

Computer Graphics

ECSE-4750 FALL 2015

CLASS 5

Class

- MidTerm
- Scene Organization
 - Scene Graph
 - Object Hierarchy
- New Rendering Classes
 - Geoemtries
 - Topologies
 - Cells
 - Actors
- Bring it all together.

MidTerm

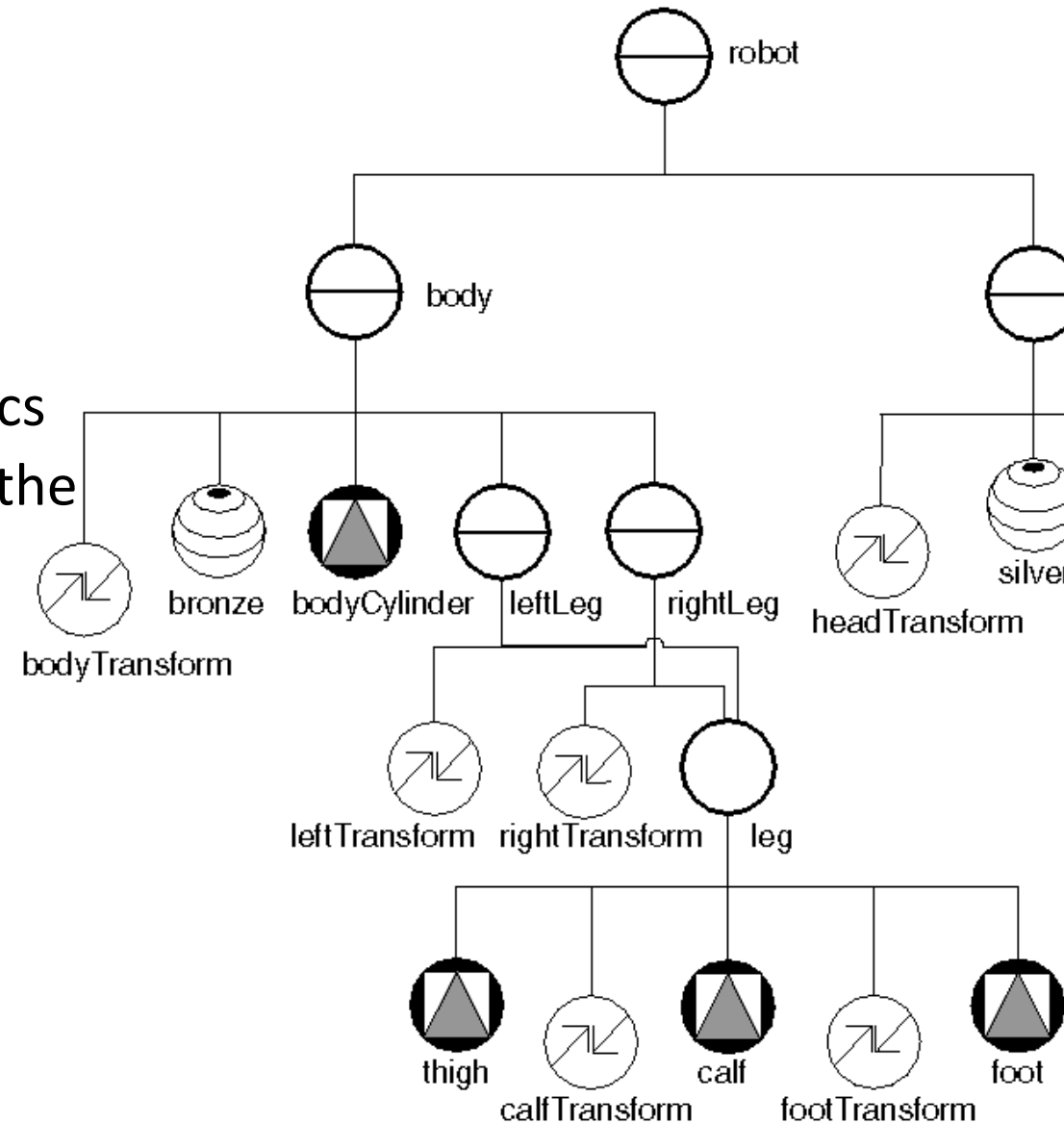
[Midterm answers](#)

