作业6实验报告

实验要求

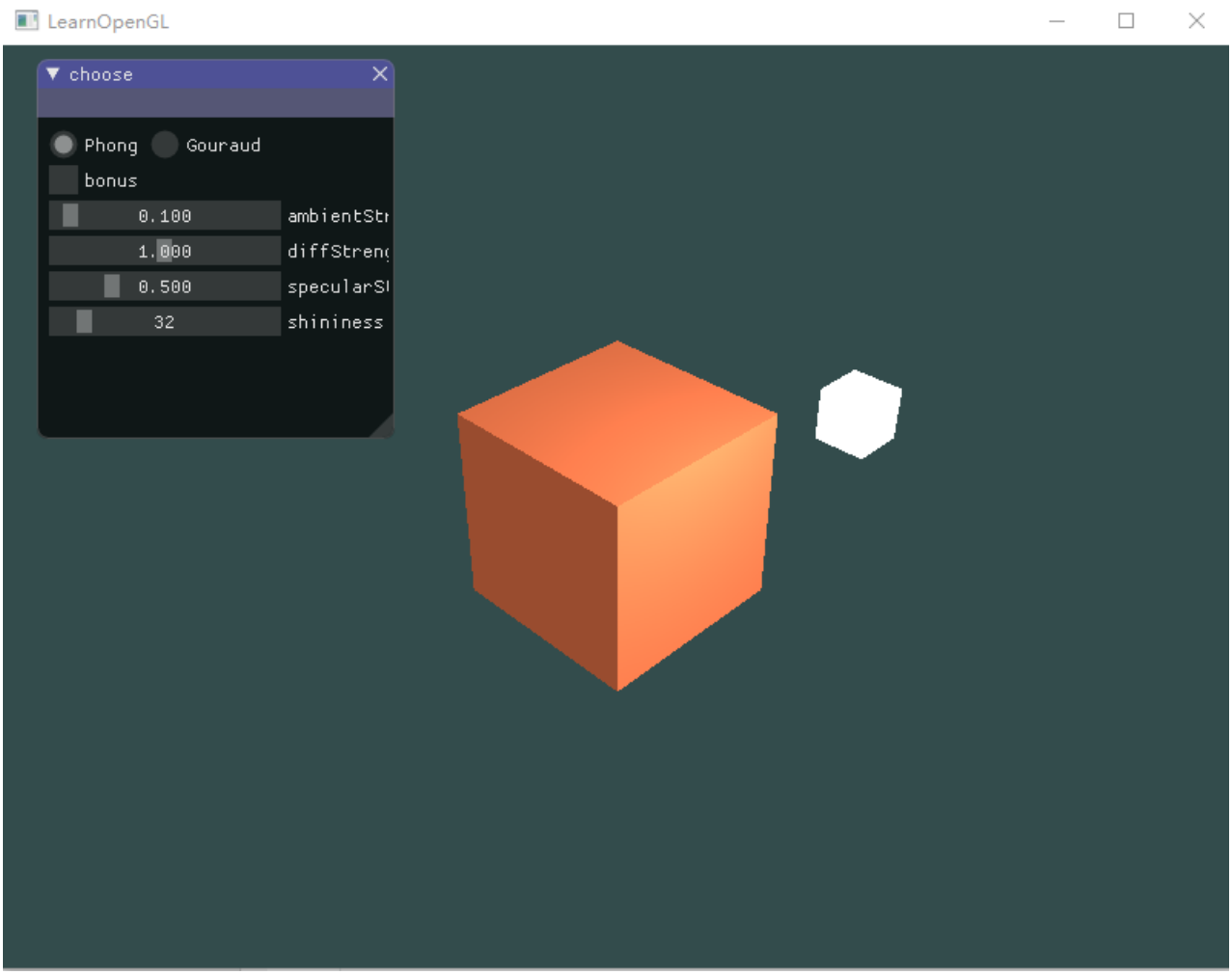
Basic:

1. 实现Phong光照模型： 场景中绘制一个cube 自己写shader实现两种shading: Phong Shading 和 Gouraud Shading，并解释两种shading的实现原理，合理设置视点、光照位置、光照颜色等参数，使光照效果明显显示。
2. 使用GUI，使参数可调节，效果实时更改： GUI里可以切换两种shading 使用如进度条这样的控件，使ambient因子、diffuse因子、specular因子、反光度等参数可调节，光照效果实时更改

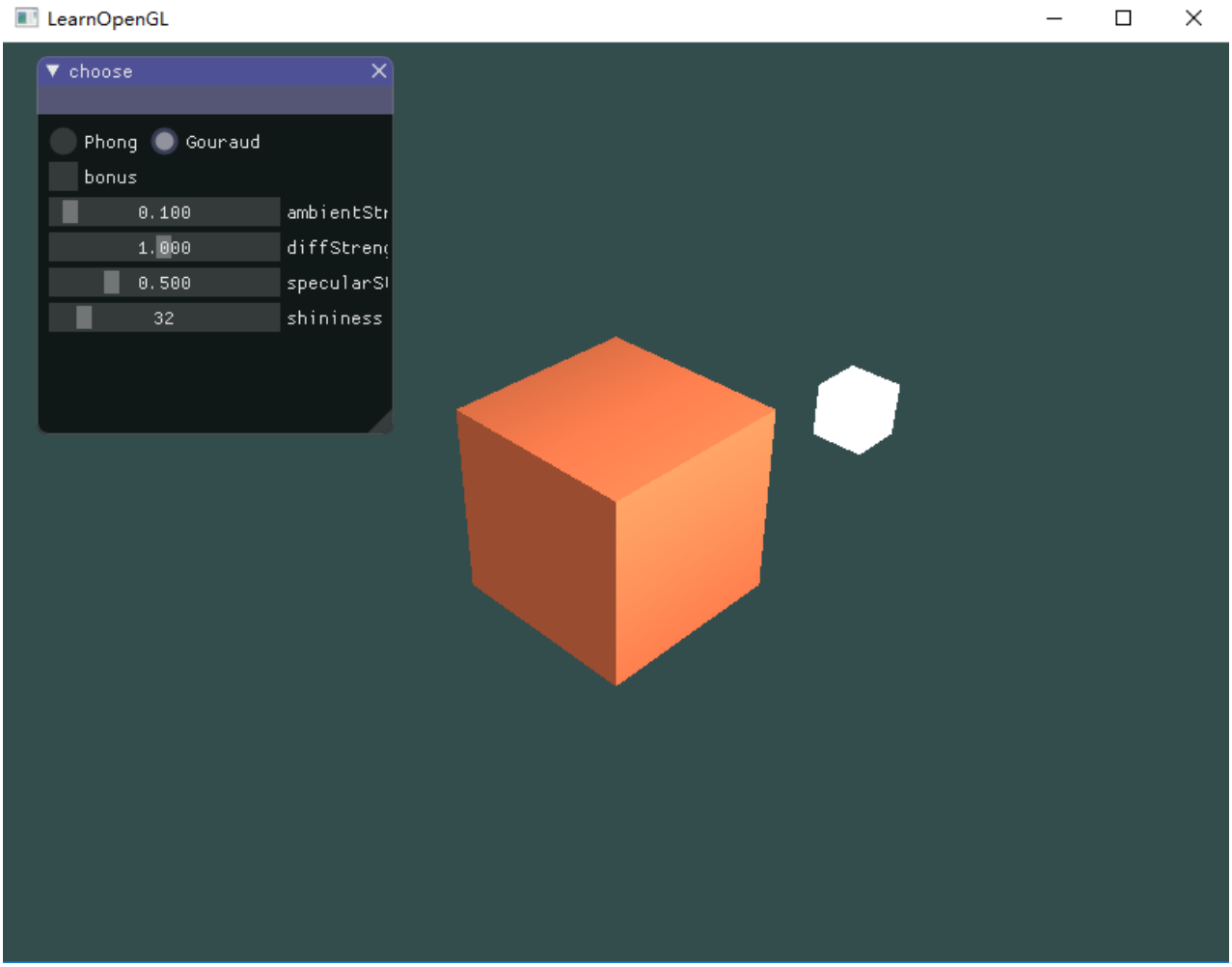
Bonus: 当前光源为静止状态，尝试使光源在场景中来回移动，光照效果实时更改。

