Announcement: A4 Collision Detection

- Note: `Block.overlap()` is approximate:

```java
public static boolean overlaps(Block a, Vector2D u, Block b, Vector2D v) {
    Vector2D c1 = Vector2D.add(new Vector2D(a.position), u);
    Vector2D c2 = Vector2D.add(new Vector2D(b.position), v);
    return Vector2D.dist(c1, c2) < a.halfwidth + b.halfwidth;
}
```

\[\|\vec{c}_{21}\|_2 \leq 2h\]
\[\|\vec{c}_{21}\|_\infty \leq 2h\]
\[\|\vec{c}\|_\infty \equiv \max_i |c_i|\]
Graphical User Interface: a type of user interface that allows users to interact with programs through manipulation of graphical elements as opposed to text-based interfaces.
Some GUI history

`60s: Sutherland’s “SketchPad”

http://toastytech.com/guis/guitimeline.html
Displays for Office Automation

Large, High-Resolution, Bit-Map
- many uses at same time
- text and graphics
- display like printed paper

Northwest sales region

1985
4.4 billion

1984
2.1 billion

Oil Production

Xerox’s “Star” workstation
Mouse tales...

Their mouse had a mean time between failure of … a week … it would jam up irreparably, or … jam up on the table-- … It had a flimsy cord whose wires would break. Steve Jobs: "... Xerox says it can't be built for < $400, I want a $10 mouse that will never fail and can be mass produced, because it's going to be the primary interface of the computer ..."

... Dean Hovey ... came back, "I've got some good and some bad news. Good news: we've got a new project with Apple. Bad news: I told Steve we'd design a mouse for 10 bucks."

... year later ... we … filed … and were granted a patent, on the electro-mechanical-optical mouse of today; ... we ended up ... [making] the mouse as invisible to people as it is today.


(see also https://alumni.stanford.edu/get/page/magazine/article/?article_id=37694)
Suddenly, everything clicks. And swipes. And scrolls.

Introducing Magic Mouse. The world’s first Multi-Touch mouse. Now included with every new iMac. And available on its own for just $69.

We’ve built a better mouse.

It began with iPhone. Then came iPod touch. Then MacBook Pro. Intuitive, smart, dynamic. Multi-Touch technology introduced a remarkably better way to interact with your portable devices — all using gestures. Now, with Magic Mouse, you can take even greater advantage of it all.
Shop for **apple mouse** on Google

- **Apple® - Magic Wireless Laser**
  - Price: $69.99
  - Location: Best Buy
  - Rating: ★★★★★ (1k+)

- **Apple Magic Mouse with Multi-Touch**
  - Price: $69.00
  - Location: Apple Store
  - Rating: ★★★★★ (1k+)

- **Apple® - Optical Mouse**
  - Price: $49.99
  - Location: Best Buy
  - Rating: ★★★★☆ (1k+)

- **Free shipping Bluetooth 2.4GHz Wireless Laser**
  - Price: $20.00
  - Location: AliExpress.com
  - Rating: ★★★★☆ (1k+)

- **Apple Magic Wireless Laser**
  - Price: $34.49
  - Location: eBay
  - Rating: ★★★★★ (1k+)

---

Shop for **microsoft mouse** on Google

- **Microsoft Arc Touch Mouse**
  - Price: $69.99
  - Location: Abt Electronics
  - Rating: ★★★★★ (155)

- **Microsoft Sculpt Comfort Mouse**
  - Price: $39.95
  - Location: Microsoft Store
  - Rating: ★★★★★ (169)

- **Microsoft Touch Mouse**
  - Price: $79.95
  - Location: Microsoft Store
  - Rating: ★★★★★ (127)

- **Microsoft Wireless Mobile Mouse 3500**
  - Price: $29.95
  - Location: Microsoft Store

- **Microsoft Arc Mouse - Black**
  - Price: $39.99
  - Location: Newegg.com
  - Rating: ★★★★★ (613)

---

Shop for **monoprice mouse** on Google

- **6-Key Ergonomic Gaming Mouse**
  - Price: $10.16
  - Location: Monoprice.com

- **6-Key Gaming Mouse**
  - Price: $10.16
  - Location: Monoprice.com

- **5-Button Optical Laser**
  - Price: $11.43
  - Location: Monoprice.com

- **Mini/Travel Optical Mouse - Black**
  - Price: $4.59
  - Location: Monoprice.com

- **Super Slim Optical USB 2.0**
  - Price: $5.19
  - Location: Monoprice.com
Modern GUI Examples: “Katana”

Modern GUI Examples: “Houdini”
Modern GUI Examples: “Houdini”

