Computer Game Technologies

Java 3D Example

Java 3D Examples

- Examples will often be taken from Andrew Davison, "Killer Game Programming", O'Reilly 2005
- Code and extra chapters available from

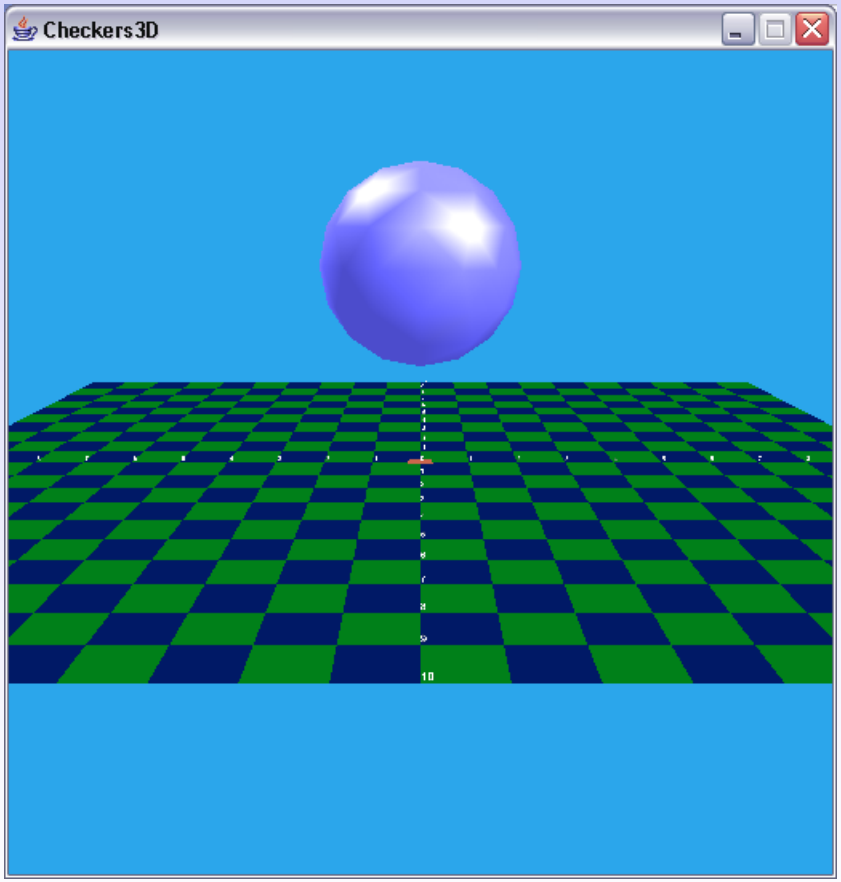
http://fivedots.coe.psu.ac.th/~ad/jg/

- Java applications that embed the Canvas3D in a JPanel for inclusion within a Swing GUI

Checkers3D

The scene consists of

- a dark green and blue tiled surface (and red center)
- labels along the X and Z axes
- a blue background
- a floating sphere lit from two different directions
- the user (viewer) can move through the scene by moving the mouse



