CS 300 | Advanced Computer Graphics I
Assignment 3 | Shadow Mapping with PCF

Description

In this assignment, the main task to implement shadow mapping with percentage closer filtering for a spotlight. The parsed scene format will have all the content used in assignment 0 with new added data listed below:

- Light data:
  - Lights will have two extra parameters for shadows:
    - `bias`: bias value used for the shadow depth comparison. Default is 0.
    - `pcf`: number of samples in the implementation of percentage closer filtering. The value will be the number of samples at each side of the selected pixel, so for a value of 3, the final number of samples will be $49 = (3 + 1 + 3)^2$. Default is 0.

The application should:

1. Read the input file
   a Load/Generate mesh data
   b Generate Texture
2. Upload data to OpenGL
3. Accept from the keyboard the user input in order to move the camera
4. Update objects/light with the corresponding animation
5. Build the camera and perspective transformation according to the user input
6. Set frame buffer, shader program and uniform to render shadow map
7. Draw each mesh (first pass):
   a **Vertex Shader**:
      i Transform position to light space.
   b **Fragment Shader**:
      i Stored depth value.
8. Set frame buffer, shader program and uniforms to render the scene from the camera
9. Draw each mesh
   a **Vertex Shader**:
      i Transform N from model to camera space by multiplying it by the normal matrix.
      ii Compute position in camera space for lighting computation.
      iii Output the vector to the fragment shader.
   b **Fragment Shader**:
      i Transform position from camera to light space and get texture coordinates to sample the shadow map.
      ii Apply percentage closer filtering to get shadow factor.
      iii Use the shadow factor for the the Phong Reflection Model
10. Finish frame

Notes

- Normal mapping is **NOT** required for this assignment and it should be disabled.
- Multiple lights are **NOT** required for this assignment and it should be disabled.
- The shadow map generated in the first pass should be visible in a small viewport on screen (with proper contrast adjustments so that the texture does not look fully white).

Material Properties

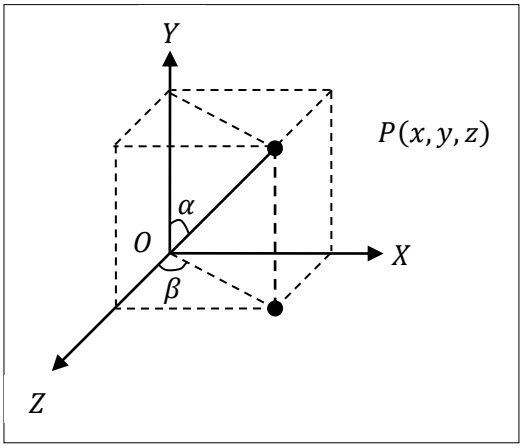
- Most material properties are hardcoded with the following values:
  - Texture to map on shape (when texturing is disabled use UV as color)
  - Ambient and Diffuse color (texture color)
  - Specular color (always white)
  - Shininess read from the scene file
  - Ambient coefficient will be 1
  - Normal map read from the scene file

Light

- Requirement:
  - One light properly lighting the scene. If the scene file contains multiple lights and they are not supported use the first one loaded.
  - Extra credit will be rewarded if multiple lights are supported up to a maximum of 8 lights. If the scene file contains more than 8 lights keep only the first 8 listed.
- Properties:
  - Type of light
  - Its position and/or direction.
  - Light color. Specular component will be white.
  - Attenuation coefficients (for the spotlights this includes the angular attenuation parameters).
  - Bias to apply on the depth comparison.
  - PCF number of neighbor samples on the Percentage Closer Filtering.

Input

- Camera will be controlled using spherical coordinates defined in the diagram. The target will be the origin of that coordinate system. The input should alter r, α and β as follows:
  - W: Make α angle smaller. It should move the camera towards the top of the target.
  - S: Make α angle greater. It should move the camera towards the bottom of the target.
  - A: Make β angle smaller. It should move the camera towards the left rotating around the target.
  - D: Make β angle greater. It should move the camera towards the left rotating around the target.
  - E: Make r greater. It should move the camera away from the target.
  - Q: Make r smaller. It should move the camera



closer to the target.

- N: Toggle normal/tangent/bitangent rendering
- T: Enable disable rendering shadow maps.
- F: Toggle face/averaged normal
- M: Toggle wireframe on/off
- +/- or Z/X: Increase/reduce number of slices (4 is the minimum number of slices)

Assignment Submission

Please refer to the syllabus for assignment submission guideline. Failure to the submission guidelines correctly might cause you to lose point.

Grading Rubrics

The following is a rough guideline on how your assignment will be graded and the weight of each part.

Feature	Grade %
Shadow map generation	30%
Shadow map usage	35%
PCF	25%
Scene and presentation	10%