上机作业2：手工计算光照效果

1. 设置光线方向

设定光线方向为$(1.0, 2.0, 1.0)$.

2. 计算光线和三角面的法向量的点积：

2.1 存储：

创建双精度向量存储光线和三角面的法向量点积.

```
vector<double> dot_products;
```

2.2 计算向量叉乘的函数：

按照叉乘计算公式计算，并将向量单位化.

```
vector<double> cross_product(vector<double> v1, vector<double> v2) {
    double x = v1[1] * v2[2] - v1[2] * v2[1];
    double y = v1[2] * v2[0] - v1[0] * v2[2];
    double z = v1[0] * v2[1] - v1[1] * v2[0];
    double norm = sqrt(x * x + y * y + z * z);
    return { x / norm, y / norm, z / norm };
}
```

2.3 计算三角面的法向量：

通过三角形的三个点得到两个平面向量，通过向量叉乘得到三角面的法向量.

```
vector<double> face_normal(vector<double> v1, vector<double> v2,
vector<double> v3) {
    vector<double> e1 = { v2[0] - v1[0], v2[1] - v1[1], v2[2] - v1[2] };
    vector<double> e2 = { v3[0] - v1[0], v3[1] - v1[1], v3[2] - v1[2] };
    return cross_product(e1, e2);
}
```

2.4 计算光线和法向量的点积

计算光线和法向量的点积并存入$dot_products$.

```
double dot_product(vector<double> v1, vector<double> v2) {
    return v1[0] * v2[0] + v1[1] * v2[1] + v1[2] * v2[2];
}
```

```
    void calculate_dot_products(float vertices[], int faces[]) {
        for (int i = 0; i < facesVector.size(); i += 3) {
        vector<double> v1 = { vertices[faces[i] * 3], vertices[faces[i] * 3 +
1], vertices[faces[i] * 3 + 2] };
        vector<double> v2 = { vertices[faces[i + 1] * 3], vertices[faces[i + 1]
* 3 + 1], vertices[faces[i + 1] * 3 + 2] };
        vector<double> v3 = { vertices[faces[i + 2] * 3], vertices[faces[i + 2]
* 3 + 1], vertices[faces[i + 2] * 3 + 2] };
        vector<double> normal = face_normal(v1, v2, v3);
        double dot = dot_product(normal, { 1.0, 2.0, 1.0 });
        dot_products.push_back(dot);
        }
    }
```

3. 深度测试

开启深度测试:

```
    glEnable(GL_DEPTH_TEST);
```

4. 网格着色

设置绘制模式为填充模式.

```
    double cl[3] = { 0.4f, 0.09f, 0.6f }; //设置为茄子色
    for (int i = 0; i < facesVector.size(); i += 3) {
       glPolygonMode(GL_FRONT_AND_BACK, GL_FILL);
       glBegin(GL_TRIANGLES);
       double t = dot_products[i / 3];
       glColor3f(cl[0] * t, cl[1] * t, cl[2] * t);
       glVertex3f(vertices[(faces[i]) * 3], vertices[(faces[i]) * 3 + 1],
vertices[(faces[i]) * 3 + 2]);
       glVertex3f(vertices[(faces[i+1]) * 3], vertices[(faces[i+1]) * 3 + 1],
vertices[(faces[i+1]) * 3 + 2]);
       glVertex3f(vertices[(faces[i+2]) * 3], vertices[(faces[i+2]) * 3 + 1],
vertices[(faces[i+2]) * 3 + 2]);
       glEnd();
   }
```