Checkers3D Scene Graph

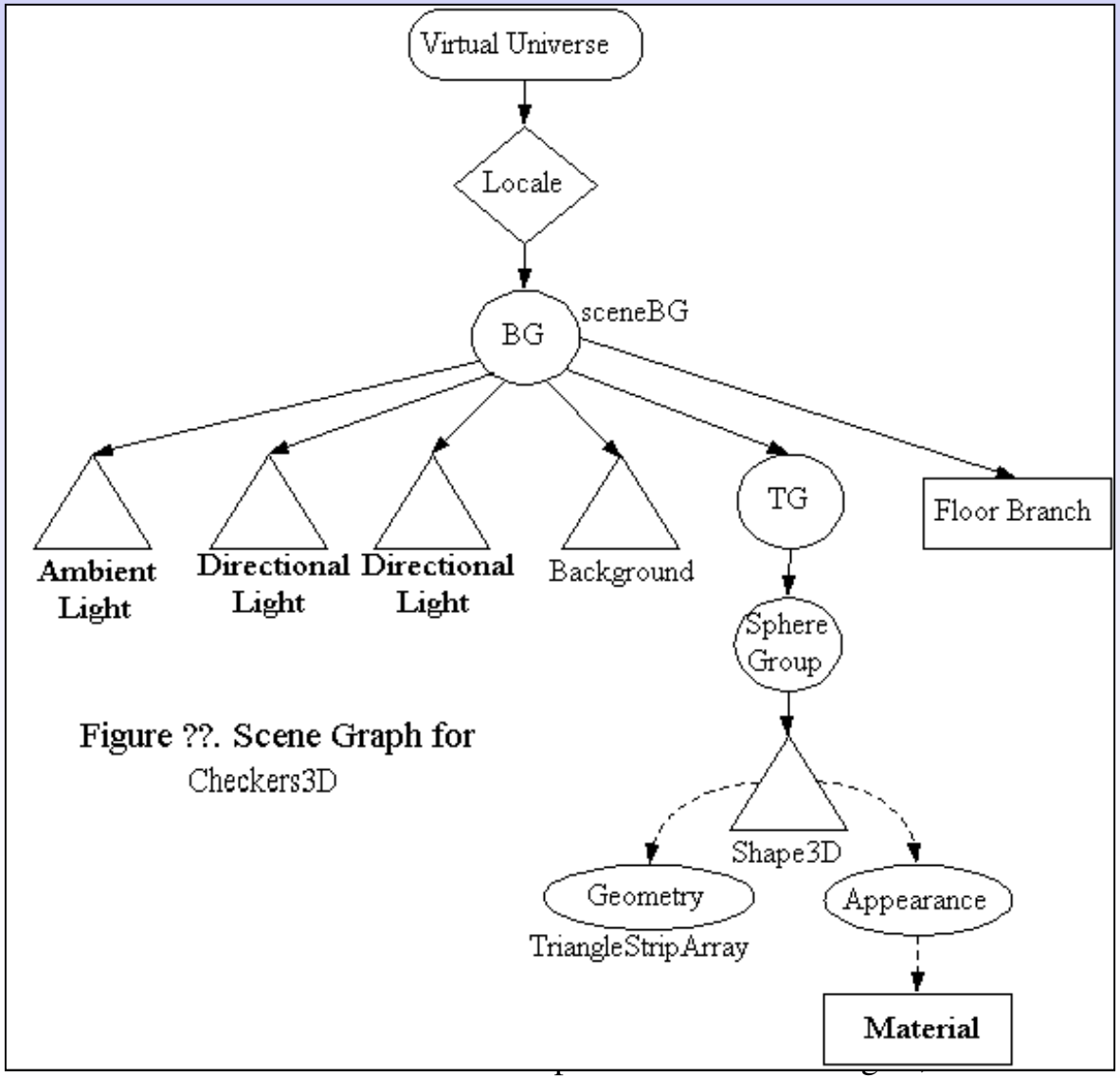


Figure ??. Scene Graph for Checkers3D

- View branch not shown

(from Davison's lectures)

Checkers3D Code Structure

- Windowed Java application
- Java Swing plus Java3D
- Checkers3D
  - Main class that extends JFrame
  - WrapCheckers3D JPanel added to JFrame
- WrapCheckers3D
  - Holds all the 3D code
  - Extends JPanel
  - Canvas3D added to JPanel
  - SimpleUniverse
  - createSceneGraph() method

Checkers3D Code

```
public class Checkers3D extends JFrame
{
  public Checkers3D()
  {
    super("Checkers3D");
    Container c = getContentPane();
    c.setLayout( new BorderLayout() );
    WrapCheckers3D w3d = new WrapCheckers3D();
    c.add(w3d, BorderLayout.CENTER);

    setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
    pack();
    setResizable(false);    // fixed size display
    setVisible(true);
  } // end of Checkers3D()

  public static void main(String[] args)
  { new Checkers3D(); }

} // end of Checkers3D class
```

WrapCheckers3D Code

```
public class WrapCheckers3D extends JPanel
// Holds the 3D canvas where the loaded image is displayed
{
:::::::
  private SimpleUniverse su;
  private BranchGroup sceneBG;
  private BoundingSphere bounds;   // for environment nodes

  public WrapCheckers3D()  // A panel holding a 3D canvas
  {
    setLayout( new BorderLayout() );
    setOpaque( false );
    setPreferredSize( new Dimension(PWIDTH, PHEIGHT));

    GraphicsConfiguration config =
              SimpleUniverse.getPreferredConfiguration();
    Canvas3D canvas3D = new Canvas3D(config);
    add("Center", canvas3D);
    canvas3D.setFocusable(true);     // give focus to the canvas
    canvas3D.requestFocus();
```