实验截图

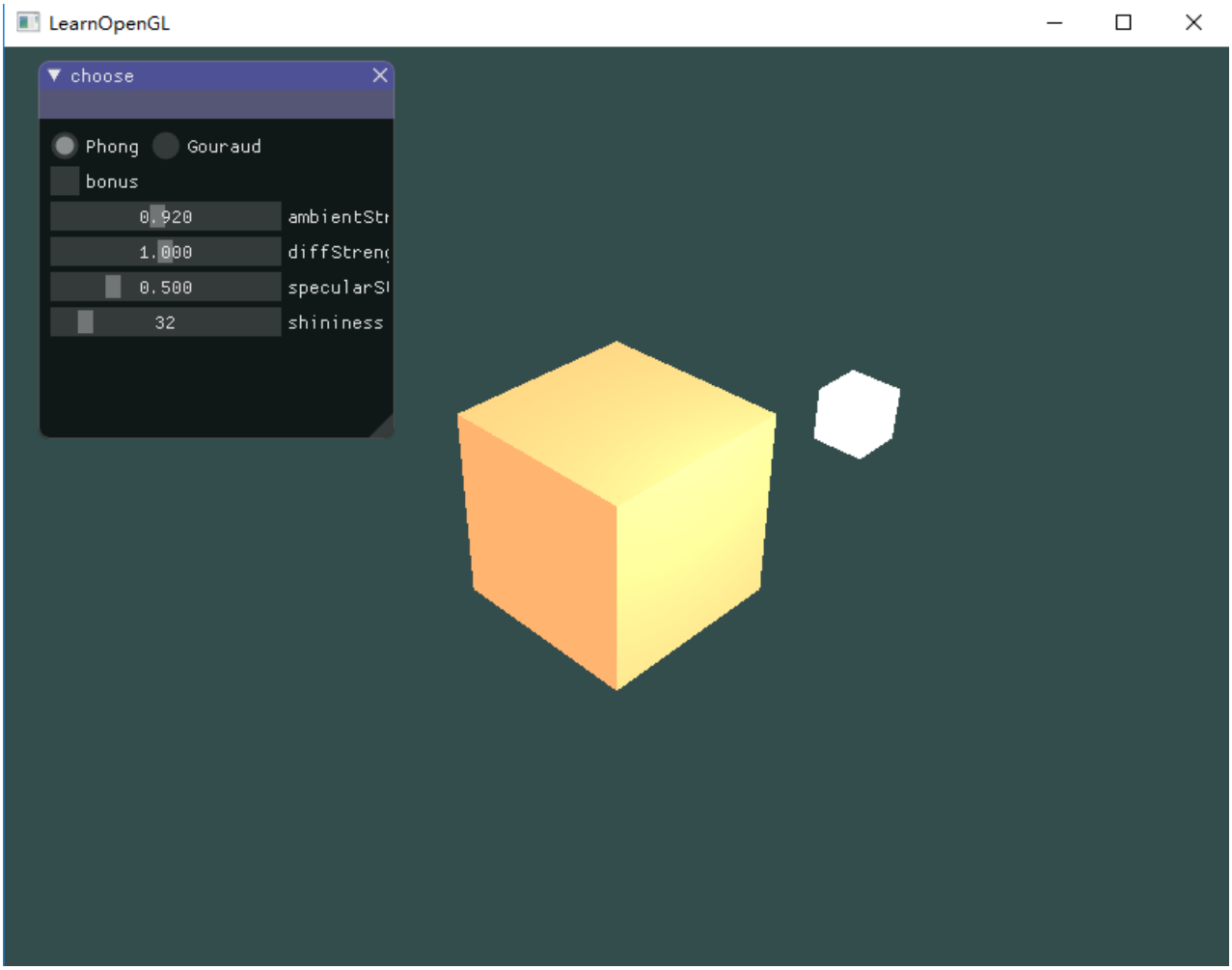
1. phong光照模型

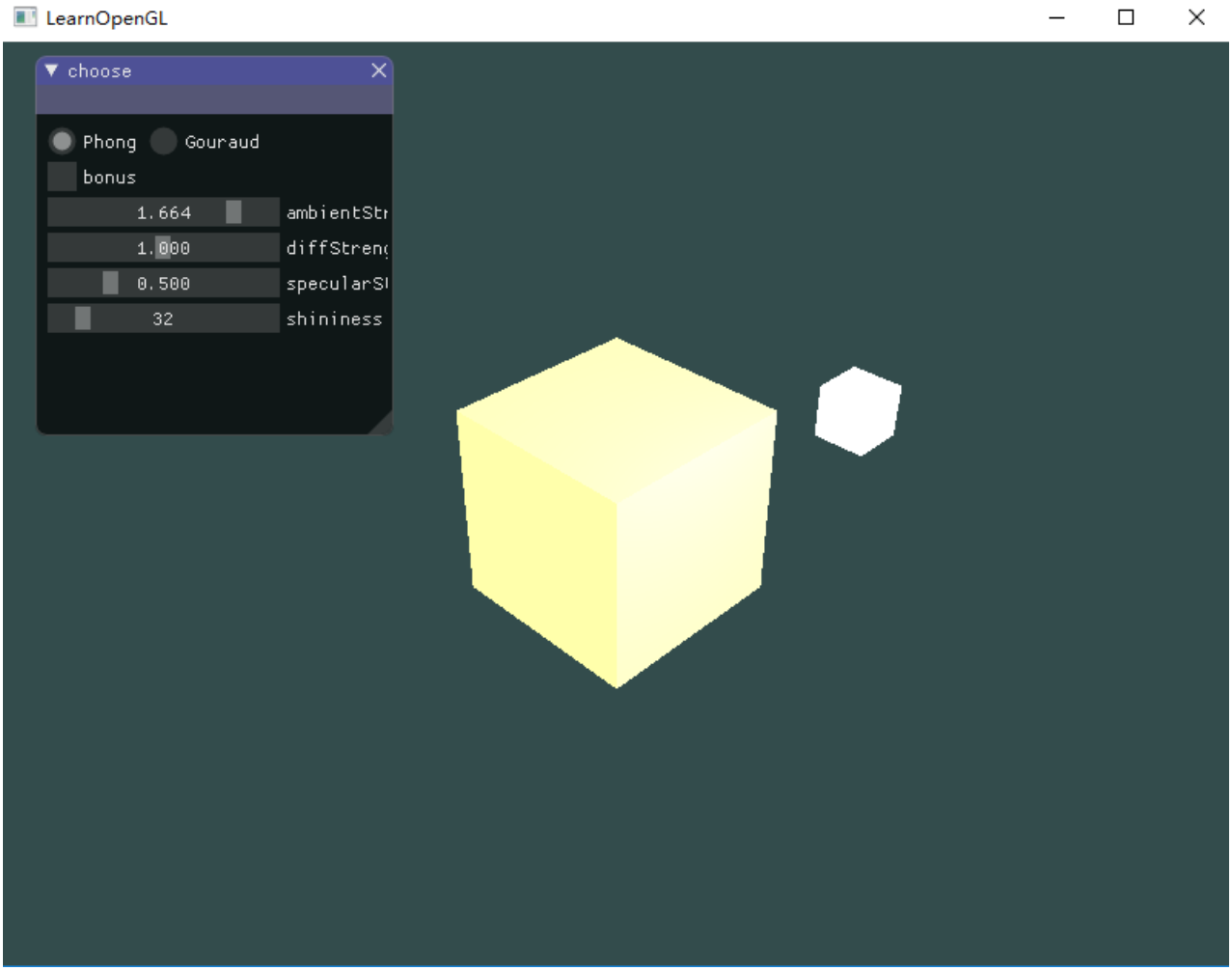


2. gouraud光照模型
3.

