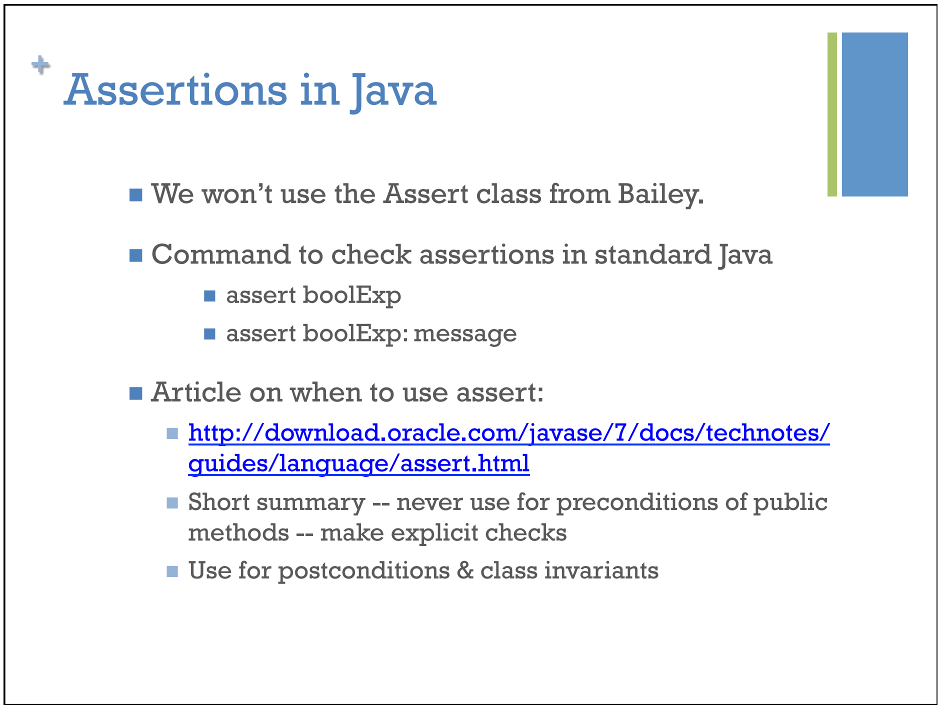
Random Number Generator

- Random class in the java.util package
  - int nextInt(int n) -- returns random k s.t. 0 ≤ k < n
  - See bottom of JS pg 30 for example
- *Create Random object once*. Call nextInt many times.
- See LottoHelper example.