Scene Organization

Scene Composition

- Provides an abstraction layer to graphics
- Consists of nodes connected by arcs
- All nodes have parents except for the root node

This produces a directed acyclic graph

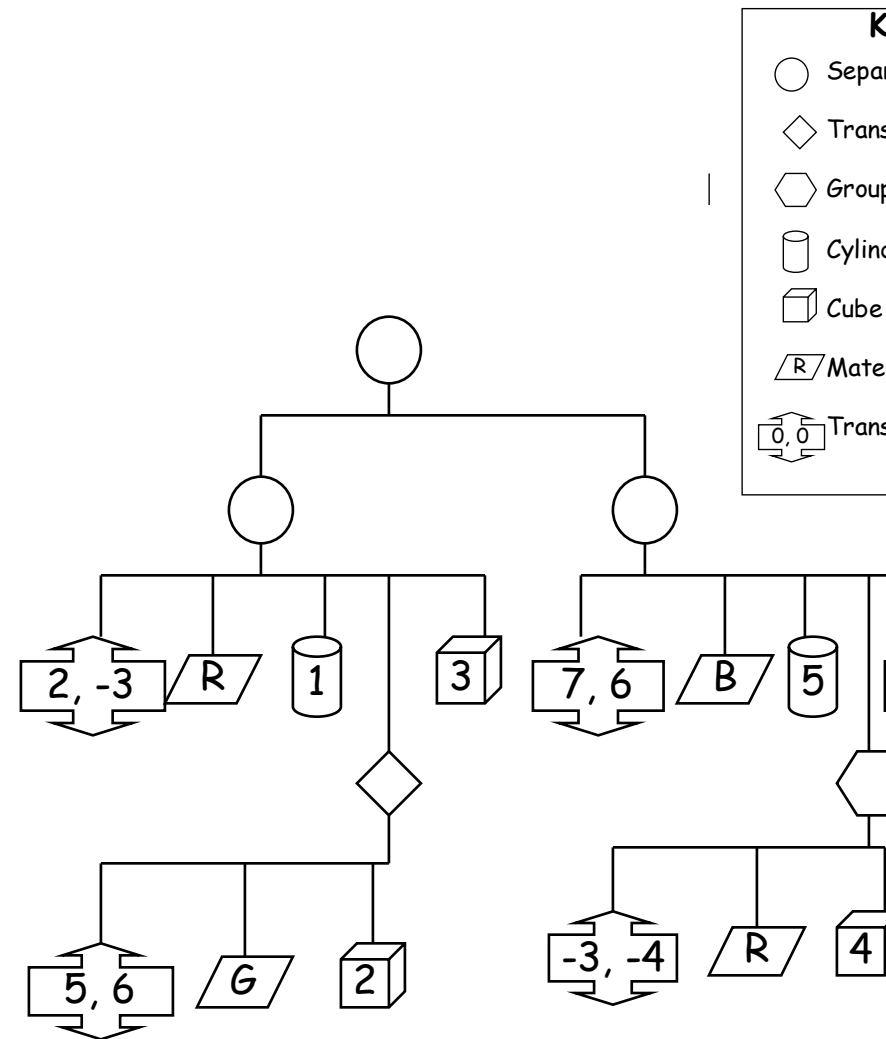


Scene Graph Traversal

Supports many operations

- Transformations
- Clipping and culling
- Lighting
- Interaction operations such as collision detection and picking
- Caching