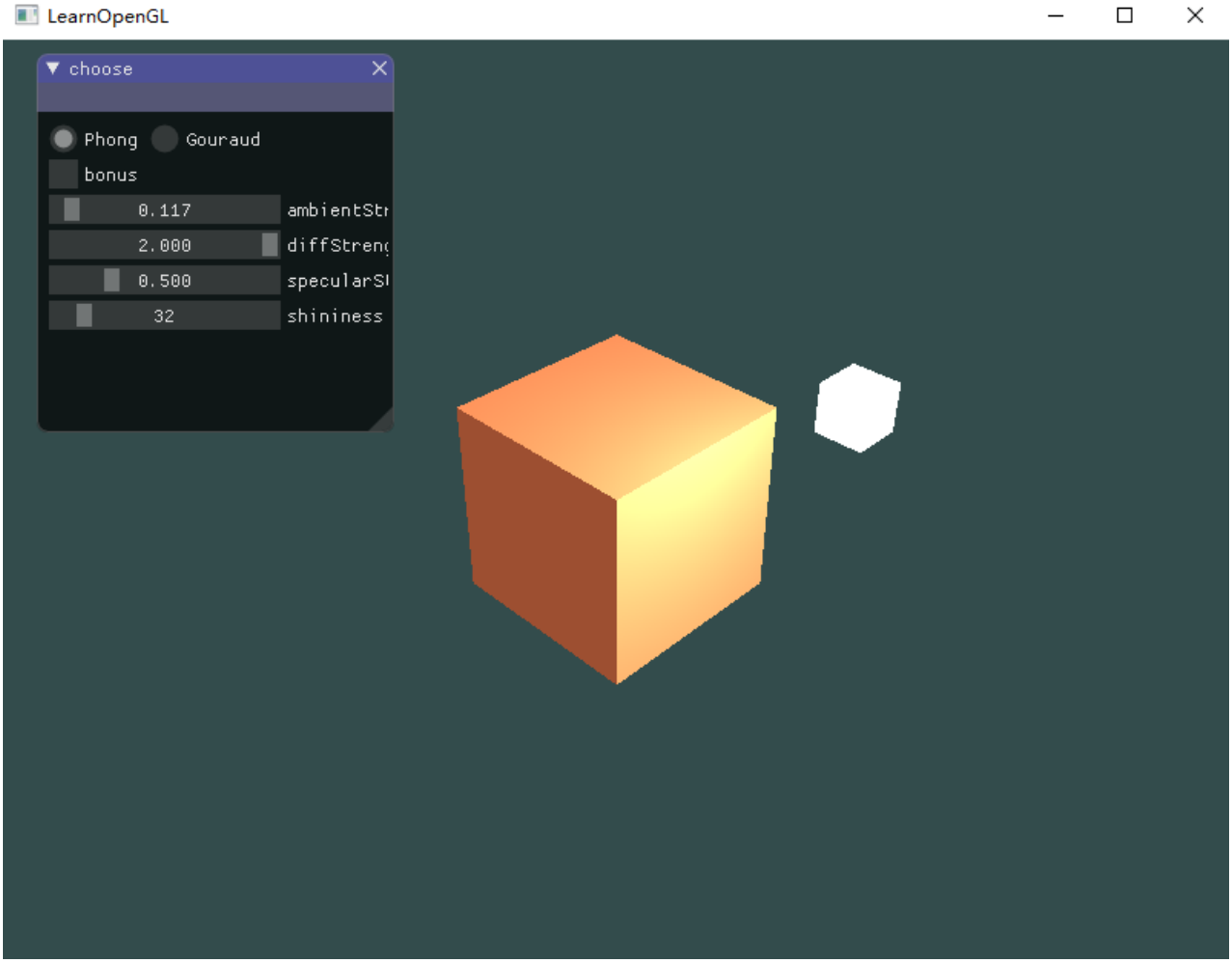


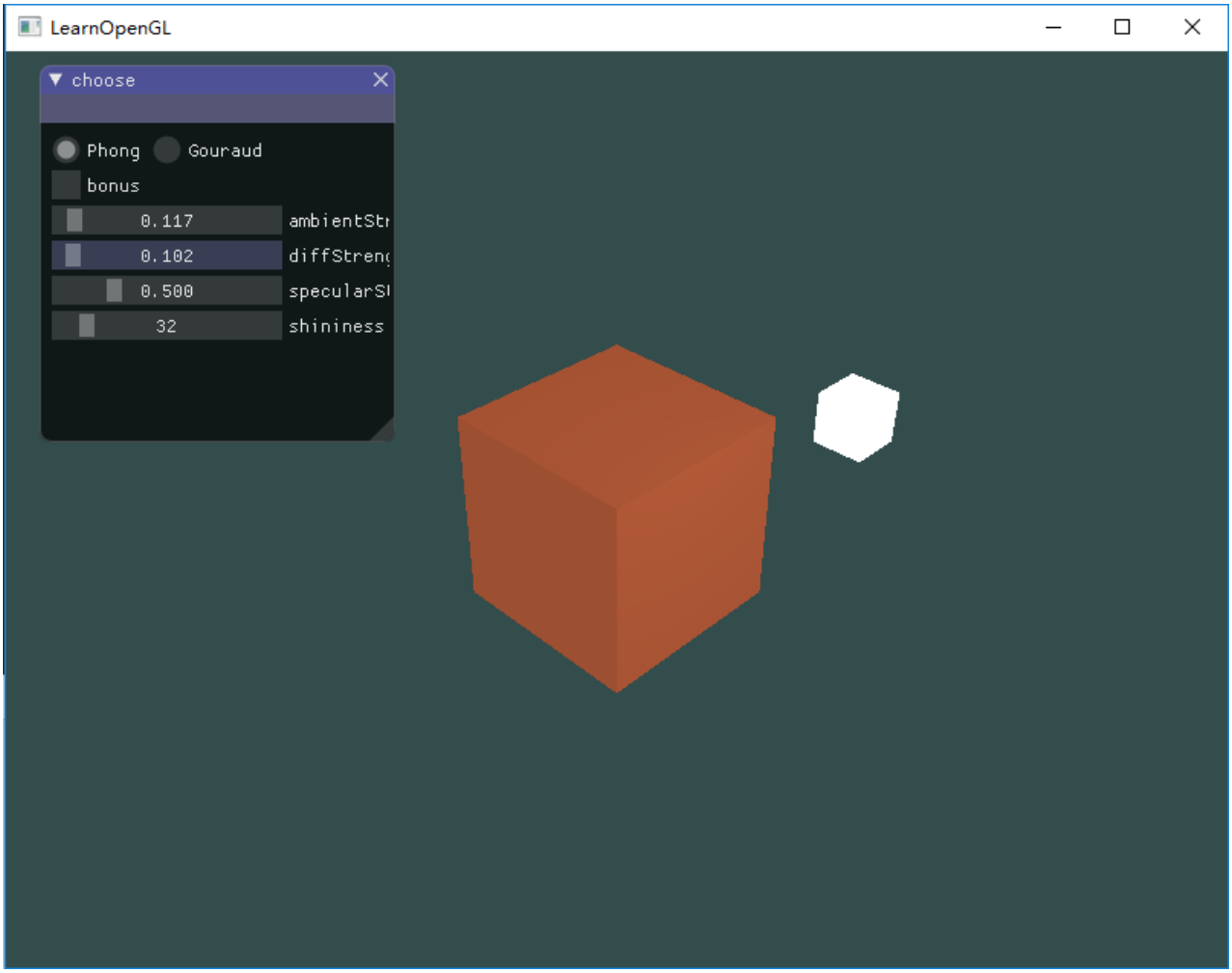
4. GUI调整ambient因子


LearnOpenGL
choose
Phong
Gouraud
bonus
0.920
ambientStr
1.000
diffStreng
0.500