WrapCheckers3D Code (2)

```
  su = new SimpleUniverse(canvas3D);

  createSceneGraph();
  initUserPosition();         // set user's viewpoint
  orbitControls(canvas3D);    // viewpoint controls

  su.addBranchGraph( sceneBG );

} // end of WrapCheckers3D()
```

The Content Scene Graph

- The sphere, lights and background

```
private void createSceneGraph()
 // initilise the scene
 {
   sceneBG = new BranchGroup();
   bounds = new BoundingSphere(new Point3d(0,0,0), BOUNDSIZE);

   lightScene();          // add the lights
   addBackground();       // add the sky
   sceneBG.addChild( new CheckerFloor().getBG() );
   floatingSphere();      // add the floating sphere

   sceneBG.compile();   // fix the scene
 } // end of createSceneGraph()
```

Bounds

```
bounds = new BoundingSphere(new Point3d(0,0,0), BOUNDSIZE);
```

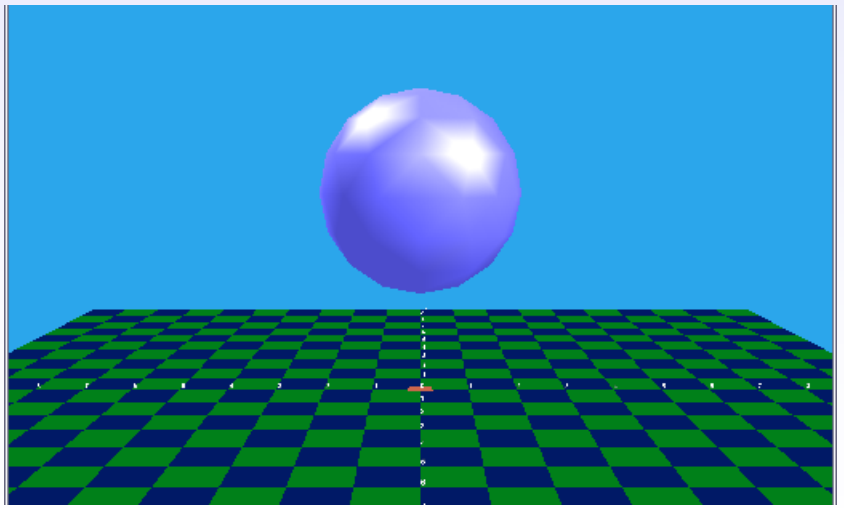
- Much 3D scene rendering is computationally expensive
  - The effect of lights
  - Behaviours that animate objects
- Bounds define when to bother calculating lighting, animation etc
  - setInfluencingBounds for lights
  - setSchedulingBounds for behaviours
- Calculations only done if the current view intersects the bounds

Visible Object - The Sphere

```
 private void floatingSphere()
// A shiny blue sphere located at (0,4,0)
{
  // Create the blue appearance node
  Color3f black = new Color3f(0.0f, 0.0f, 0.0f);
  Color3f blue = new Color3f(0.3f, 0.3f, 0.8f);
  Color3f specular = new Color3f(0.9f, 0.9f, 0.9f);

  Material blueMat= new Material(blue, black, blue,
                                 specular, 25.0f);
     // sets ambient, emissive, diffuse, specular, shininess
  blueMat.setLightingEnable(true);

  Appearance blueApp = new Appearance();
  blueApp.setMaterial(blueMat);
```

The Sphere (2)

```
  // position the sphere
  Transform3D t3d = new Transform3D();
  t3d.set( new Vector3f(0,4,0));
  TransformGroup tg = new TransformGroup(t3d);

  tg.addChild(new Sphere(2.0f, blueApp));
     // set its radius and appearance

  sceneBG.addChild(tg);
}  // end of floatingSphere()
```