5.旋转后重新计算绘图

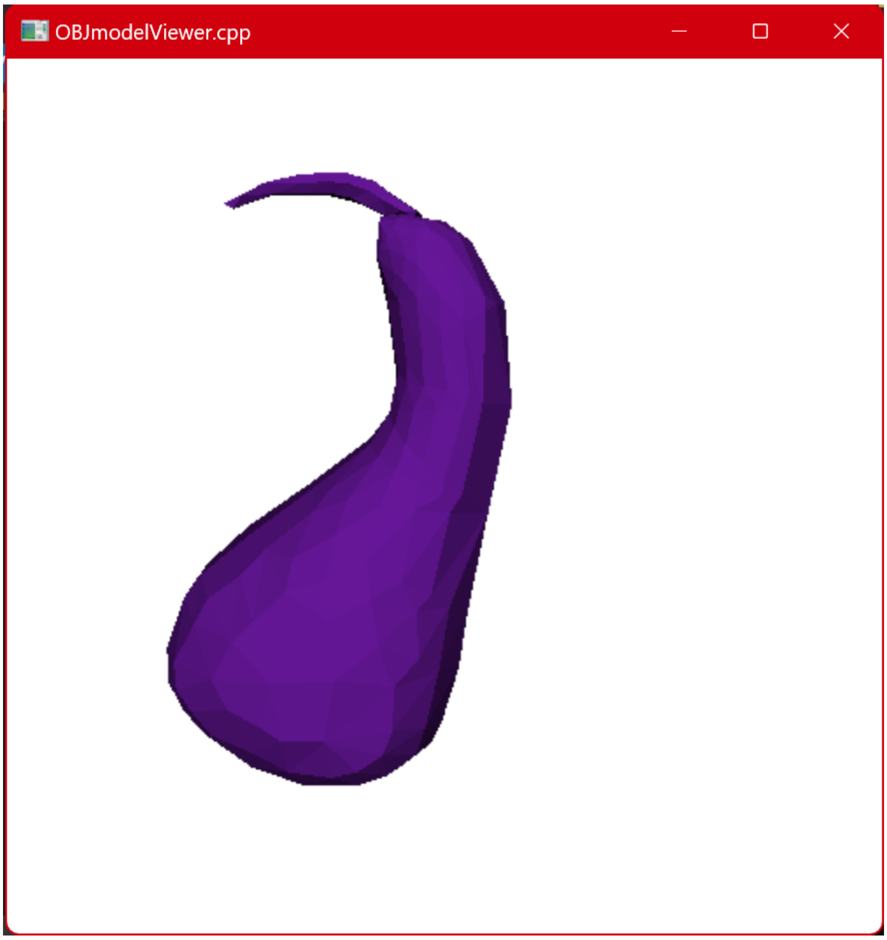
获取旋转矩阵:

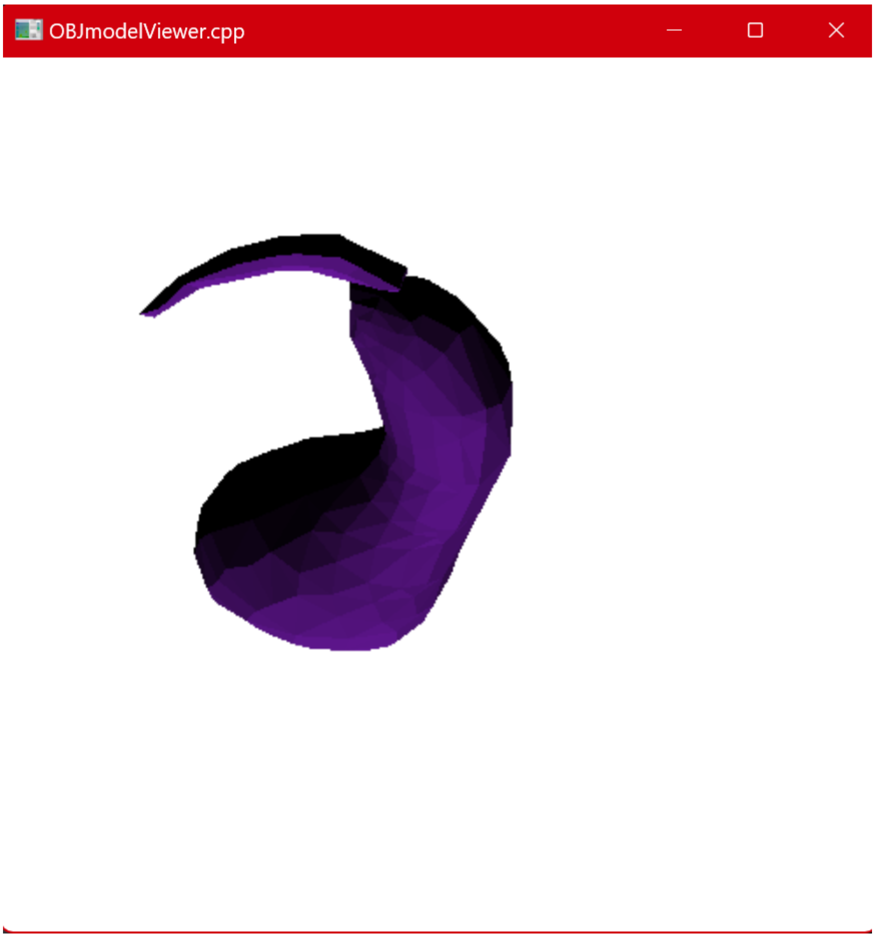
```
    glPushMatrix();
    glRotatef(Zangle, 0.0, 0.0, 1.0);
    glRotatef(Yangle, 0.0, 1.0, 0.0);
    glRotatef(Xangle, 1.0, 0.0, 0.0);
    glGetFloatv(GL_MODELVIEW_MATRIX, rotation_matrix);
    glPopMatrix();
```