specularSt
32
shininess

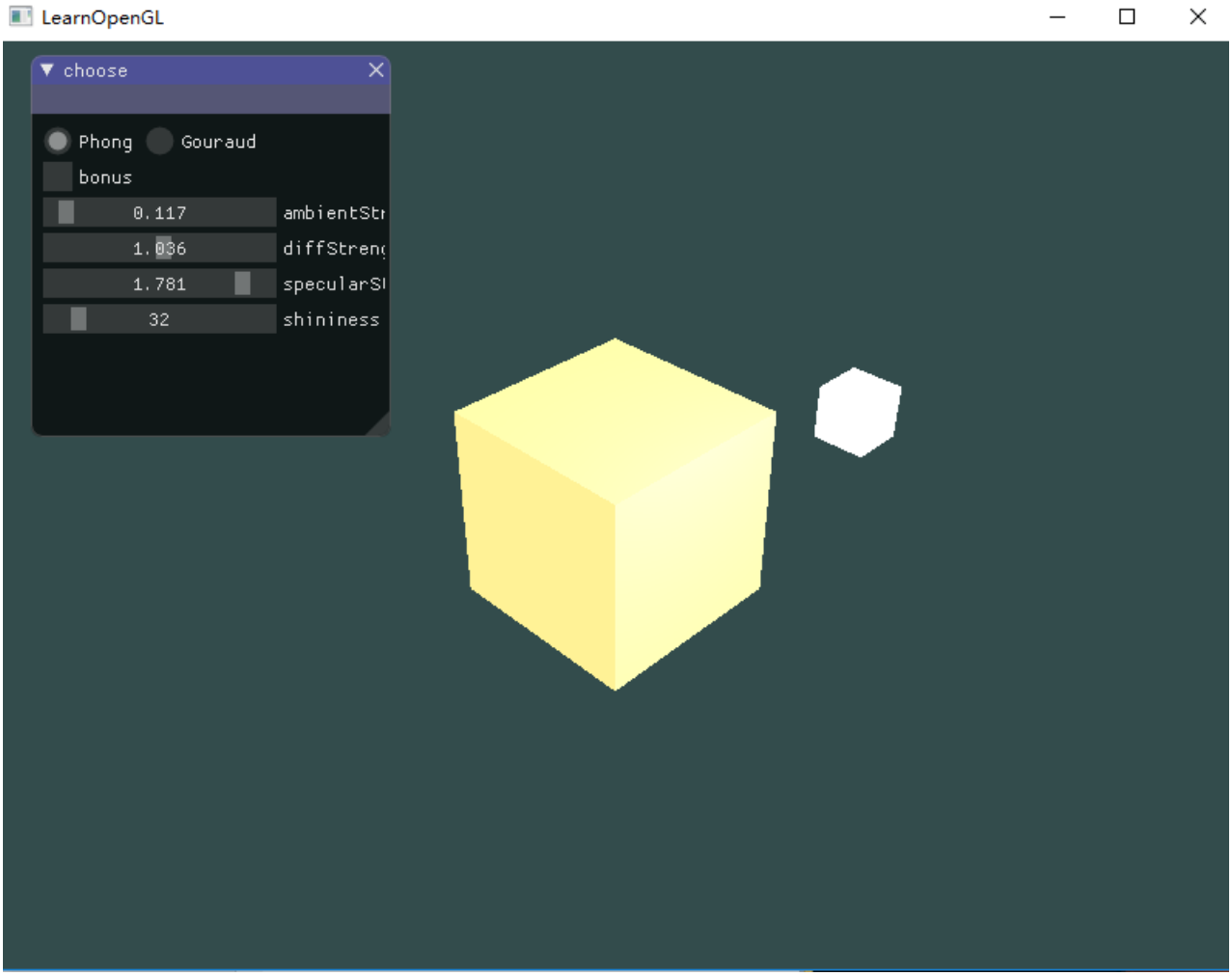


5. GUI调整diffuse因子


LearnOpenGL
choose
Phong
Gouraud
bonus
0.117
ambientStr
2.000
diffStreng
0.500
specularSt
32
shininess



