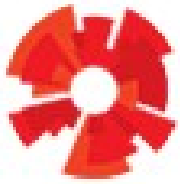

HÁSKÓLINN Í REYKJAVÍK
REYKJAVIK UNIVERSITY

Computer Graphics
T-511-TGRA
Final exam

Teacher: Kári Halldórsson

Date: November 24th 2014

Time: 14:00 – 17:00

Helping materials: Calculator

Answers can be given in English and/or Icelandic

Name:_____

ID: _____

1. **Describe depth calculations and depth testing in OpenGL (10%)**
   Consider the following questions:
   - What values are used and where are they calculated?
   - Where does the test itself occur and what is it's effect?

2. **Transparency (10%)**
   How could one render a transparent object in OpenGL?
   - Where in the OpenGL pipeline would this affect the calculations (and very briefly how)?
   - What would one specifically have to consider when rendering a transparent object, in order for the effect to appear as intended?

3. **Window-2-Viewport mapping (10%)**
   Points are drawn in a 2D world window (l,r,b,t) = (-10, 30, 50, 80).
   In which pixels on a 1600x1200 viewport (bottom left corner (0,0)) will the following points be rendered?
   - P1 = (-5, 70)
   - P2 = (20, 65)

4. **Matrix Transformations (40%)**
   A camera is set up to be positioned in (-3,3,3) looking at the point (-4,0,-2). It has an up vector (0,1,0).
   If at any point you have no answer at all to one question needed to continue to the next, use unit vectors and/or identity matrices and add clear explanations for what you're doing.

   a) Find the point of origin and vectors for the camera's coordinate frame (15%)

b) Set up the matrix to calculate eye coordinates for the camera (5%)
Which matrix is this?

c) Add to that matrix a rotation about the x-axis by 30° (10%)

d) What are the eye coordinates for the vertex with world coordinates (2,1,4) *(considering the current state after **b** and **c**)*? (10%)

5. **Perspective Projections (10%)**
   Consider the following code:

```
gluPerspective(60.0, 1.6, 10.0, 110.0);
```

   In OpenGL 1,using the GL utilities it sets up a camera with an angle of 60°, an aspect ratio of 1.6, near plane at 10 and a far plane at 110.
   Show how such a camera is set up in the OpenGL state?
   Which matrix is affected and what are it's exact values afterwards?

6. **Lighting calculations (10%)**

   A single light is in the light model in an OpenGL program. It has the ambient values (0.0, 0.0, 0.0), diffuse values (0.5, 0.3, 0.7), specular values (0.3, 0.8, 0.7) and position (5.0, 8.0, -1.0). There is also a global ambient factor of (0.3, 0.2, 0.4) in the light model. A camera is positioned in (4.0, 6.0, 5.0) and looks towards P.

   P has the color values: ambient (0.4, 0.2, 0.3), diffuse (0.4, 0.7, 0.2) and specular (0.6, 0.6, 0.6). It has a shininess value of 13. It has the position (4.0, 4.0, 3.0) and a normal (0.0, 1.0, 0.0).

   What will be the blue color value for P on the screen ?

7. **Rasterization (10%)**
   Three vertices of a triangle have been sent through the OpenGL pipeline. Their pixels and greyscale color values are:
   P1: (4,3) - c1: 0.1
   P2: (5,8) - c2: 0.8
   P3: (1,6) - c3: 0.5

   After shading the whole triangle what will the color value be in pixel (3,5)?

Bonus 3%
In which movie does the following dialog occur?
Who is character A?
Who is character B?

A: A census taker once tried to test me.
I ate his liver with some fava beans and a nice chianti.
B: ...