Computer Graphics, Lab Assignment 5

Handed out: April 29, 2020

Due: 23:59, May 8, 2019 **(NO SCORE for late submissions!)**

Submit your assignment only through Computer Graphics course page on Blackboard.

1. Write your own myLookAt() and myOrtho() functions (of the following form) that behaves exactly same as gluLookAt() and glOrtho().

   A.
   ```
   def myLookAt(eye, at, up): # eye, at, up are 1D numpy array of length 3
   def myOrtho(left, right, bottom, top, zNear, zFar):
   ```

   B. Set the window title to **CG_weekly_practice_05-1_studentID** (e.g. **CG_weekly_practice_05-1_2017123456**) and the window size to (480,480).

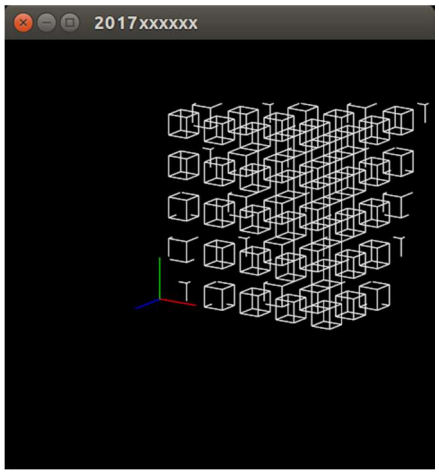
   C. Code skeleton

   ```
   def render():
       glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)
       glEnable(GL_DEPTH_TEST)
       glPolygonMode( GL_FRONT_AND_BACK, GL_LINE )
       glLoadIdentity()

       myOrtho(-5,5, -5,5, -8,8)
       myLookAt(np.array([5,3,5]), np.array([1,1,-1]), np.array([0,1,0]))

       # Above two lines must behaves exactly same as the below two lines

       #glOrtho(-5,5, -5,5, -8,8)
       #gluLookAt(5,3,5, 1,1,-1, 0,1,0)

       drawFrame()

       glColor3ub(255, 255, 255)
       drawCubeArray()

   def myOrtho(left, right, bottom, top, near, far):
       # implement here

   def myLookAt(eye, at, up):
       # implement here
   ```

   D. Find code for drawFrame(), drawCubeArray() from 5-RenderingPipeline.pdf (pp. 52-53) slides.

   E. DO NOT use gluLookAt() inside myLookAt() and glOrtho() inside myOrtho()!

   F. Your program should render the following scene:

i. 

G. Hint:

1. Everything you need to write code is in 5-RenderingPipeline slides.
2. l2 norm of **v** : ||**v**|| = np.sqrt(np.dot(**v**, **v**))
3. **a** x **b** (cross product) : np.cross(**a**, **b**)
4. **a** · **b** (inner product) : np.dot(**a**, **b**) or **a**@**b**
5. Use glMultMatrixf() to multiply your projection matrix and viewing matrix to the current transformation matrix.

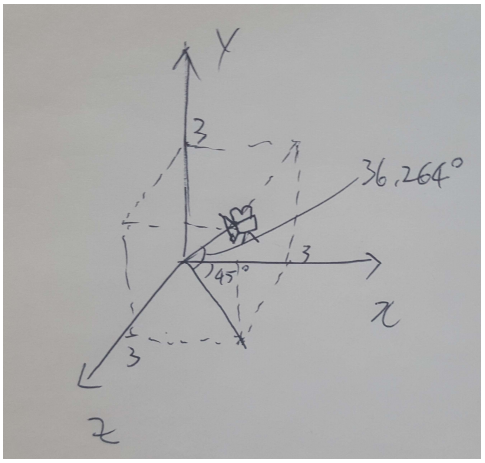
H. Submit a single .py file - **CG_weekly_practice_05-1_studentID.py** (e.g. **CG_weekly_practice_05-1_2017123456.py**)

2. As mentioned in the lecture, "moving camera" and "moving world" are two equivalent operations. Based on the following figure, replace the gluPerspective call() in the following code with **two glRotatef() calls and one glTranslatef() call** and complete the program.

A.

```
def render():
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)
    glEnable(GL_DEPTH_TEST)
    glPolygonMode( GL_FRONT_AND_BACK, GL_LINE )
    glLoadIdentity()

    gluPerspective(45, 1, 1,10)

    # Replace this call with two glRotatef() calls and one
glTranslatef() call
    gluLookAt(3,3,3, 0,0,0, 0,1,0)

    drawFrame()

    glColor3ub(255, 255, 255)
    drawCubeArray()
```

B.

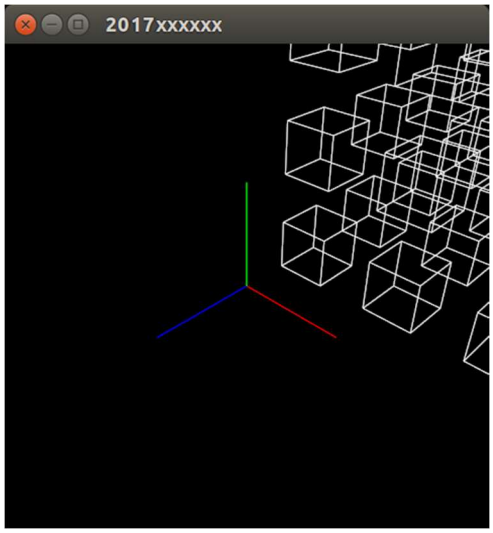


C. Set the window title to **CG_weekly_practice_05-2_studentID** (e.g. **CG_weekly_practice_05-2_2017123456**) and the window size to (480,480).

D. Find code for drawFrame(), drawCubeArray() from 5-RenderingPipeline slides.

E. Your program should render the following scene:

i.



F. Submit a single .py file - **CG_weekly_practice_05-2_studentID.py** (e.g. **CG_weekly_practice_05-2_2017123456.py**)