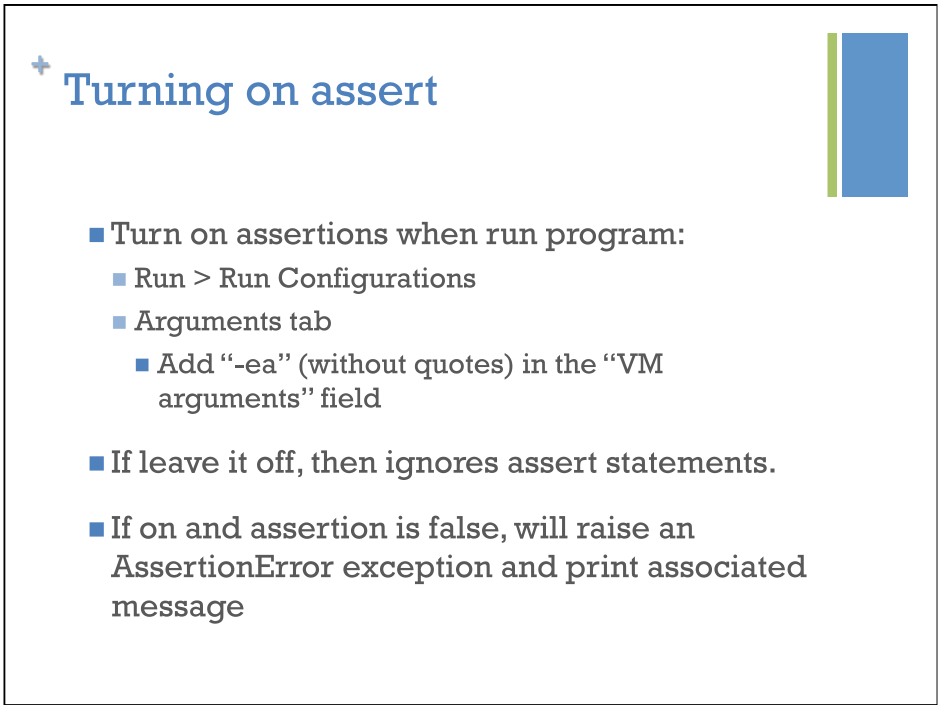
Text Input

- Scanner class
  - Constructor: myScanner = new Scanner(System.in)
    - can use file instead of System.in
    - new Scanner(new File(“filename”))
  - Read values:
    - myScanner.nextInt() -- returns an int
    - myScanner.nextDouble() -- returns a double
    - myScanner.nextLine() -- returns String to end of line
    - see documentation for more



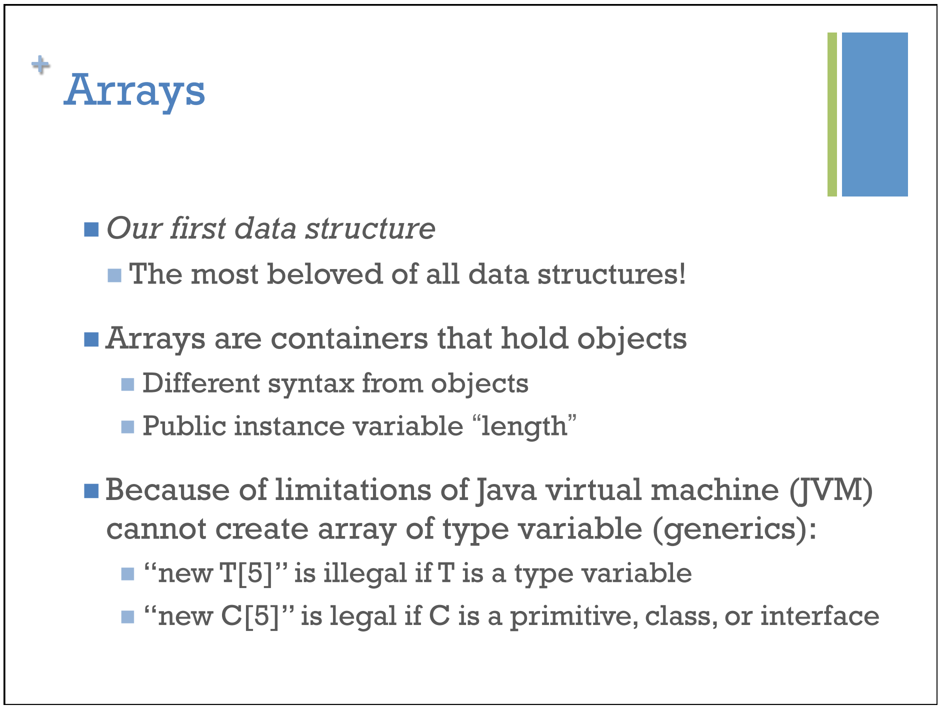
Assertions in Java

- We won't use the Assert class from Bailey.
- Command to check assertions in standard Java
  - assert boolExp
  - assert boolExp: message
- Article on when to use assert:
  - http://download.oracle.com/javase/7/docs/technotes/guides/language/assert.html
  - Short summary -- never use for preconditions of public methods -- make explicit checks
  - Use for postconditions & class invariants



