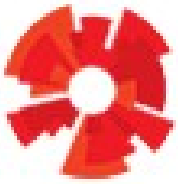

HÁSKÓLINN Í REYKJAVÍK
REYKJAVIK UNIVERSITY

Computer Graphics
T-511-TGRA
Final exam

Teacher: Kári Halldórsson

Date: December 14th 2012

Time: 9:00 – 12:00

Helping materials: Calculator

Answers can be given in English and/or Icelandic

Name:_____

ID: _____

1. **Shortly describe 3D meshes (10%)**
   Consider the following questions:
   What basic data is needed to represent a mesh?
   How is this data connected?
   How would the mesh be drawn in an OpenGL program?

2. **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?

3. **Describe Rasterization in OpenGL (10%)**
   Consider the following questions:
   What data do you have before the process starts?
   What data does the process calculate/generate?
   How does the algorithm work?
   What tests can happen here and where do they fit in?

4. **Matrix Transformations (40%)**
   A camera is set up to be positioned in (7,7,7) looking at the point (2,6,4). 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 by 30° about the z-axis (10%)

d) What are the eye coordinates for the vertex with world coordinates (2,6,4)? (10%)

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

```
gluPerspective(60.0, 0.75, 3.0, 130.0);
```

   What happens in the OpenGL state machine when it is run?
   Which matrix is affected and what are it's exact values afterwards?

6. **Bezier motion (10%)**
   Scalars in bezier curves are found by factoring Bernstein polynomials:
   BL = ((1- t) + t) L for a bezier curve with L + 1 control points.

   An object is moved along a bezier curve with 4 control points.
   P1 = (15, 5, 2), P2 = (10, 2, 2), P3 = (5, 7, 2), P4 = (0, 0, 2)

   The motion should start 4 seconds after the program starts and it should end 20 seconds later, 24 seconds after the program starts.

   Where is the object's center 19 seconds after the program started?

7. Light 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 (0.4, 0.5, 0.6), specular values (0.4, 0.3, 0.8) 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 (0.5, 0.1, 0.2), diffuse (0.5, 0.3, 0.3) and specular (0.4, 0.4, 0.4). It has a shininess value of 11. It has the position (4.0, 4.0, 3.0) and a normal (0.0, 1.0, 0.0).

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

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

A: Why didn't you just kill me?
B: You don't fear death. You welcome it.
Your punishment must be more severe.
A: Torture?
B: Yes. But not of your body. Of your soul.