Advanced Computer Graphics and Data Visualization

ECSE-4750 MidTerm Exam

October 20, 2015

Name _____

You have the whole class to finish the exam, take your time and remember to answer the questions you know first. Each question is worth 5 points total with the points divided between the various parts. Please feel free to use the back of the page.

1. OpenGL

a. (1 Pt) What is OpenGL?

b. (1 Pt) What is meant by immediate and retained mode graphics?

c. (3 Pts) Name and describe each of the material color components.

2. OpenGL

a. (2 Pts) Explain why OpenGL needs a utility library.

b. (3 Pts) Explain what is happening with this OpenGL code snippet, and any possible problems.

```
// look up where the vertex data needs to go.
var positionLocation = gl.getAttribLocation(program, "a_position");

var buffer = gl.createBuffer();
gl.bindBuffer(gl.ARRAY_BUFFER, buffer);
gl.bufferData(
    gl.ARRAY_BUFFER,
    new Float32Array([
        -1.0, -1.0,
         1.0, -1.0,
        -1.0,  1.0,
        -1.0,  1.0,
         1.0, -1.0,
         1.0,  1.0]),
    gl.STATIC_DRAW);
gl.enableVertexAttribArray(positionLocation);
gl.vertexAttribPointer(positionLocation, 2, gl.FLOAT, false, 0, 0);

gl.drawArrays(gl.TRIANGLES, 0, 2);
```

3. Transforms

a) (2 Pts) What does this do to the input x and y.

$$\begin{vmatrix} x' \\ y' \end{vmatrix} = \begin{vmatrix} sx & 0 \\ 0 & sy \end{vmatrix} . \begin{vmatrix} x \\ y \end{vmatrix}$$

b) (3 Pts) Based on our RobotArm and knowing state is inherited from the parent, describe the position and color of the shoulder, elbow, and wrist.

```
shoulder = geoms[0];
shoulder.setColor([0,0,1]);

elbow = geoms[0].copy();
elbow.setTranslate([0,0,1]);
elbow.setColor([0,0,1]);

wrist = elbow.copy();
wrist.setTranslate([0,0,-1]);

shoulder.addGeom(elbow);
elbow.addGeom(wrist);
```

4. Data Storage

a. (3Pts) The choice of data representation is important because it effects our ability to interface to external data and the performance of the overall visualization system. Name and describe 3 of the 5 design criterion for our visualization system described in class and in the text.

b. (2 Pts) If we group our Actor classes and contained Cells as data sets, describe what is meant by structure and attributes.

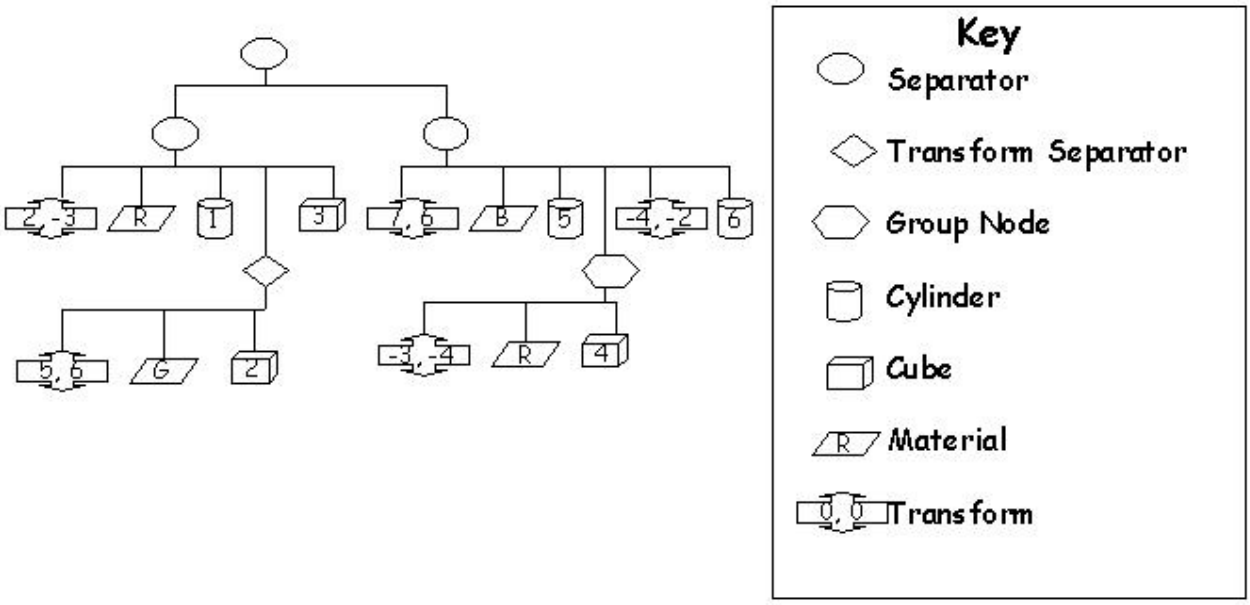
5. Graphics systems

a. (3 Pts) Using the objects from robot example, discuss how to include animation object into the class hierarchy. Specifically, explain where the algorithm would exist (in its own object or attached to some other object) also would there be a need to change the class hierarchy.

b. (2 Pts) Based on our discussion of scene graphs, explain how properties (materials and geometry) are shared.

6. Data Algorithms

(5 Pts) Based on our discussions of the Scene Graph structure, fill in the blanks below with the position and color of each of the objects.



Object	Position	Color
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	_____
6	_____	_____

Extra credit:

(2 Pts) What is the acronym GLSL?

(2 Pts) What are some weaknesses of the Object Rendering system we used for hw2?