Lighting - Ambient

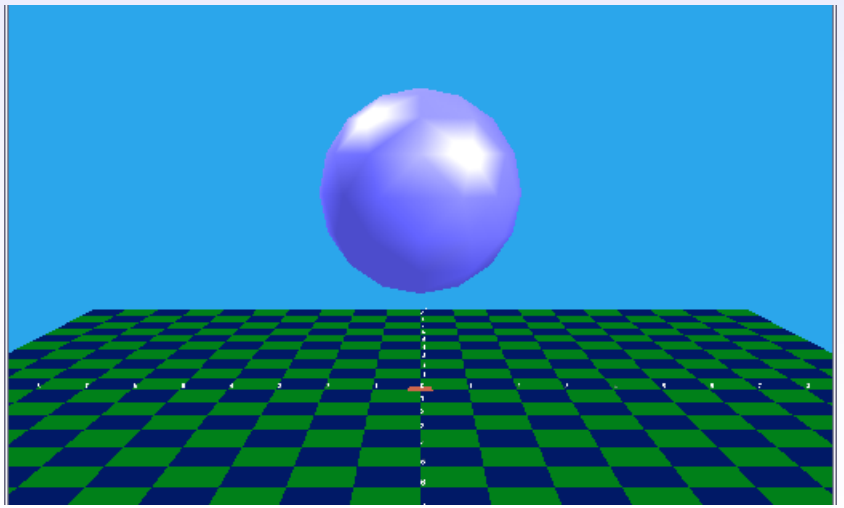
```
private void lightScene()
 /* One ambient light, 2 directional lights */
 {
   Color3f white = new Color3f(1.0f, 1.0f, 1.0f);

   // Set up the ambient light
   AmbientLight ambientLightNode = new AmbientLight(white);
   ambientLightNode.setInfluencingBounds(bounds);
   sceneBG.addChild(ambientLightNode);
```

Lighting - Directional

```
  // Set up the directional lights
  Vector3f light1Direction  = new Vector3f(-1.0f, -1.0f, -1.0f);
     // left, down, backwards
  Vector3f light2Direction  = new Vector3f(1.0f, -1.0f, 1.0f);
     // right, down, forwards

  DirectionalLight light1 =
          new DirectionalLight(white, light1Direction);
  light1.setInfluencingBounds(bounds);
  sceneBG.addChild(light1);

  DirectionalLight light2 =
      new DirectionalLight(white, light2Direction);
  light2.setInfluencingBounds(bounds);
  sceneBG.addChild(light2);
}  // end of lightScene()
```

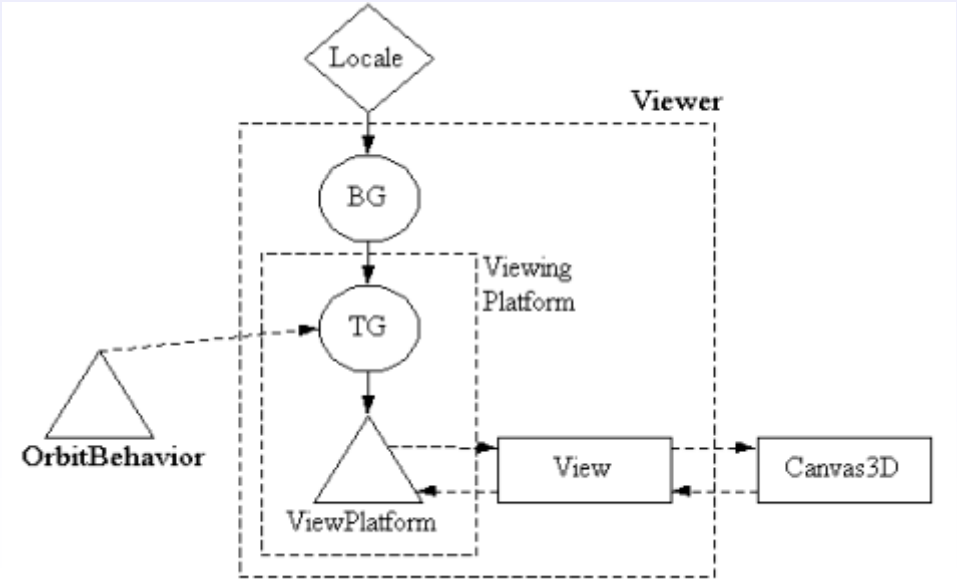
Coloured Background

```
private void addBackground()
// A blue sky
{ Background back = new Background();
  back.setApplicationBounds( bounds );
  back.setColor(0.17f, 0.65f, 0.92f);    // sky colour
  sceneBG.addChild( back );
}  // end of addBackground()
```