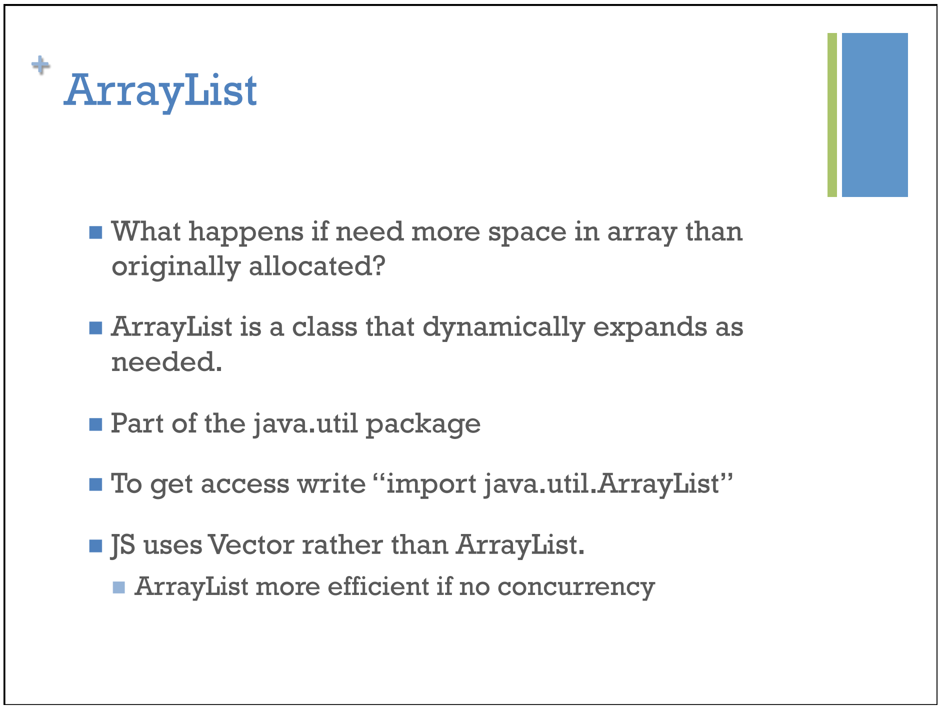
Turning on assert

- Turn on assertions when run program:
  - Run > Run Configurations
  - Arguments tab
    - Add "-ea" (without quotes) in the "VM arguments" field
- If leave it off, then ignores assert statements.
- If on and assertion is false, will raise an AssertionError exception and print associated message



