

## CS606: Computer Graphics / Term 2 (2020-21) / Programming Assignment 3

International Institute of Information Technology Bangalore

**Announcement Date: Mar 12, 2021**

**Submission Deadline: 11:59 pm IST, Apr 04, 2021**

---

**Summary:** 3D rendering with lighting and shading, and rotation using quaternions

Learning Objectives:

- Setting up lighting for a scene
- Experimenting with lights
- Experimenting with Gouraud and Phong shading models
- Using quaternions for rotation

**Assignment: Illuminator**

### Assignment-3 Specifications

1. Generate or import a set of 3-4 mesh models that can be used in the following steps. These could be models you create using, say Blender, or import publicly available mesh objects (e.g .ply files).
2. Add a point light source corresponding to each mesh model, with different colors for ambient, diffuse, and specular components. Assign different material properties for each of the mesh objects, such as the three reflectance coefficients,  $k_a$ ,  $k_d$ ,  $k_s$  for ambient, diffuse, and specular, respectively, choice of material color, and distance attenuation terms, i.e.  $(a+bd+cd^2)$  where  $a$ ,  $b$ ,  $c$  are constant, linear, quadratic terms, respectively, and specular reflectance exponential value  $\alpha$ . Compute the local illumination model using all the light sources for all the surfaces in the scene.
  - a. The light source corresponding to a mesh must be always present within a bounding box, 1.25 times that of the bounding box of the mesh, where the bounding boxes of the light source and of the mesh are centered at the centroid of the mesh.
3. Give single-digit numeric IDs other than "0", "1", "2" to meshes, to be used for selecting the mesh. Set the default selected-mesh-ID as "2", implying none-of-the-meshes have been selected.
4. Set the **mesh-transformation mode** using key "m" to perform the affine transformations (translation, rotation, scaling) of the objects in the scene. When objects translate, their corresponding light source must translate using the same values.
  - a. After activating this mode, select a mesh for affine transformation.

- b. Each affine transformation on the selected mesh can be done in the “m” mode using keys or mouse buttons, except for rotation, which must be done using the left mouse button. You are free to design the user interaction rules for translation and scaling. Commonly used patterns are the right mouse button for translation, and +/- keys or the middle mouse button (where usable) for zooming. The idea is to use intuitive or commonly defined user interactions for these actions.
  - c. The rotations must be done using the trackball and quaternions. This involves mapping the distances moved on the screen by pressing down the left mouse to angle and axis of rotation.
  - d. The rotation and scaling must be done about the centroid of the mesh object.
  - e. The scaling of the mesh object cannot violate the position constraint provided for its corresponding light source, given in 2a. If the scaling violates the constraint, then the scaling cannot be implemented.
- 5. Set the **shading-model-choice mode** using the “s” key to toggle between the shading models, Gouraud, and Phong shading models.
  - a. Gouraud shading is implemented using a vertex shader, and Phong using a fragment shader.
  - b. Gouraud shading can be set as the default shader for all meshes.
  - c. The toggling can be implemented only for the selected mesh.
- 6. Set the **illuminator mode** “l” key to be in the mode of moving light sources. Reserve “0”/”1” to turn off/on the light source corresponding to the selected mesh.
  - a. Light sources which are turned off must not be used in the local illumination model.
  - b. Implement the local illumination model using the Blinn-Phong local illumination model.
  - c. The default setting of all light sources is “on”.
  - d. Use 6 keys, other than the ones used for mesh IDs and modes to manipulate translation of light source corresponding to selected mesh along +/- direction in the x, y, z directions. Specify this selection of keys in your README.txt
  - e. The translation of the light sources can be implemented only if it does not violate the position constraint of each light source, as specified in 2a.

### **Deliverables:**

Submissions must be made on LMS.

- 1. The deliverables in a zipper folder must include a source code folder, a folder with screenshots, and a demo video not longer than 5 minutes. More details on the submission are given in the course handbook on the LMS course page.

2. If the deliverables are larger than the maximum allowable size on LMS, submit a text document with a repository URL (Google Drive, OneDrive, etc.). Care must be taken to not change this repository until grading is done.

Questions to be answered in the report:

1. What are your observations of the distance attenuation terms used for lighting?
  2. What are your observations about the change in the shading model?
  3. You are now able to generate different sizes of specular highlights using different settings for lighting, shading, and materials. When do you see focussed sharper and smaller specular highlights, and when do you see larger ones?
  4. What are your comments about your choice of mesh models for this assignment?
-