Modern GUI Examples: Drum machine

Many GUI tools & APIs

Biggest Gui Set ever: 1000+ Elements

http://www.webdesignshock.com/wp-content/uploads/2012/05/Gui_Apollo_WDS_901.jpg
Many GUI tools & APIs: QT (cross platform)

http://upload.wikimedia.org/wikipedia/commons/f/f3/Qt_Designer_4_4_3.png
Many GUI tools & APIs: Swing (Java)
Example: Swing (Java)

GUI (Graphical User Interface)

GUI (Graphical User Interface): Graphical Interface

- TFT-Display: 1920x1080@60Hz, 16.6ms / frame, Pixel response time: 4-20ms, Sample-and-Hold, problematic
- VR-TFT-Display: 1280x800@95Hz, 10.5ms / frame
- Speaker/Headphone: 3D Positional Audio, etc.
- Gamepad: ForceFeedback et al.
- Keyboard
- Mouse: RTOS = latency
- Gamepad: Accelerometers, Tilt-sensors, etc.
- Joystick
- Microphone

Output:
- Graphics accelerator: 1520x1080@60fps, 60fps ≤ 16.6ms between 2 frames, 1280x800@95fps for VR, 95fps ≤ 10.5ms between 2 frames

Software:
- Video subsystem (GEM/TTM) DRM KMS
- Audio subsystem ALSA
- Input subsystem evdev

Latency?

Kernel space

User space

Middleware

Game

Middleware

User space

OpenGL
user space
device drivers

Gesture recognition

Speech recognition

http://en.wikipedia.org/wiki/Graphical_user_interface
GUI (Graphical User Interface)

- Provides a friendly interface between user and program
- Allows event-driven or reactive programming: The program reacts to events such as button clicks, mouse movement, keyboard input
- Often is multi-threaded: Different threads of execution can be going on simultaneously

We use Java’s two packages for doing GUIs:
- **AWT** (Abstract Window Toolkit) — first one; very simple
- **Swing** — a newer one, which builds on AWT as much as possible

Two aspects to making a GUI:
1. Laying out components (buttons, text, etc.) in it. **TODAY**
2. Listening/responding to events **Next Lecture**
**Class JFrame**

**JFrame object**: associated with a window on your monitor.

Generally, a GUI is a JFrame object with various components placed in it.

**Some methods in a JFrame object**

hide() show() setVisible(boolean)

getX() getY() (coordinates of top-left point)

getWidth() getHeight() setLocation(int, int)

getTitle() setTitle(String)

getLocation() setLocation(int, int)

Over 100 methods in a JFrame object!

**Class JFrame is in package javax.swing**
Placing components in a JFrame

**Layout manager:** Instance controls placement of components.

**JFrame layout manager default:** BorderLayout.

**BorderLayout** layout manager: Can place 5 components:

```java
public class C extends JFrame {
    public C() {
        Container cp = getContentPane();
        JButton jb = new JButton("Click here");
        JLabel jl = new JLabel("label 2");
        cp.add(jb, BorderLayout.EAST);
        cp.add(jl, BorderLayout.WEST);
        pack();
        setVisible(true);
    }
}
```

BorderLayout diagram:

- North
- South
- West
- Center
- East

**JFrameDemo.java**
import java.awt.*; import javax.swing.*;

/** Demonstrate placement of components in a JFrame. 
   Places five components in 5 possible areas:
   (1) a JButton in the east,              (2) a JLabel in the west,
   (3) a JLabel in the south,             (4) a JTextField in the north
   (5) a JTextArea in the center. */

public class ComponentExample extends JFrame {
   /** Constructor: a window with title t and 5 components */
   public ComponentExample(String t) {
      super(t);
      Container cp= getContentPane();
      cp.add(java.awt.Button("click me"), BorderLayout.EAST);
      cp.add(new JTextField("type here", 22), BorderLayout.NORTH);
      cp.add(new JLabel("I got up today"), BorderLayout.SOUTH);
      cp.add(new JLabel("label 2"), BorderLayout.WEST);
      cp.add(new JTextArea("type\nhere", 4, 10), BorderLayout.CENTER);
      pack();
   }
}

ComponentExample.java
Packages -- Components

Packages that contain classes that deal with GUls:
java.awt: Old package.  javax.swing: New package.

javax.swing has a better way of listening to buttons, text fields, etc. Components are more flexible.

Component: Something that can be placed in a GUI window. They are instances of certain classes, e.g.