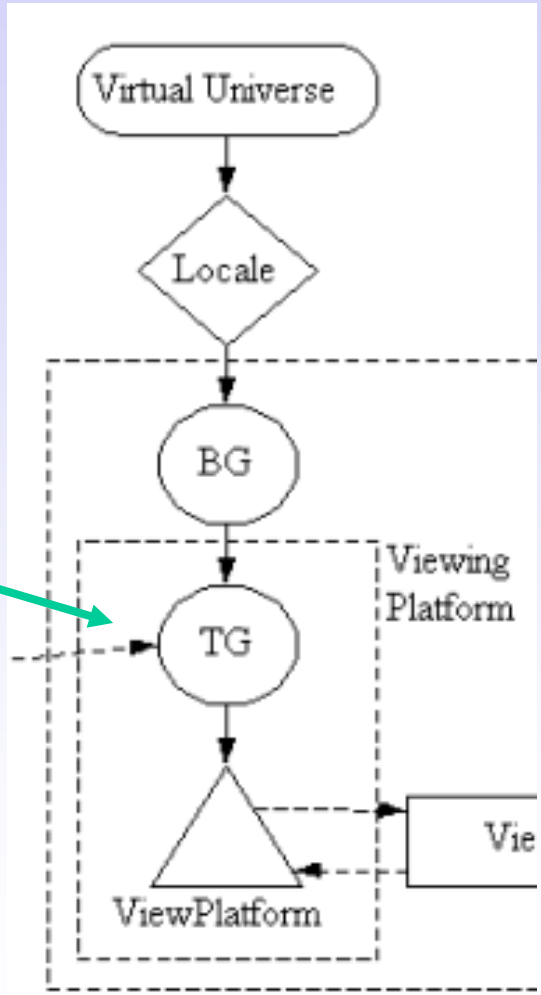
Viewpoint Control

```
 private void orbitControls(Canvas3D c)
/* OrbitBehaviour allows the user to rotate around
   the scene and zoom in and out.  */
{
  OrbitBehavior orbit =
            new OrbitBehavior(c, OrbitBehavior.REVERSE_ALL);
  orbit.setSchedulingBounds(bounds);

  ViewingPlatform vp = su.getViewingPlatform();
  vp.setViewPlatformBehavior(orbit);
}  // end of orbitControls()
```



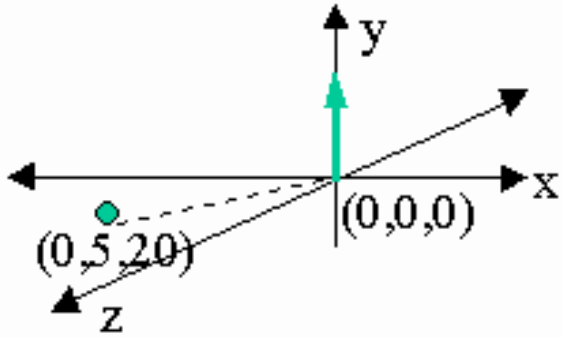
Initial Viewer Position

- Viewer position needs to be set
- Use the lookAt() method
  - Viewer position
  - A point they are looking at
  - A vector specifying which way is up
- Apply to viewer transform group



Initialise Viewer Position

```
private void initUserPosition()
// Set the user's initial viewpoint using lookAt()
{
  ViewingPlatform vp = su.getViewingPlatform();
  TransformGroup steerTG = vp.getViewPlatformTransform();

  Transform3D t3d = new Transform3D();
  steerTG.getTransform(t3d);

  // args are: viewer posn, where looking, up direction
  t3d.lookAt(USERPOSN, new Point3d(0,0,0), new Vector3d(0,1,0));
  t3d.invert();

  steerTG.setTransform(t3d);
}  // end of initUserPosition()
```



Alternative Viewer Position

- setNominalViewingTransform() method
  - ViewPlatform utility method
- Moves viewer position back along the Z-axis so that objects at the origin of size -1 to 1 along the x axis are fully viewable

```
// SimpleUniverse is a Convenience Utility class
SimpleUniverse simpleU = new SimpleUniverse(canvas3D);

// This will move the ViewPlatform back a bit so the
// objects in the scene can be viewed.
simpleU.getViewingPlatform().setNominalViewingTransform();
```

The End