6. GUI调整specular因子


LearnOpenGL
choose
Phong
Gouraud
bonus
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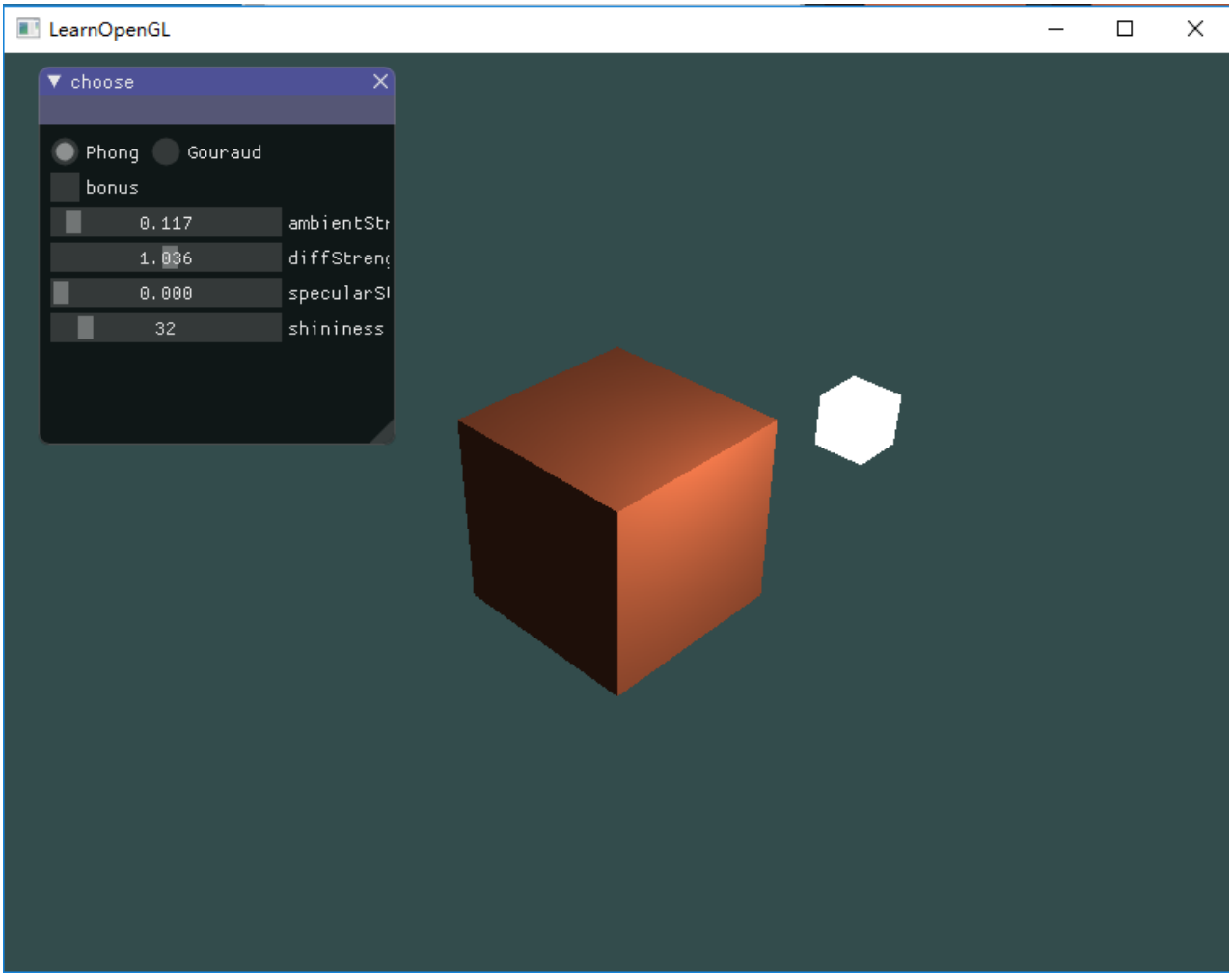
ambientStr
1.036
diffStreng
1.781
specularSt
32
shininess


LearnOpenGL
choose
Phong
Gouraud
bonus
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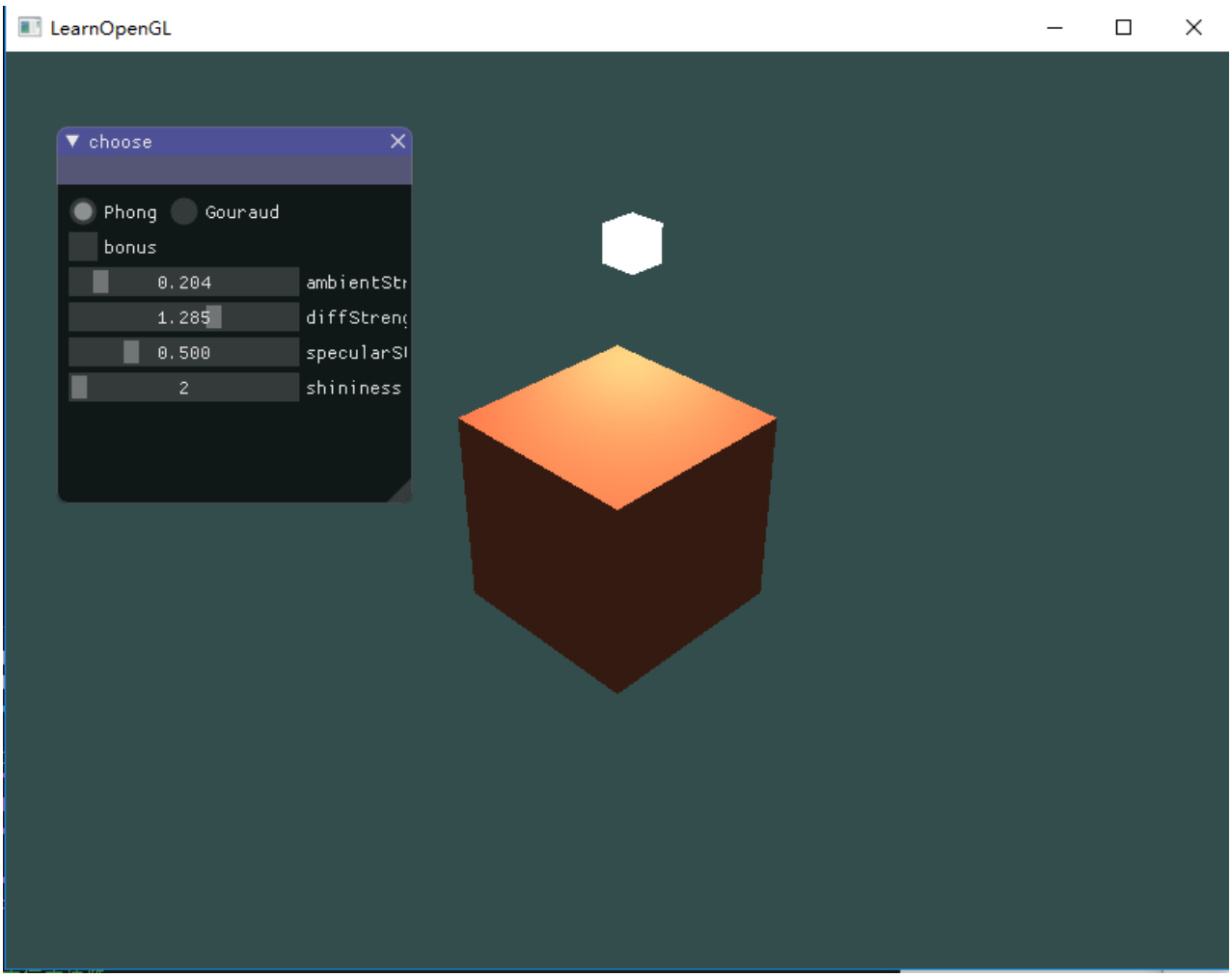
ambientStr
1.036
diffStren
0.000
specularSt
32
shininess