- JButton, Button: Clickable button
- JLabel, Label: Line of text
- JTextField, TextField: Field into which the user can type
- JTextArea, TextArea: Many-row field into which user can type
- JPanel, Panel: Used for graphics; to contain other components
- JCheckBox: Checkable box with a title
- JComboBox: Menu of items, one of which can be checked
- JRadioButton: Same functionality as JCheckBox
- Container: Can contain other components
- Box: Can contain other components

xxxx in awt
Jxxxx in Swing
Basic Components

Buttons

Combo Box

List

TextField

Slider

Menu

Label

TextArea

Progress Bar

FileChooser

Color Chooser

ToolTip

Table

Tree

Split Pane

Tabbed Pane

http://www.ntu.edu.sg/home/ehchua/programming/java/images/Swing_Components.png
### Basic Components

**Component**: Something that can be placed in a GUI window. These are the basic ones used in GUIs.

<table>
<thead>
<tr>
<th>Component</th>
<th>Subclasses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checkbox, Choice</td>
<td>Subclasses: JCheckBox, JRadioButton</td>
</tr>
<tr>
<td>Label, List, Scrollbar</td>
<td>Subclasses: JLabel, JList, JScrollBar, JSlider</td>
</tr>
<tr>
<td>TextComponent</td>
<td>Subclasses: JTextComponent, JTextField, JTextArea</td>
</tr>
<tr>
<td>Container</td>
<td>Subclasses: JComponent, JOptionPane, JPanel, JPopupMenu, JScrollPane</td>
</tr>
</tbody>
</table>

Note the use of subclasses to provide structure and efficiency. For example, there are two kinds of JToggleButtons, so that class has two subclasses.
Components that can contain other components

Component
  Box
  Container
    JComponent
    JPanel
  Panel
    Applet
Window
Frame
  JFrame
  JWindow

java.awt is the old GUI package.

javax.swing is the new GUI package.
When they wanted to use an old name, they put J in front of it.
(e.g. Frame and JFrame)

When constructing javax.swing, the attempt was made to rely on the old package as much as possible.

So, JFrame is a subclass of Frame.

But they couldn’t do this with JPanel.
import java.awt.*;  import javax.swing.*;

/** Instance has labels in east /west, JPanel with four buttons in center. */
public class PanelDemo extends JFrame {
    JPanel p = new JPanel();

    /** Constructor: a frame with title "Panel demo", labels in east/west,
         blank label in south, JPanel of 4 buttons in the center */
    public PanelDemo() {
        super("Panel demo");
        p.add(new JButton("0"));  p.add(new JButton("1"));
        p.add(new JButton("2"));  p.add(new JButton("3"));

        Container cp = getContentPane();
        cp.add(new JLabel("east"), BorderLayout.EAST);
        cp.add(new JLabel("west"), BorderLayout.WEST);
        cp.add(new JLabel(" "), BorderLayout.SOUTH);

        cp.add(p, BorderLayout.CENTER);
        pack();
    }
}

JPanel as a container

FlowLayout layout manager: Place any number of components. They appear in the order added, taking as many rows as necessary.

import javax.swing.*; import java.awt.*;

/** Demo class Box. Comment on constructor says how frame is laid out. */
public class BoxDemo extends JFrame {
  /** Constructor: frame with title "Box demo", labels in the east/west,
   blank label in south, horizontal Box with 4 buttons in center. */
  public BoxDemo() {
    super("Box demo");
    Box b = new Box(BoxLayout.X_AXIS);
    b.add(new JButton("0"));   b.add(new JButton("1"));
    b.add(new JButton("2"));   b.add(new JButton("3"));
    Container cp = getContentPane();
    cp.add(new JLabel("east:"), BorderLayout.EAST);
    cp.add(new JLabel("west:"), BorderLayout.WEST);
    cp.add(new JLabel(" "), BorderLayout.SOUTH);
    cp.add(b, BorderLayout.CENTER);
    pack();
  }
}

Class Box: a container

Box layout manager default: BoxLayout.

BoxLayout layout manager: Place any number of components. They appear in the order added, taking only one row.
public class BoxDemo2 extends JFrame {
/** Constructor: frame with title t and 3 columns with n, n+1, and n+2 buttons. */
public BoxDemo2(String t, int n) {
    super(t);
    // Create Box b1 with n buttons.
    Box b1 = new Box(BoxLayout.Y_AXIS);
    for (int i = 0; i != n; i = i+1)
        b1.add(new JButton("1 " + i));
    // Create Box b2 with n+1 buttons.
    Box b2 = …
    // Create Box b3 with n+2 buttons.
    Box b3 = …
    // Create horizontal box b containing b1, b2, b3
    Box b = new Box(BoxLayout.X_AXIS);
    b.add(b1);
    b.add(b2);
    b.add(b3);
    Container cp = getContentPane();
    cp.add(b, BorderLayout.CENTER);
    pack(); show();
}
Simulate BoxLayout Manager in a JFrame

To simulate using a BoxLayout manager for a JFrame, create a Box and place it as the sole component of the JFrame:

```java
JFrame jf = new JFrame("title");
Box b = new Box(BoxLayout.X_AXIS);
Add components to b;
jf.add(b, BorderLayout.CENTER);
```

1. **Start developing a GUI by changing an already existing one.** A lot of details. Hard to get all details right when one starts from scratch and has little idea about the Java GUI package.