Rendering traversals occurs constantly
Interactive and animated graphics



Scene Graph History

VRML, formalized around 1995

ISO standard in 1997

Based on OpenInventor format from SGI

```
#VRML V2.0 utf8
#Example VRML 2.0 file for teaching basic
#of color and 3D primitive shapes.
#Created by Theresa-Marie Rhyne
# A Cylinder
  Shape {
    appearance Appearance {
      material Material {
        diffuseColor 0.75 0.5 1.
        specularColor 0.7 0.7 0.
        shininess 0.1
      }
    }
    geometry Cylinder {
      height 0.2
      radius 3.
    }
  }
# A Sphere
Shape {
  appearance Appearance {
    material Material {
      diffuseColor 0.2 0.5 0.75
      transparency 0.0
    }
  }
  geometry Sphere {
    radius 1.0
  }
}
```

Scene Graph Syntax

X3D Format – The header

```
<?xml version="1.0" encoding="UTF-8"?>

<!-- ----- X3D header and X3D root node with profile declaration -->
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.2//EN"
    "http://www.web3d.org/specifications/x3d-3.2.dtd">
<X3D profile='Immersive' version='3.2'
    xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance'
    xsd:noNamespaceSchemaLocation='http://www.web3d.org/specifications/x3d-3.2.xsd'>

<!-- ----- head section with included meta data -->
  <head>
    <meta content='HelloWorld.x3d' name='title' />
    <meta content='Simple X3D example' name='description' />
    <meta content='30 October 2000' name='created' />
    <meta content='7 August 2010' name='modified' />
    <meta content='Don Brutzman' name='creator' />
    <meta content='http://www.web3D.org' name='reference' />
    <meta content='http://x3dGraphics.com' name='reference' />
    <meta content='http://www.web3d.org/x3d/content/examples/HelloWorld.x3d' name='iden
    <meta content='http://www.web3d.org/x3d/content/examples/HelloWorldTall.png' name='
    <meta content='http://www.web3d.org/x3d/content/examples/license.html' name='licens
    <meta content='X3D-Edit 3.2, https://savage.nps.edu/X3D-Edit' name='generator' />
  </head>
```

Scene Graph Syntax

X3D – The Scene

```
<!-- ----- the X3D scene node with X3D nodes -->
<Scene>
  <!-- Example scene to illustrate X3D nodes and fields (XML elements and attri
  <Group>
    <Viewpoint centerOfRotation='0 -1 0' description='Hello world!' position='0
    <Transform rotation='0 1 0 3'>
      <Shape>
        <Sphere/>
        <Appearance>
          <Material diffuseColor='0 0.5 1' />
          <ImageTexture url='"earth-topo.png" "earth-topo.jpg" "earth-topo-smal
            "http://www.web3d.org/x3d/content/examples/Basic/earth-topo.png"
            "http://www.web3d.org/x3d/content/examples/Basic/earth-topo.jpg"
            "http://www.web3d.org/x3d/content/examples/Basic/earth-topo-small.gif
          </ImageTexture>
        </Appearance>
      </Shape>
    </Transform>
    <Transform translation='0 -2 0'>
      <Shape>
        <Text string='"Hello" "world!"'>
          <FontStyle justify='"MIDDLE" "MIDDLE"' />
        </Text>
        <Appearance>
          <Material diffuseColor='0.1 0.5 1' />
        </Appearance>
      </Shape>
    </Transform>
  </Group>
</Scene>

<!-- ----- footer, closing X3D toot element -->
</X3D>
```


Scene Graphs live

<http://www.openscenegraph.org/>

Open source 3D graphics toolkit

C++ implementation leveraging OpenGL

Scene Graphs in Code

File formats are nice but how about code based scenes

Robot Arm in OpenScene Graph based library

- <http://osgjs.org/>

Code

Homework 3

Using OSG.js build a robot that includes a body, head, arms (3 segments), and legs (3 segments).

Basic segments can be cubes in the OSGjs library

Ensure:

- The hierarchy is correct, moving the body moves everything
- Each segment is movable on its own.
- Some UI to manipulate your robot. (Can be one set of sliders that switch between joints.

Extra credit:

- Add hand, feet, fingers, and toes.

X-Extra credit

- Animate the included Ogre