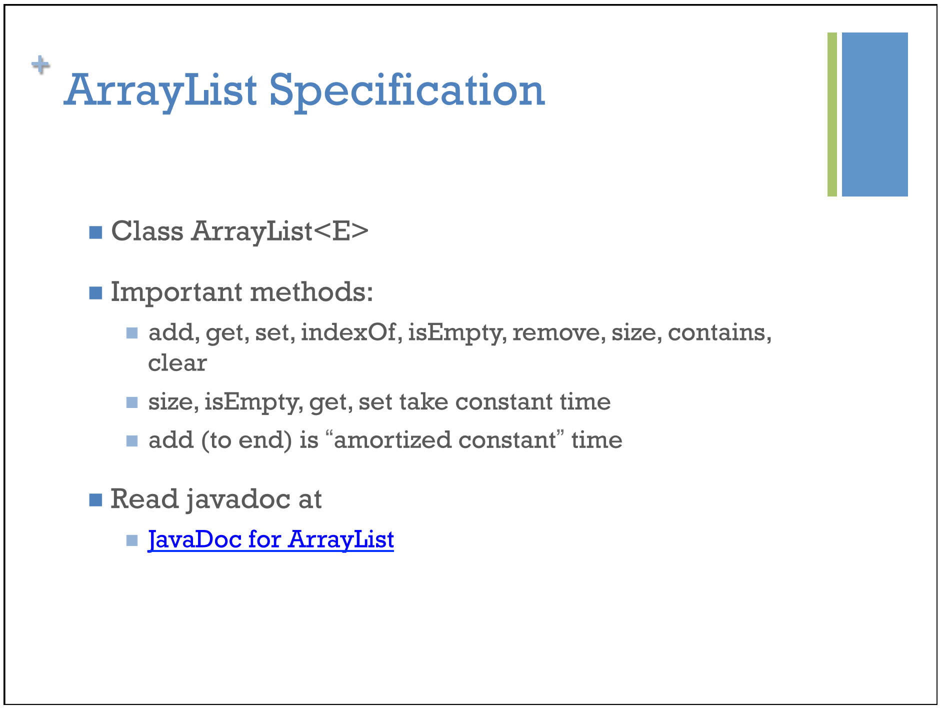
Arrays

- *Our first data structure*
  - The most beloved of all data structures!
- Arrays are containers that hold objects
  - Different syntax from objects
  - Public instance variable "length"
- Because of limitations of Java virtual machine (JVM) cannot create array of type variable (generics):
  - "new T[5]" is illegal if T is a type variable
  - "new C[5]" is legal if C is a primitive, class, or interface



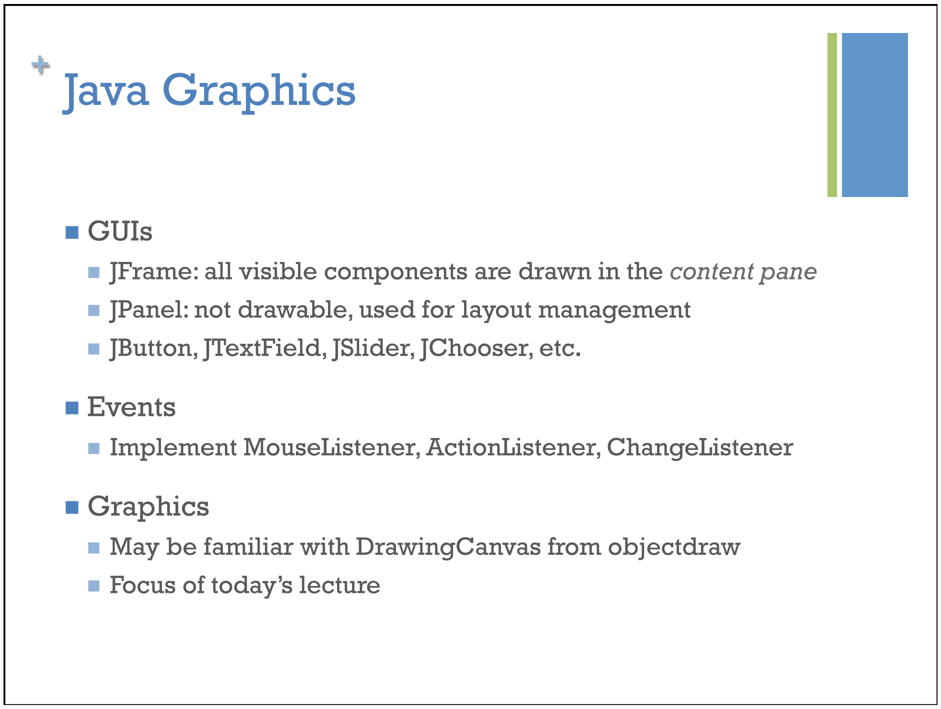
ArrayList

- What happens if need more space in array than originally allocated?
- ArrayList is a class that dynamically expands as needed.
- Part of the java.util package
- To get access write "import java.util.ArrayList"
- JS uses Vector rather than ArrayList.
  - ArrayList more efficient if no concurrency