2. Showed how to place components in a GUI. Next class: how to “listen” to things like button clicks in a GUI.
Checkers Example
Checkers Example

Layout Manager for Checkers game has to process a tree

pack(): Traverse the tree, determining the space required for each component

boardBox: vertical Box
row: horizontal Box
Square: Canvas or JPanel
infoBox: vertical Box
the GUI future...
Rethinking GUIs

Big Data

“In 2011 we will have generated more data than mankind has since the beginning of history” - Peter Hirshberg (global pulse Summit)
Rethinking GUIs
Rethinking GUls

Graphics Performance

Increasing Graphics Performance

Source: Intel 3DMark6

Baseline

80x

70x

60x

50x

40x

30x

20x

10x

2006 2007 2008 2009 2010 2011 2012 2013

4th Gen Intel Core™

3rd Gen Intel Core™

2nd Gen Intel Core™

75X Increase

Theoretical GFLOP/s

NVIDIA GPU Single Precision
NVIDIA GPU Double Precision
Intel CPU Double Precision
Intel CPU Single Precision

GeForce 780 Ti
GeForce GTX TITAN
GeForce GTX 680
GeForce GTX 580
GeForce GTX 480
GeForce GTX 280
GeForce 8800 GTX
GeForce 7800 GTX
GeForce 6800 Ultra
Woodcrest
Harpertown
Bloomfield
Westmere
Sandy Bridge
Ivy Bridge
GeForce FX
GeForce 6800
GeForce 5800
Testa M2090
Testa K20X
Testa K40

Apr-01 Sep-02 Jan-04 May-05 Oct-06 Feb-08 Jul-09 Nov-10 Apr-12 Aug-13 Dec-14
Rethinking GUIs

Human Performance
Rethinking GUlS

Natural User Interfaces

http://eecatalog.com/digital-signage/files/2013/12/131209_digitalsignage_1.jpg

nuigroup.com
Rethinking GUls

Natural User Interfaces

http://www.inventinginteractive.com/2013/11/04/enders-game/
Rethinking GUls

Natural User Interfaces

http://www.inventinginteractive.com/2013/11/04/enders-game/
Rethinking GUIs

Augmented Reality


http://ngm.nationalgeographic.com/big-idea/14/augmented-reality

In March one of our staff designers enhanced the reality of his Washington, D.C., neighborhood. Smart phone applications (apps) added layers of information to what his eye—called out in this composite of five photos, each taken with his phone.

UP AND AWAY Point your phone at the sky and find stars hidden by daylight. Aim at a tourist spot and see its history plus info for visitors. For an augmented-reality check, tap into crime stats.

HERCULES
Hercules
Rises: 6:23 a.m. Sets: 9:29 a.m.
A large constellation representing the mythological hero

Corona Borealis
U.S. Capitol complex
1.7 miles
Construction of the Capitol began in 1793. When built, it was...

Anchorage restaurant
3 stars out of 5
Thursday

Car center

Gas station
500 feet
Unleaded
$3.19

Eastern Market
600 feet
1 turn right on 7th St.

Robbery
275 feet west
18 days ago

REAL DEALS Various apps can steer you to the cheapest gas around, mass-transit options, good food, and Wi-Fi spots. You can also learn the price of that town house that's up for sale.

022-624 North Carolina Ave. SE
500 feet
List price: $2,950,000
Bed: 7 Bath: 8
On market: 420 days

Peregrine Espresso
105 feet
Free Wi-Fi

Biko: Eastern Market Free
310 feet
Token: 2007-04-30
06:30 a.m.

Twitter users in the area
Perfect day to head to @EasternMarketDC; anyone want to meet up? @spring4d0 @mental

STREET PALS The Tweets Around app tells if tweeters are near. Flickr displays area photos by members (Eastern Market, above). In the works: an app to match faces to social network profiles.
Rethinking GUls

Virtual Reality


http://upload.wikimedia.org/wikipedia/commons/7/78/AC89-0437-20_a.jpeg