HÁSKÓLINN Í REYKJAVÍK
REYKJAVÍK UNIVERSITY

Tölvugrafík, haust 2008

T-511 TGRA

Lokapróf

Kennari: Kári Halldórsson
Dagsetning: 6. desember 2008
Kl: 9:00 – 13:00 (4 klst)

Hjálpargögn: Reiknivél & meðfylgjandi formúlublað

Nafn_____

Kennitala _____

1. (5%)
How do the following code samples affect OpenGL's drawing and where/how does this happen in the calculations?

```
glEnable(GL_ALPHA_TEST);
glAlphaFunc(GL_GREATER, 0.8);
```

2. (5%)
Shortly describe the use of the Depth-buffer.

3. (10%)
I line goes throught he points (3, 5, 6) and (5, 6, 6).
Points (6, 9, 6), (8, 5, 4) and (8, 5, 8) lie in a plane.
In which point do the line and the plane intersect?

4. (20%)
Values are set in the Modelview matrix, transforming coordinates in relation to the direction and orientation of the camera like this:

$$\begin{bmatrix} u_X & u_Y & u_Z & -eye \circ u \\ v_X & v_Y & v_Z & -eye \circ v \\ n_X & n_Y & n_Z & -eye \circ n \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

a) How will the matrix look if the following code is run ? (10%)

```
glLoadIdentity();
gluLookAt(5.0, 7.0, 3.0, 4.0, 7.0, 1.0, 0.0, 1.0, 0.0);
```

b) Show the values in the modelview metrix if the this code is run following the previous code from a). (10%)

```
glRotated(30.0, 1.0, 0.0, 0.0);
glTranslated(0.0, 10.0, 0.0);
```

5. (20%)

a) Describe what happens when the following code is run and show the values that will end up in the Projection matrix. (10%)

```
gluPerspective(90.0, 1.25, 10.0, 110.0);
```

b) Using the projection values from a) and a identity modelview matrix (that has no effect), where will a point appear on a 1024x768 viewport that is created using the following code ?
Also show that the point is displayed on the screen, pointing out where/when this desicion is made. (10%)

```
glBegin(GL_POINTS);
      glVertex3f(18.0, -9.0, -27.0);
glEnd();
```

6. (10%)
A triangle is sent through the OpenGL pipeline and ends up on the viewport with corners in pixels:
P1: (5, 3)
P2: (3, 9)
P3: (14, 12)
The corners are linked to the color values:
P1: (0.2, 0.2, 0.2)
P2: (0.6, 0.6, 0.6)
P3: (0.9, 0.9, 0.9)
What color will pixel (5, 6) in the viewport have ?

7. (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 (0.3, 0.6, 0.2), specular values (0.7, 0.7, 0.7) and position (-1.0, 7.0, 5.0).
There is also a global ambient factor of (0.4, 0.4, 0.4) in the light model.
A camera is positioned in (5.0, 7.0, 7.0) and looks towards P.
P has the color values: ambient (0.1, 0.3, 0.2), diffuse (0.3, 0.4, 0.6) and specular (0.9, 0.9, 0.9). It has the position (3.0, 7.0, 2.0) and a normal (0.0, 0.0, 1.0).
What will be the blue color value for P on the screen ?

8. (10%)
A landscape is drawn in a display function. A texture value has also been aquired from OpenGL and a texture image loaded for it. Add to the code what is needed to map this texture over the whole landscape. The complete image should be mapped onto the landscape and the image should not be repeated in whole or in part.
(the space between line reflects the size of the page, not the amount of code)

```
int textureID;  //an image has been loaded for this.

//somewhere inside display()
//add to this part of the program



for( int i = 0 ; i < TERRAIN_WIDTH ; i++ )
{



    glBegin( GL_TRIANGLE_STRIP );



    for( int j = 0 ; j <= TERRAIN_DEPTH ; j++ )
    {



        glNormal3f( normals[i][j].x ,
                    normals[i][j].y ,
                    normals[i][j].z );



        glVertex3f( i , height_map[i][j] , j );



        glNormal3f( normals[i+1][j].x ,
                    normals[i+1][j].y ,
                    normals[i+1][j].z );



        glVertex3f( i+1 , height_map[i+1][j] , j );



    }



}



glEnd( );
```

```
}
```

9. (10%)
Scalars in bezier curves are found by factoring Bernstein polynomials:
$B^L = \left((1 - t) + t\right)^L$ for a bezier curve with $L + 1$ control points.

A camera is moved along a bezier curve with 4 control points.

P_1 = (3, 5, 7), P_2 = (7, 5, 3), P3 = (10, 5, 4), P_4 = (15, 5, 8)

The motion should start 20 seconds after the program starts and it should end 10 seconds later, 30 seconds after the program starts.
Where is the camera at the time 24 seconds after the program started ?

Bonus question (3%)

A: What do you want?
B: My face on the one dollar bill.
A: You must be joking.
B: Do I look like I'm joking?

Who are speaking and in which film ?