旋转面法向量，并重新计算其与光向量的点乘：

```
    dot_products.clear();

    for (int i = 0; i < face_normal_vector.size(); ++i) {
        vector<double> normal = face_normal_vector[i];
        vector<double>temp(normal);

        temp[0] = rotation_matrix[0] * normal[0] + rotation_matrix[1] *
normal[1] + rotation_matrix[2] * normal[2] ;//+ rotation_matrix[3] * 0;
        temp[1] = rotation_matrix[4] * normal[0] + rotation_matrix[5] *
normal[1] + rotation_matrix[6] * normal[2];//+ rotation_matrix[7] * 0;
        temp[2] = rotation_matrix[8] * normal[0] + rotation_matrix[9] *
normal[1] + rotation_matrix[10] * normal[2];// + rotation_matrix[11] * 0;
        //temp[3] = 0;
        normal = temp;

        double dot = dot_product(normal, light_vector);
        if (dot < 0) dot = 0;
        dot_products.push_back(dot);
    }
```

5. 运行结果


OBJmodelViewer.cpp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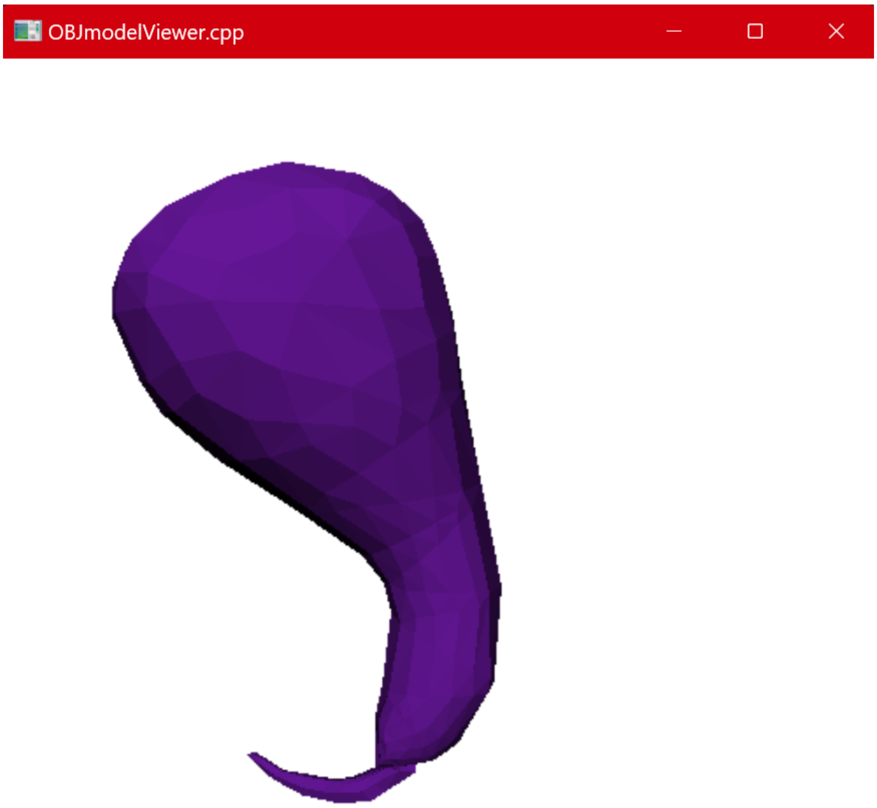
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