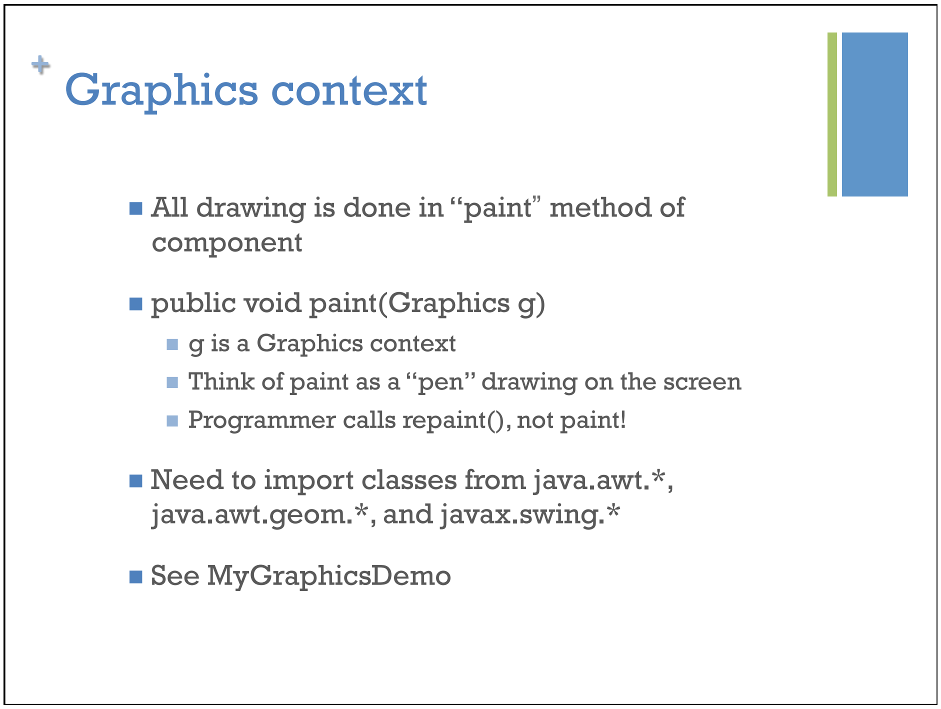
ArrayList Specification

- Class ArrayList<E>
- Important methods:
  - add, get, set, indexOf, isEmpty, remove, size, contains, clear
  - size, isEmpty, get, set take constant time
  - add (to end) is “amortized constant” time
- Read javadoc at
  - JavaDoc for ArrayList



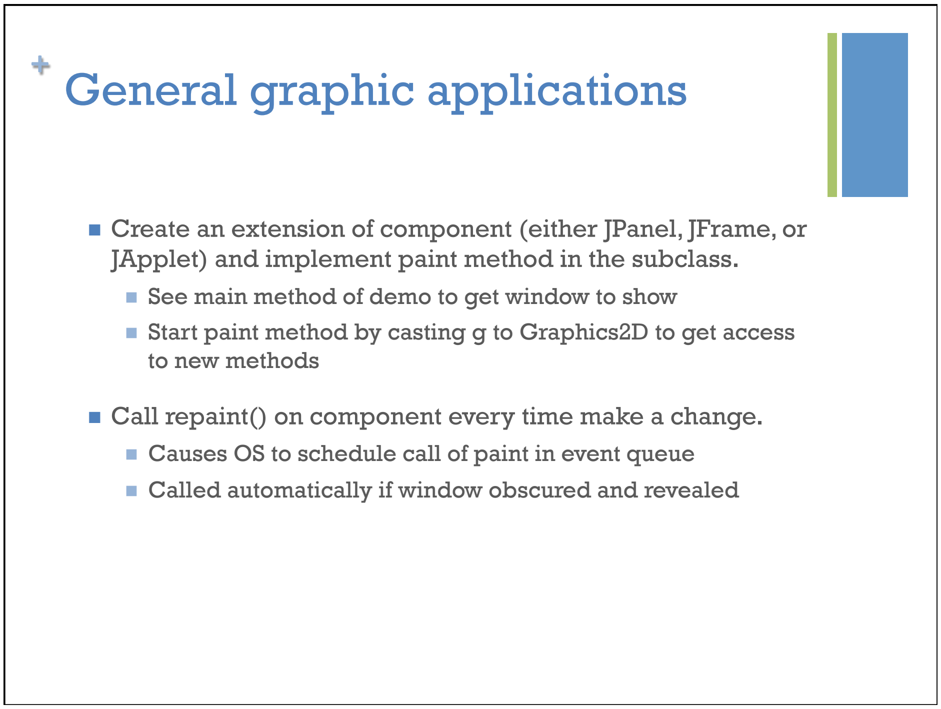
Java Graphics

- GUIs
  - JFrame: all visible components are drawn in the *content pane*
  - JPanel: not drawable, used for layout management
  - JButton, JTextField, JSlider, JChooser, etc.
- Events
  - Implement MouseListener, ActionListener, ChangeListener
- Graphics
  - May be familiar with DrawingCanvas from objectdraw
  - Focus of today’s lecture