7. GUI调整反光度


LearnOpenGL
choose
Phong
Gouraud
bonus
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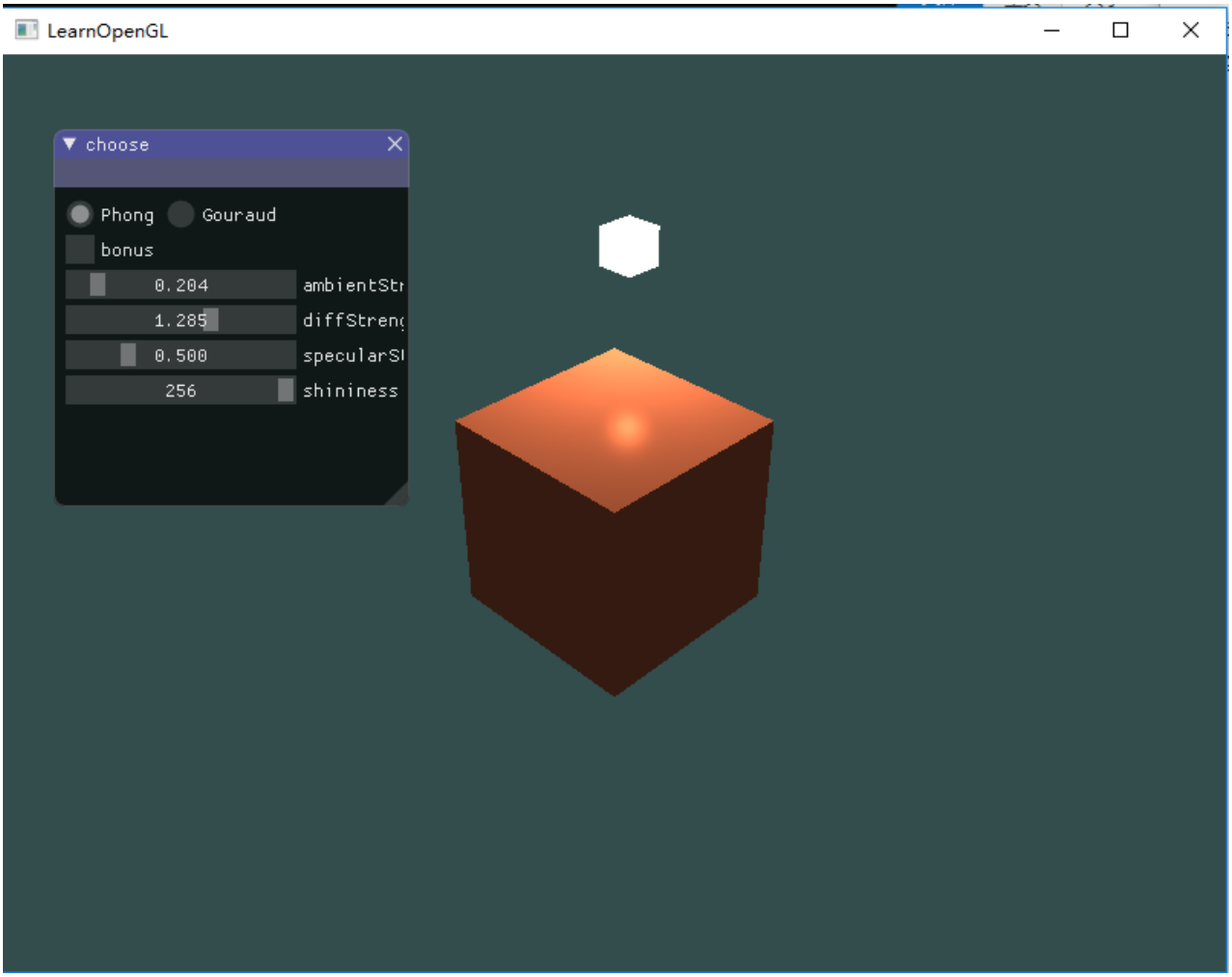
