COMP5822M

Coursework 2

This coursework was built from coursework 1's code

1. Prep and Debug
    a. The code that loads meshes was modified since neither of the models have textures. The code that created textured meshes was removed. The color buffer was removed. In its place, there are new normal, diffuse, emissive, specular, albedo and "shiny", where the final one is a vec2 of shininess and metalness.
    b. In main, the create pipeline and record commands functions were modified to have 7 inputs for the shader, rather than 2.
    c. A camera position was added to the scene uniform struct. The scene UBO was then made available to both vertex and fragment shaders since camera position is required for shading.
    d. A new struct with light color and position vectors was created so that a light uniform could be passed to only the fragment shader. The light UBO uses the same descriptor set as the scene UBO and uses binding 1.

2. Modified Blinn-Phong
    a. The Blinn-Phong model was added, as instructed. The shaders for it are the included BlinnPhong.vert and BlinnPhong.frag. The vertex shader is only different from the default shader by the values it passes to the fragment shader. All color calculations are done in the fragment shader.

3. Physically-inspired model
    a. The PBR model was added, as instructed. The shaders for it are the included PBR.vert and PBR.frag. The vertex shader is only different from the default shader by the values it passes to the fragment shader. All color calculations are done in the fragment shader.

4. Animated light position
    a. The chosen animation is a rotation around the y axis.
    b. It is rotated by a "counter", which gets increased by deltaTime each iteration of the main loop, meaning that it is framerate independent.
    c. Pressing spacebar toggles the rotation

5. Multiple light sources
    a. In the light uniform struct, position and color were changed to arrays of size 3 and a float was added for the number of lights.
    b. Changes to the fragment shaders were done accordingly, however the default and Blinn-Phong shaders still only use one light
    c. The PBR shader was modified to include up to the selected number of lights

    d. Pressing 1-3 will set the light number. It is important to note that these buttons do not turn lights off or on, they just set the maximum number of iterations for the for loop in the fragment shader.

6. Custom PBR model
    a. The component to improve chosen was the diffuse. The new model chosen is the Disney diffuse from Burley's 2012 paper "Physically based shading at disney".
    b. They found that the Lambert diffuse was too dark and that the Fresnel term made it even darker, so they designed a model that did not use it. The model they designed is as follows:

$$f_d = \frac{baseColor}{\pi} \left(1 + (F_{D90} - 1)(1 - \cos\theta_l)^5\right) \left(1 + (F_{D90} - 1)(1 - \cos\theta_v)^5\right)$$

where

$$F_{D90} = 0.5 + 2roughness\cos^2\theta_d$$

    c. In practice, this model does produce a brighter scene than the one from task 2.3.
    d. It is currently unsure whether the model was implemented correctly. The metalness of a mesh was used as the *roughness* in the equation, however that article has a separate *metalness* component.

References:

BURLEY, B. 2012. Physically based shading at disney. URL https://media.disneyanimation.com/uploads/production/publication_asset/48/asset/s2012_pbs_disney_brdf_notes_v3.pdf.