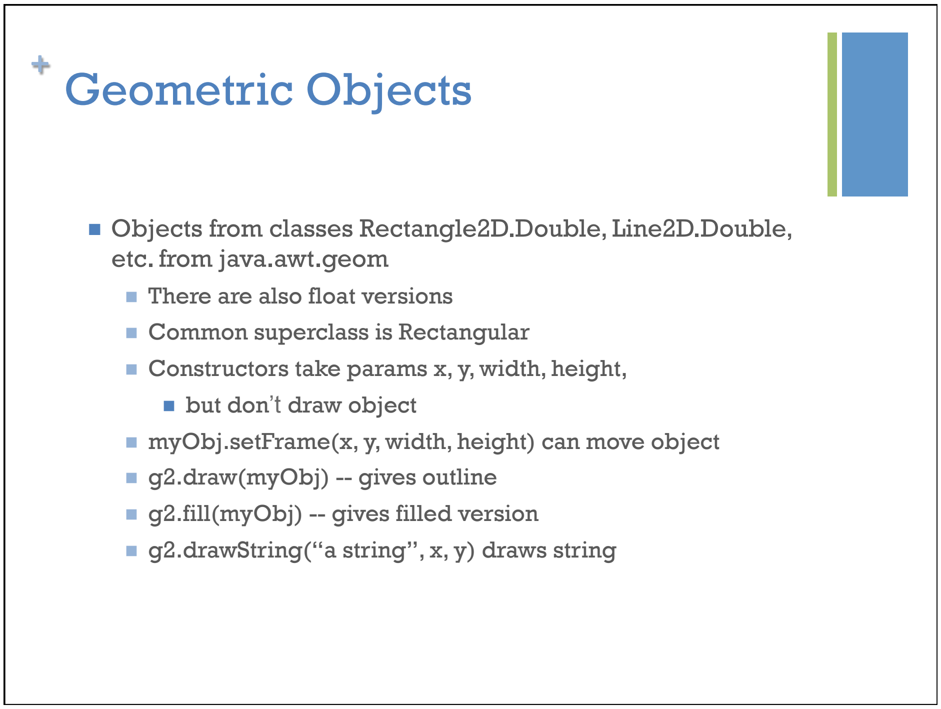
Graphics context

- All drawing is done in "paint" method of component
- public void paint(Graphics g)
  - g is a Graphics context
  - Think of paint as a "pen" drawing on the screen
  - Programmer calls repaint(), not paint!
- Need to import classes from java.awt.*, java.awt.geom.*, and javax.swing.*
- See MyGraphicsDemo