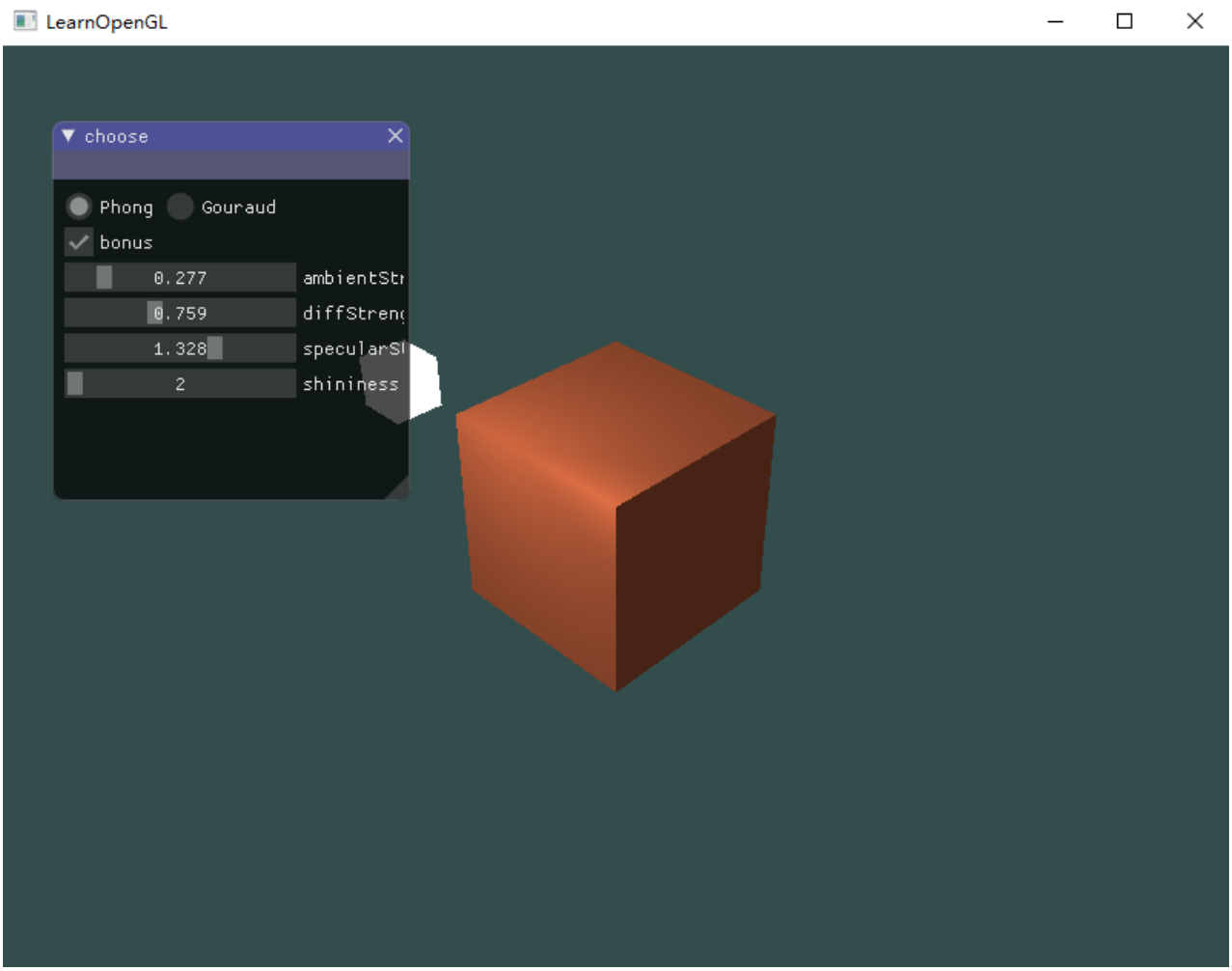
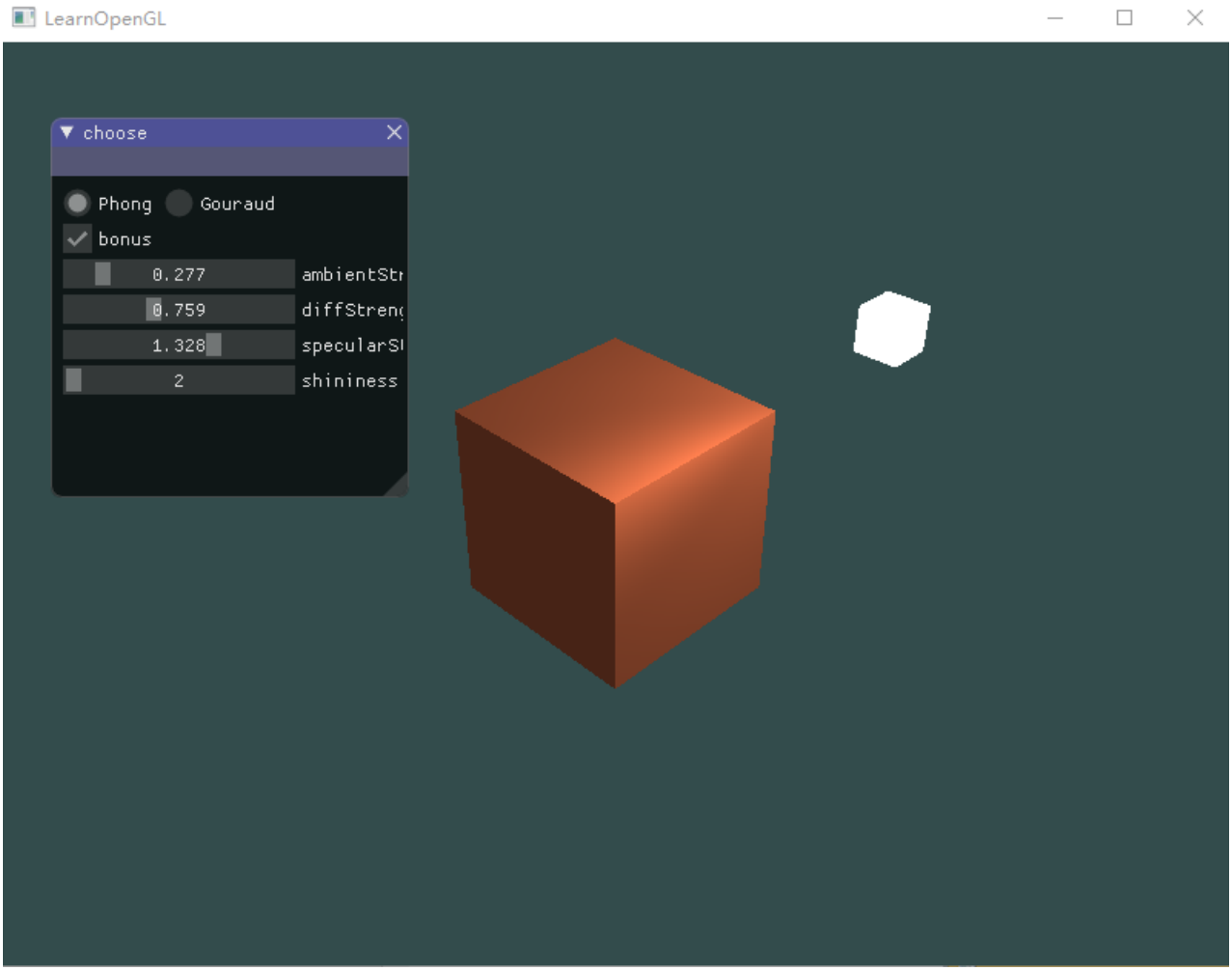
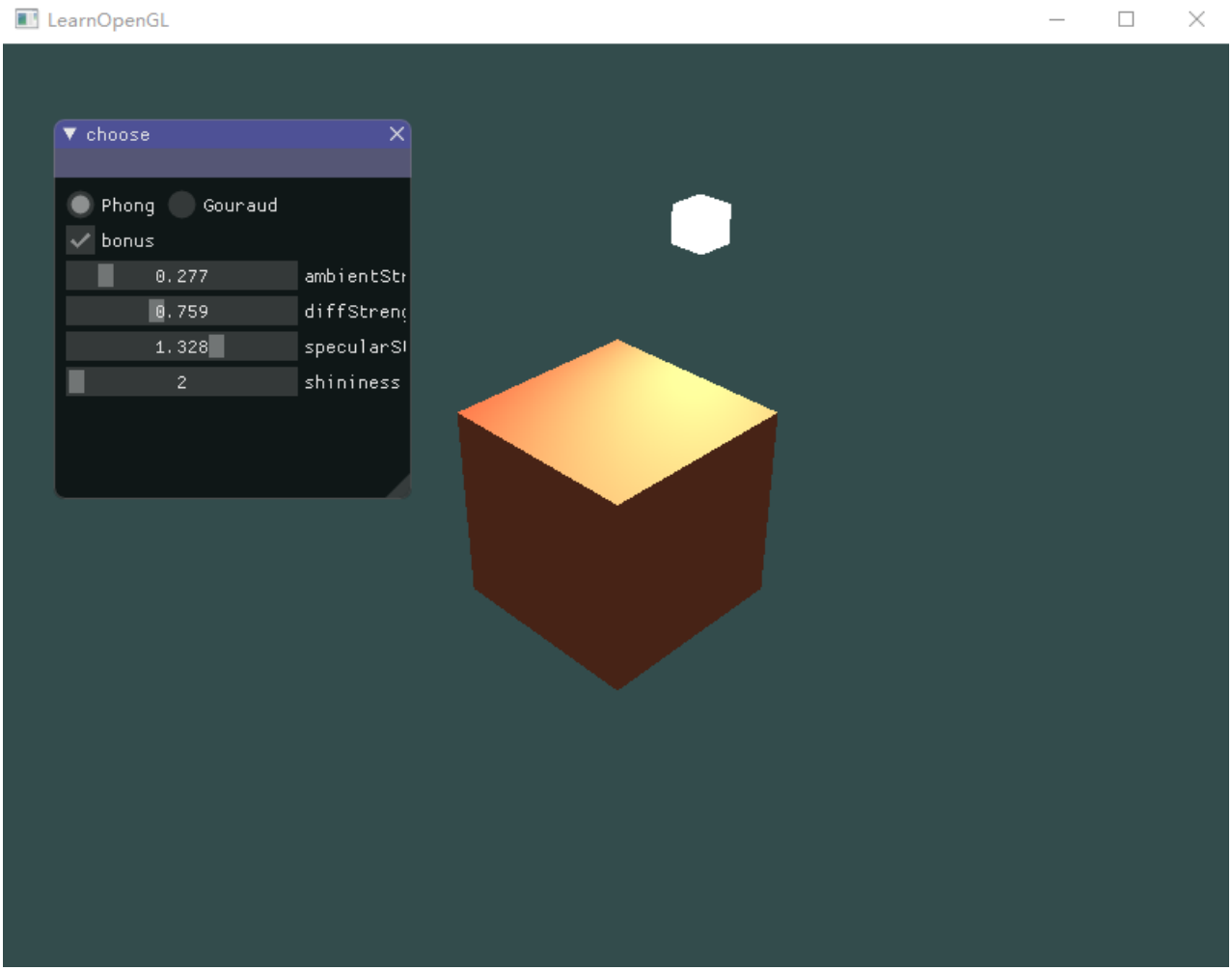
ambientStr
1.285
diffStreng
0.500
specularSt
2
shininess


