2nd Homework – Computer graphics and game technology

2nd homework is an adaptation/extension of 1st homework. To start with the 2nd homework you have to have implemented at least drawing of 3D objet as wireframe, which will be adapted and extended. 2nd homework is intended for students who have not gathered enough points with 1st homework or as bonus points.

1st step (1 point)

Implement calculation of lighting based on Phong lighting model for individual vertex of loaded geometry.

2nd step (1 point)

Draw wireframe model of loaded geometry, where lines are drawn with gradient between colors calculated for individual vertex. Check this example for help. The example contains method for drawing gradient lines.

3rd step (2 points)

Implement flat shading, where color of the triangle is calculated as average color of its vertices. For correct rendering you have to consider the order of drawn triangles (check Painter's algorithm). Sort the triangles according to the distance between their centers of gravity and the camera.

4th Step (3 points)

Upgrade 3rd Step so that you will use Z-buffer instead of Painter's algorithm.

For the purpose of lighting the format of file is adapted so that we also store the normal as shown below:

```
v x y z nx ny nz
…
```

Components **x**, **y** and **z** represent the position of the vertex, components **xn**, **yn** and **xz** represent a normal defined with vector.

The file may also contain definition of material as displayed below:

```
m Ka_r Ka_g Ka_b Kd_r Kd_g Kd_b Ks_r Ks_g Ks_b Ns
```

Values **K**** are between 0 and 1, value ns is between 0 and 1000. **Ka*** defines ambient color, **Kd*** defines diffuse color and **Ks*** defines specular color responses.

The file may also contain definition of one or more point lights as displayed below:

```
l x y z L_r L_g L_b
```

Values **x**, **y** and **z** represent light position and values **L**** define light color for all light components (ambient, diffuse and specular).

An example of whole file is presented below:

```
// material
m 0.8 0.8 0.8 0.3 0.6 0.9 0.8 0.8 0.8 10

// cube
// vertices of front face
v 0.0 0.0 1.0 0.0 0.0 1.0
v 1.0 0.0 1.0 0.0 0.0 1.0
v 1.0 1.0 1.0 0.0 0.0 1.0
v 0.0 1.0 1.0 0.0 0.0 1.0
// vertices of back
v 0.0 0.0 0.0 0.0 0.0 -1.0
v 0.0 1.0 0.0 0.0 0.0 -1.0
v 1.0 1.0 0.0 0.0 0.0 -1.0
v 1.0 0.0 0.0 0.0 0.0 -1.0
// vertices of left face
v 0.0 0.0 0.0 -1.0 0.0 0.0
v 0.0 0.0 1.0 -1.0 0.0 0.0
v 0.0 1.0 1.0 -1.0 0.0 0.0
v 0.0 1.0 0.0 -1.0 0.0 0.0
// vertices of right face
v 1.0 0.0 0.0 1.0 0.0 0.0
v 1.0 1.0 0.0 1.0 0.0 0.0
v 1.0 1.0 1.0 1.0 0.0 0.0
v 1.0 0.0 1.0 1.0 0.0 0.0
// vertices of bottom face
v 0.0 0.0 0.0 0.0 -1.0 0.0
v 1.0 0.0 0.0 0.0 -1.0 0.0
v 1.0 0.0 1.0 0.0 -1.0 0.0
v 0.0 0.0 1.0 0.0 -1.0 0.0
// vertices of top face
v 0.0 1.0 0.0 0.0 1.0 0.0
v 0.0 1.0 1.0 0.0 1.0 0.0
v 1.0 1.0 1.0 0.0 1.0 0.0
v 1.0 1.0 0.0 0.0 1.0 0.0

// faces
f 1 2 3
f 1 3 4
f 5 6 7
f 5 7 8
f 9 10 11
f 9 11 12
f 13 14 15
f 13 15 16
f 17 18 19
f 17 19 20
f 21 22 23
f 21 23 24

// lights
l 5.0 5.0 5.0 1.0 0.9 0.6
l -5.0 5.0 5.0 0.7 1.0 1.0
```

Submit the homework in **ZIP** archive, which must contain source code (**html** and **js** files only). The homework is worth 7 % of the final grade.