Computer Graphics Assignment 1: Basic OpenGL viewer

Handed out: March 29, 2021

Due: 23:59, April 11, 2021 (NO SCORE for late submissions!)

- *Only accept answers submitted via git push to this course project for you at https://hconnect.hanyang.ac.kr (<Year>_<Course no.>_<Class code>/<Year>_<Course no.>_<Student ID>.git).*

- *Place your files under the directory structure **<Assignment name>/<your files>** just like the following example.*

```
+ 2020_ITE0000_2019000001
  + ClassAssignment1/
    - main.py
    - report.docx
```

- *The submission time is determined not when the commit is made but when the git push is made.*

1. Implement a basic OpenGL viewer. This viewer will also be used in your future class assignments.

   A. You have to implement all requirements in a single program. This assignment DOES NOT require each requirement to be a separate program.

   B. The window size doesn't need to be (480, 480). Use the larger window that is enough to see the details of the viewer.

   C. **DO NOT** set the window title to **your student ID**.

   D. Total points: 80 pts

2. **Requirements**

   A. **Manipulate the camera with mouse movement (70 pts)**

      i. Refer the camera manipulation of Blender software.

         1. https://www.blender.org/download/

ii.   The camera of your program should initially look at a target point, similar to that of Blender.

1.   Initialize the target point to the origin (0, 0, 0)
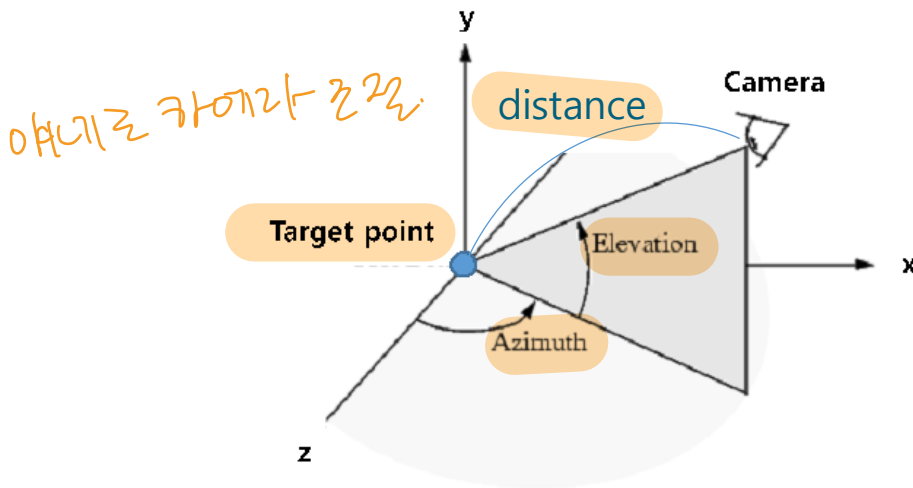
2.

iii.   Provide the following three camera control operations.

1.   **Orbit**: Rotate the camera around the target point by changing azimuth / elevation angles. (MMB (mouse middle button) in Blender) **(20 pts)**

A.   Do not rotate the camera about a vector from the camera to the target point.

2.   **Panning**: Move both the target point and camera in left, right, up and down direction of the camera (Shift-MMB in Blender) **(20 pts)**

A.   More specifically, translate both the target point and camera along u axis (left & right) and v axis (up & down) of the camera frame.

3.   **Zooming**: Move the camera forward toward the target point (zoom in) and backward away from the target point (zoom out) (Ctrl-MMB in Blender) **(15 pts)**

A.   A.   More specifically, translate the camera along w axis of the camera frame.

B.
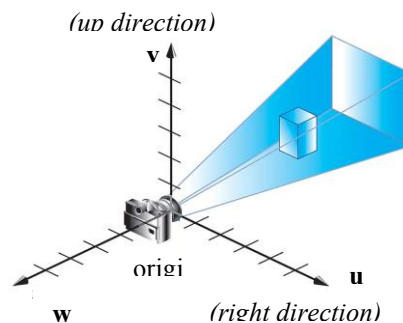
4. You MUST use the following mouse movement:

  A. Orbit: Click mouse left button & drag

  B. Panning: Click mouse right button & drag

  C. Zooming: Rotate mouse wheel → distance

  D. Using above mouse movements is essential for scoring your assignment, so if you use any other set of mouse movement or keyboard shortcuts for Orbit / Panning / Zooming, you won't get any score for them.

iv. Toggle perspective projection / orthogonal perspective projection by pressing **'v' key (10 pts).**

  1. When the program is executed, it starts in perspective projection mode.

v. Draw **a rectangular grid with lines (not polygons) on xz plane** as a reference ground plane (similar to Blender). Choose number of rows and columns, size as you want. **(5 pts)**

3. Report (10 pts)

A. Submit a report of **at most 2 pages** in docx file format (MS Word). Do not exceed the limit.

B. The report should include:

  i. Which requirements you implemented (5 pts)

  ii. A few screenshot images of your program (5 pts)

~~C.~~ You do not need to try to write a long report. Just only write down the required information. ~~Use either English or Korean.~~

4. Runtime Environment

A. **Your program should be able to run on systems only with Python 3.7 or later, NumPy, PyOpenGL, glfw. Do not use any other additional python modules.**

B. Only **glfw** is allowed for event processing and window & OpenGL context management. **Do not use glut functions for this purpose.**

C. **If your program does not meet this requirement, it will not run on TA's computer so**
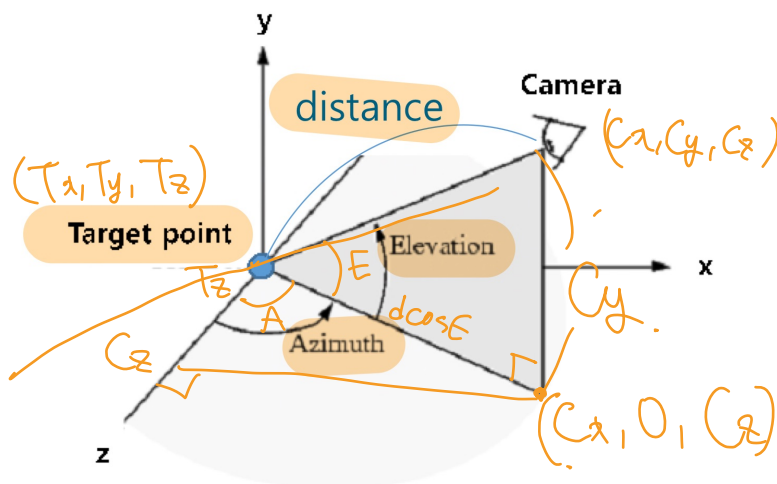
5. **What you have to submit:**

   A. **.py files**

      i. You can use multiple .py files for this assignment. In this case, explain how to run the program in the report.

   B. **.docx report file**
      pdf 도가능

$$C_y = d \sin E$$

$$d \cos E \cos A = C_z$$

$$d \cos E \sin A = C_x.$$