1.提交说明

您提交的文件将包含一个包含源代码和报告的单个存档（少于6页）。只接受标准.zip、.tar.gz和.tar.bz2存档。通过Minerva提交（不要通过电子邮件发送解决方案！）。有关更多说明，请参见Minerva页面。该报告是评估的基础。源代码支持报告中的断言。

源代码必须在实验室会话中提供配置1的计算机上编译并运行。您的代码必须基于本课程提供的代码。您必须使用包含的预制构建系统（该系统也已在本模块的练习和作业中使用）。您的代码必须干净地编译，即不应产生任何警告。如果有您无法解决或认为有错误的警告，您必须在报告中列出这些警告，并解释警告的含义以及在您的情况下可以接受的原因。不要更改分发代码中定义的警告级别。通过各种方式禁用单个警告仍然需要在报告中记录警告。

报告必须是一个名为report.PDF的PDF文件。在此报告中，您必须列出您尝试过的所有任务，并描述每个任务的解决方案。你可以在描述中引用你的代码，但是仅仅说“查看源代码”的描述是不够的。在相关的地方包括程序的屏幕截图（但是，不要包括代码的屏幕截图/图像-如果您希望包括代码，请确保使用适当的格式和布局将其呈现为PDF中的文本）。

应用良好的报告撰写实践。适当地组织报告。使用完整的英语句子。使用适当的语法、标点符号和拼写。为图片/截图提供图片说明，说明图片/截图显示的内容以及读者应注意的事项。请参考正文中的图片。适当引用外部参考文献。

您的提交不得包含构建或运行提交所需的任何“额外”文件（报告除外）。特别是，您不能包含构建工件（例如最终二进制文件、.o文件等）、IDE或其他工具生成的临时文件（例如.vs目录和内容）或版本控制使用的文件（例如.git目录和相关文件）。请注意，这些文件中的一些默认情况下可能是隐藏的，但在检查存档文件（.zip或类似文件）时，它们几乎总是可见的。不要提交未使用的代码（例如为测试而创建的代码）。提交不必要的文件可能会导致扣分。

2.任务

使用提供的框架，您将创建一个应用程序，演示使用OpenGL渲染视觉场景的能力。必须将基于现代着色器的OpenGL与顶点缓冲区和数组对象一起使用。

在一定范围内，您可以自由创建自己选择的场景。评估将基于场景的技术复杂性、场景元素以及用户交互的可能性。下面的方案列出了某些波段分级必须满足的最低要求。每个级别的评分基于：代码质量（正确性、清晰度、注释和效率）；报告中的设计选择和实施说明；以及视觉冲击。

⚫ 40%-50%：必须使用多组对象创建一个显示合理复杂性的视觉场景。您必须至少包含一个在代码中构造的复杂对象（例如，不是从文件加载的）。您必须实现一个透视投影，该投影在调整大小时适应窗口大小。您必须包括一个第一人称风格的3D相机，用户可以使用鼠标和键盘（WSAD+EQ控制位置，鼠标四处查看，shift加速，ctrl减速）来导航场景。相机控件必须与帧速率无关。必须实现源自点光源的漫反射和环境光着色；点光源必须在CPU代码中定义，即不能在着色器中“硬编码”。阴影的效果必须是可感知的。您的场景必须与XJCO3811中练习和演示中使用的简单场景有很大不同。

⚫ 50%-60%：您必须满足上一个乐队的所有要求。场景必须至少包含一个动画对象。动画必须与帧速率无关。用户必须能够通过键盘交互控制动画（暂停/恢复和加速/减速）。您必须包含完整（且正确）的Blinn Phong照明模型，至少包含一个点光源。场景中必须至少有一个：具有主要漫反射材质的对象、具有主要镜面反射材质的物体和具有发射材质的物体。（在你的报告中包括这些的截图，并讨论外观上的差异。）

⚫ 60%-70%：您必须满足之前乐队的所有要求。必须实现纹理映射。至少有一个对象必须使用课程提供的纹理之一（在Minerva上单独下载）；纹理必须在三维场景中可见和可识别。您必须使用多个光源（三个或更多），并且它们必须相互区分。必须至少包含一个从外部Wavefront.obj文件加载的对象。加载的对象必须同时包含纹理坐标和法线。