LearnOpenGL
choose
Phong
Gouraud
bonus
0.204
ambientStr
1.285
diffStren
0.500
specularSt
256
shininess

8. bonus


LearnOpenGL
choose
Phong
Gouraud
bonus
0.277
ambientStr
0.759
diffStren
1.328
specularSt
2
shininess


LearnOpenGL
choose
Phong
Gouraud
bonus
0.277
ambientStr
0.759
diffStren
1.328
specularSt
2
shininess



关键代码

1. 设置phong、gouraud模型并提供选择

```
Shader phongShader("base_light.vs", "base_light.fs");
Shader gouraudShader("gouraud_light.vs", "gouraud_light.fs");

if (phong) {
    phongShader.use();
    // 设置uniform变量
    phongShader.setVec3("objectColor", 1.0f, 0.5f, 0.31f);
    phongShader.setVec3("lightColor", 1.0f, 1.0f, 1.0f);
    phongShader.setVec3("lightPos", glm::vec3(light_x, light_y, light_z));
    phongShader.setVec3("viewPos", glm::vec3(3, 3, 3));
    phongShader.setFloat("ambientStrength", ambientStrength);
    phongShader.setFloat("diffStrength", diffStrength);
    phongShader.setFloat("specularStrength", specularStrength);
    phongShader.setInt("shininess", shininess);
}
else {
    gouraudShader.use();
    // 设置uniform变量
    gouraudShader.setVec3("objectColor", 1.0f, 0.5f, 0.31f);
    gouraudShader.setVec3("lightColor", 1.0f, 1.0f, 1.0f);
```

```
    gouraudShader.setVec3("lightPos", glm::vec3(light_x, light_y, light_z));
    gouraudShader.setVec3("viewPos", glm::vec3(3, 3, 3));
    gouraudShader.setFloat("ambientStrength", ambientStrength);
    gouraudShader.setFloat("diffStrength", diffStrength);
    gouraudShader.setFloat("specularStrength", specularStrength);
    gouraudShader.setInt("shininess", shininess);
}
```

2. 提供各因子的调节：

```
// 初始化变量
float ambientStrength = 0.1f, diffStrength = 1.0f, specularStrength = 0.5f;
int shininess = 32;
bool bonus = false;
static int phong = 1;
...
ImGui::RadioButton("Phong", &phong, 1); ImGui::SameLine();
ImGui::RadioButton("Gouraud", &phong, 0);
ImGui::Checkbox("bonus", &bonus);
ImGui::SliderFloat("ambientStrength", &ambientStrength, 0.0f, 2.0f);
ImGui::SliderFloat("diffStrength", &diffStrength, 0.0f, 2.0f);
ImGui::SliderFloat("specularStrength", &specularStrength, 0.0f, 2.0f);
ImGui::SliderInt("shininess", &shininess, 2, 256);

// 传入shader中
phongShader.setFloat("ambientStrength", ambientStrength);
phongShader.setFloat("diffStrength", diffStrength);
phongShader.setFloat("specularStrength", specularStrength);
phongShader.setInt("shininess", shininess);

// 在shader中的设置
uniform float ambientStrength;
uniform float diffStrength;
uniform float specularStrength;
uniform int shininess;

void main()
{
    // ambient
    vec3 ambient = ambientStrength * lightColor;

    // diffuse
    vec3 norm = normalize(Normal);
    vec3 lightDir = normalize(lightPos - FragPos);
    float diff = max(dot(norm, lightDir), 0.0);
    vec3 diffuse = diffStrength * diff * lightColor;

    // specular
    vec3 viewDir = normalize(viewPos - FragPos);
    vec3 reflectDir = reflect(-lightDir, norm);
    float spec = pow(max(dot(viewDir, reflectDir), 0.0), shininess);
    vec3 specular = specularStrength * spec * lightColor;
```

```
    vec3 result = (ambient + diffuse + specular) * objectColor;
    FragColor = vec4(result, 1.0);
}
```

3. bonus设置光源旋转

```
// 初始化光源位置
float light_x = 1.2f, light_y = 1.0f, light_z = 0.0f;

// 设置旋转
if (bonus) {
    light_x = sin((float)glfwGetTime()) * 1.2f;
    light_z = cos((float)glfwGetTime()) * 1.0f;
}
else {
    light_x = 1.2f;
    light_z = 0.0f;
}

//设置光源
lightShader.use();
lightShader.setMat4("projection", projection);
lightShader.setMat4("view", view);

model = glm::mat4(1.0f);
model = glm::translate(model, glm::vec3(light_x, light_y, light_z));
model = glm::scale(model, glm::vec3(0.2f));
lightShader.setMat4("model", model);
```

实验思考

两种shading的实现原理

phong shading主要结构由3个元素组成：环境、漫反射和镜面光照。

- 环境光照：即使在黑暗的情况下，世界上也仍然有一些光亮(月亮、一个来自远处的光)，所以物体永远不会是完全黑暗的。我们使用环境光照来模拟这种情况，也就是无论如何永远都给物体一些颜色。
- 漫反射光照：模拟一个发光物对物体的方向性影响。它是冯氏光照模型最显著的组成部分。面向光源的一面比其他面会更亮。
- 镜面光照：模拟有光泽物体上面出现的亮点。镜面光照的颜色，相比于物体的颜色更倾向于光的颜色。

先在顶点着色器中计算得到顶点的法向量，再传给片段着色器中进行颜色的计算。

Gouraud Shading则是再顶点着色器中进行颜色的计算，之后再直接传给片段着色器。其开销会较低，但其光照效果则没有phong shading真实。