Computer Graphics, Lab Assignment 4

Handed out: March 23, 2021

Due: 23:59, March 23, 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>/<Problem no.>/<your file> just like the following example.*

```
+ 2021_ITE0000_2019000001
  + LabAssignment4/
    + 1/
      - 1.py
    + 2/
      - 2.py
    + 3/
      - 3.py
```

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

1. Write down a Python program to draw a transformed triangle in a 2D space.
   A. Set the window title to **your student ID** and the window size to (480,480).
   B. Complete the render() function below to draw a triangle in the manner described in C.
      i. **You have to use OpenGL transformation functions. Do not use numpy matrix multiplication for composing transformations.**

```
def render():
    glClear(GL_COLOR_BUFFER_BIT)
    glLoadIdentity()

    # draw cooridnates
    glBegin(GL_LINES)
    glColor3ub(255, 0, 0)
    glVertex2fv(np.array([0.,0.]))
    glVertex2fv(np.array([1.,0.]))
    glColor3ub(0, 255, 0)
    glVertex2fv(np.array([0.,0.]))
    glVertex2fv(np.array([0.,1.]))
    glEnd()

    glColor3ub(255, 255, 255)

    ###########################
    # implement here
    ###########################

    drawTriangle()

def drawTriangle():
    glBegin(GL_TRIANGLES)
    glVertex2fv(np.array([0.,.5]))
    glVertex2fv(np.array([0.,0.]))
    glVertex2fv(np.array([.5,0.]))
    glEnd()
```

C. If you press or repeat a key, the triangle should be transformed as shown in the Table:

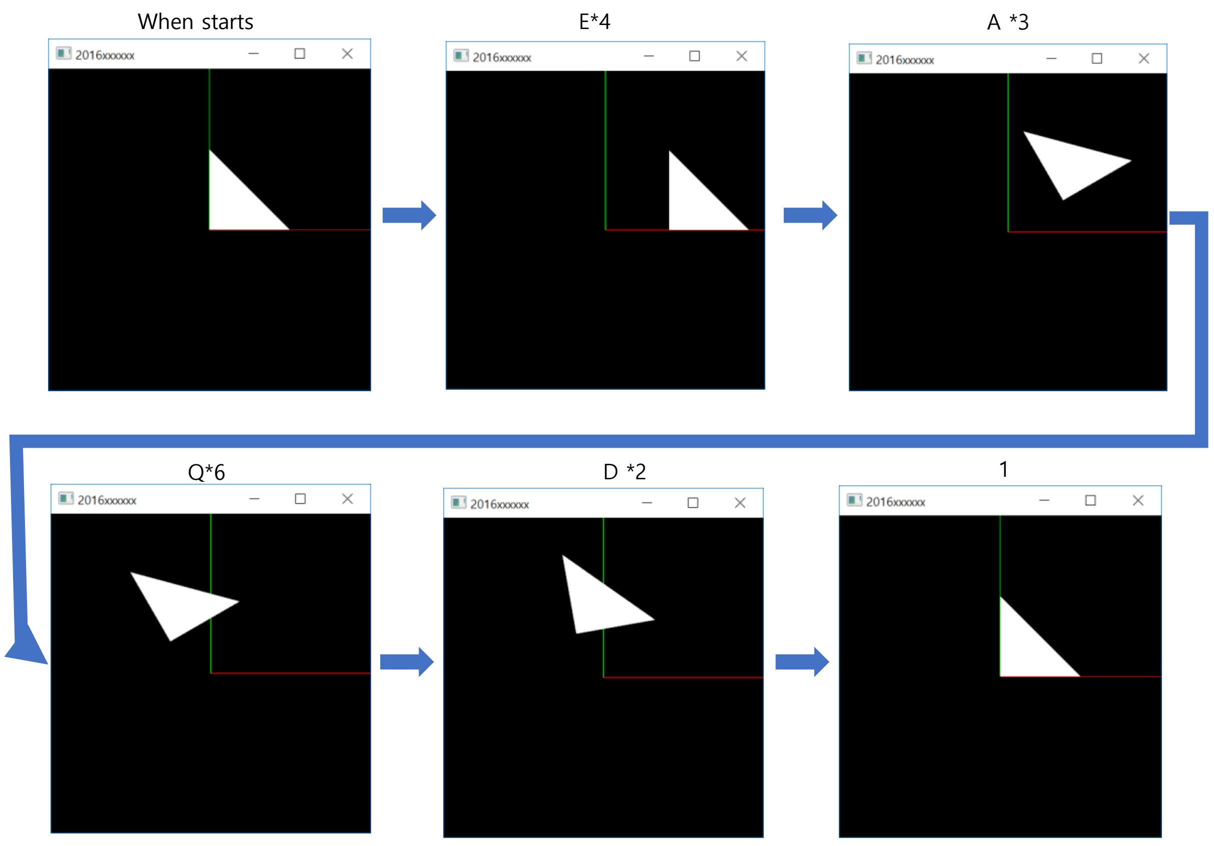
Key	Transformation
Q	Translate by -0.1 in x direction
E	Translate by 0.1 in x direction
A	Rotate by 10 degrees counterclockwise
D	Rotate by 10 degrees clockwise
1	Reset the triangle with identity matrix

D. Transformations should be accumulated (composed with previous one) unless you press '1'.

   i. You may need a global variable (like a python list object) to store key inputs.

E. Files to submit: A Python source file (Name the file whatever you want (in English). Extension should be .py)

F. Expected result:



2. Write down a Python program to draw rotating point p1=(0.5, 0), p2=(0, 0.5) and vector v1=(0.5, 0), v2=(0, 0.5) in a 2D space.

   A. Set the window title to **your student ID** and the window size to (480,480).

   B. Use the following render() and fill "# your implementation" parts to render p1,p2 and v1,v2.

      i. Hint: Render the vector v1, v2 as a line segment starting from the origin (0,0).

      ii. Hint2: You need different translation matrix for p1 and p2 to render them correctly.

```
def render(th):
    glClear(GL_COLOR_BUFFER_BIT)
    glLoadIdentity()

    # draw cooridnate
    glBegin(GL_LINES)
    glColor3ub(255, 0, 0)
    glVertex2fv(np.array([0.,0.]))
    glVertex2fv(np.array([1.,0.]))
    glColor3ub(0, 255, 0)
    glVertex2fv(np.array([0.,0.]))
    glVertex2fv(np.array([0.,1.]))
    glEnd()

    glColor3ub(255, 255, 255)

    # calculate matrix M1, M2 using th
    # your implementation

    # draw point p
    glBegin(GL_POINTS)
    # your implementation
    glEnd()

    # draw vector v
    glBegin(GL_LINES)
    # your implementation
    glEnd()
```

C. Expected result: Uploaded LabAssignment4-2.mp4

   i. Do not mind the initial angle.

D. p1,p2 and v1,v2 should be **-t rad** rotated when t seconds have elapsed since the program was executed.

E. You need to somehow combine a rotation matrix and a translation matrix to produce the expected result.

F. Files to submit: A Python source file (Name the file whatever you want (in English). Extension should be .py)