⚫ 70%-100%：您必须满足之前乐队的所有要求。必须包含一个或多个需要层次建模和变换的对象，这些对象在其某些部分中显示运动。必须包含一个沿复杂预定义路径移动的对象（例如，通过多个线段或控制点）。必须使用多重纹理，其中附加纹理控制材质的发射颜色或镜面反射指数。您应该集成第三方UI库（例如ImGUI），并使用UI控制一个或多个对象（例如，调整其材质参数）。最后，您可以研究一个自定义（而不是Blinn Phong）着色模型并实现它（在报告中描述该模型以及相关来源）。确保列出了报告中已实现的每个元素，并包含一个屏幕截图，显示应用程序呈现的该元素。每个要素将根据其复杂性、创造力和实施质量进行评估和评分。评估主要考虑技术方面，但可能会为特别有创意和/或好看的结果分配一些分数。

以下是英文版

2. Tasks

Using the provided framework you will create an application that demonstrates the ability to render visual scenes using OpenGL. You must use modern shader-based OpenGL with vertex buffer and array objects.

You are free, within some limits, to create a scene of your choice. Assessment will be based on the technical sophistication of the scene, the scene elements as well as on the possibility for user interaction. The scheme below sets out minimum requirements that must be met for grading in certain bands. Grading within each band is assessed based on: code quality ( correctness, clarity, commenting, and efficiency); explanations of design choices and of the implementation in the report; and visual impact.

⚫ 40% - 50%: You must create a visual scene that demonstrates reasonable complexity using several groups of objects. You must include at least one complex object constructed in code (e.g., not loaded from a file). You must implement a perspective projection that adapts to window size when resized. You must include a first-person style 3D camera with which a user can navigate the scene using the mouse and keyboard (WSAD+EQ to control position, mouse to look around, shift to speed up, and ctrl to slow down). Camera controls must be frame-rate independent. You must implement diffuse and ambient shading originating from a point light; the point light must be defined in the CPU code, i. e.., you may not “hardcode” it in the shader(s). The effects of the shading must be perceptible. Your scene must deviate substantially from the simple scenes used in the exercises and demos in XJCO3811.

⚫ 50% - 60%: You must fulfill all requirements from the previous band. Your scene must include at least one animated object. The animation must be frame-rate independent. The user must be able to control the animation ( pause/ resume and speed up/slow down) via keyboard interaction. You must include the full (and correct) Blinn-Phong lighting model, with at least one point light source. You must have at least one of each in your scene: an object with a mainly diffuse material, an object with a mainly specular material, and an object with an emissive material. (Include screeshots of these in your report and discuss the difference in appearance.)

⚫ 60% - 70%: You must fulfill all requirements from the previous bands. You must implement texture mapping. At least one object must use one of the textures provided with the coursework (separate download on Minerva) ; the texture must be visible and recognizable in your 3 D scene. You must use multiple light sources (three or more) , and they must be distinguishable from each other. You must include at least one object loaded from an external Wavefront .obj file. The loaded object must include both texture coordinates and normals.

⚫ 70% - 100%: You must fulfill all requirements from the previous bands. You must include one or more objects that require hierarchical modeling and transformations and that display motion in some of their parts. You must include an object that moves along a complex predefined path ( e. g. , through multiple line segments or control points) . You must use multi-texturing, where an additional texture controls the emissive color or specular exponent of a material. You should integrate a third party UI library ( e. g. ImGUI) and control one or more objects with the UI ( e.g., adjust its material parameters). Finally, you may research a custom ( not Blinn-Phong) shading model an implement it ( describe the model in your report, along with relevant sources). Make sure that you list each element that you have implemented in your report, and include a screenshot that shows this element as rendered by your application. Each element will be assessed and assigned a score based on its complexity, creativity and quality of implementation. Assessment considers primarily the technical aspects, but some marks may be assigned for particularly creative and/or good-looking results.

Wrapping up

Please double- check the requirements in Section 1 and ensure that your submission conforms to these. In particular, pay attention to file types (archive format and report format) and ensure that you have not included any unnecessary files in the submission.