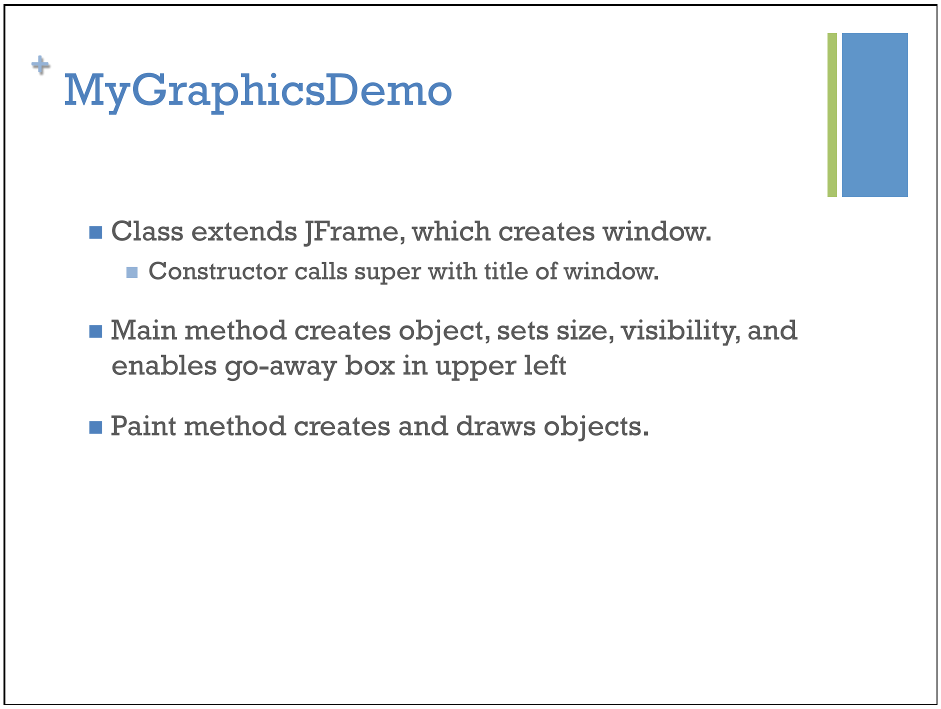
General graphic applications

- 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
  - Start paint method by casting g to Graphics2D to get access to new methods
- Call repaint() on component every time make a change.
  - Causes OS to schedule call of paint in event queue
  - Called automatically if window obscured and revealed



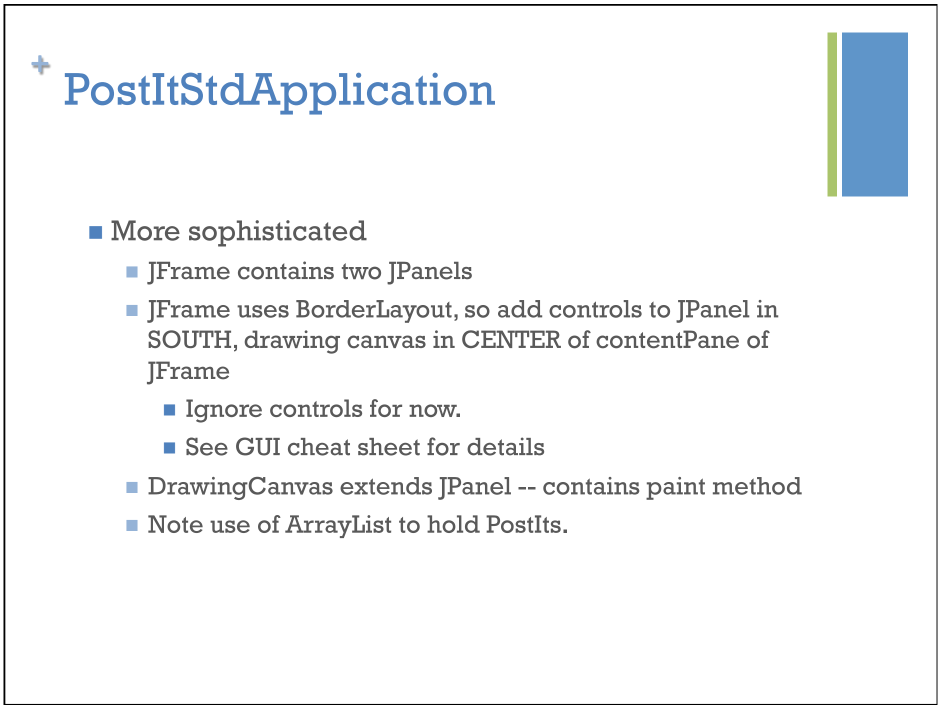
Geometric Objects

- Objects from classes Rectangle2D.Double, Line2D.Double, etc. from java.awt.geom
    - There are also float versions
    - Common superclass is Rectangular
    - Constructors take params x, y, width, height,
        - but don't draw object
    - 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 in upper left
- Paint method creates and draws objects.



PostItStdApplication

- More sophisticated
  - JFrame contains two JPanels
  - JFrame uses BorderLayout, so add controls to JPanel in SOUTH, drawing canvas in CENTER of contentPane of JFrame
    - Ignore controls for now.
    - See GUI cheat sheet for details
  - DrawingCanvas extends JPanel -- contains paint method
  - Note use of ArrayList to hold PostIts.