

Assignment 2: Rasterization

Handout date: 10/03/2019

Submission deadline: 10/24/2019, 23:59 EST

Demo date: 10/25/2019, 9AM-12PM and 1PM-6PM

This homework accounts for 17.5% of your final grade.

Goal of this exercise

In this exercise you will implement a 2D editor for vector graphics. The editor will allow to draw simple shapes interactively.

Eigen

In all exercises you will need to do operations with vectors and matrices. To simplify the code, you will use **Eigen**. Have a look at the “[Getting Started](#)” page of Eigen as well as the [Quick Reference](#) page to acquaintain yourselves with the basic matrix operations supported.

OpenGL

In all exercises you will use OpenGL 3.3 with GLSL version 150. Need to run using:

```
>make; MESA_GL_VERSION_OVERRIDE=3.3 MESA_GLSL_VERSION_OVERRIDE=150 ./Assignment2_bin
```

Submission

You must submit a zip file with all your code and libraries (glew and glfw) used in this assignment. The zip file must be submitted using the NYU Classes system as you did for Assignment 1.

Try to maintain the same directory organization as the starter code, so you don't need to change the `CMakeLists.txt` file.

1 Mandatory Tasks

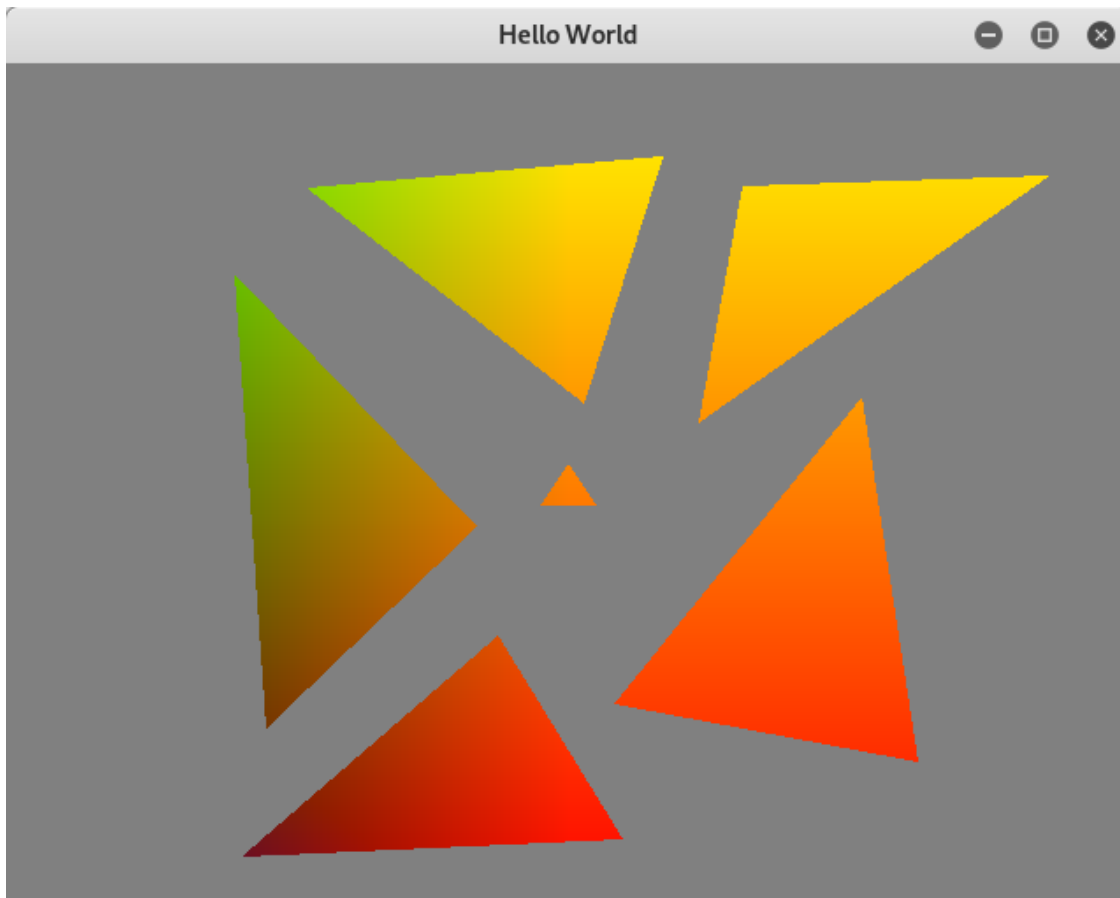
For each tasks below, add at least one image in the readme demonstrating the results. The code that you used for all tasks should be provided.

1.1 Triangle Soup Editor

Implement an interactive application that allows to add, edit, and delete triangles. The following operations should be supported:

- The key 'i' will enable triangle insertion mode. When this mode is enabled, every triple of subsequent mouse clicks will create a triangle connecting the three locations where the mouse has been pressed. The first click will create the starting point of the segment, which will be immediately visualized. As the mouse is moved, a preview of a segment will appear. After the second mouse click, a preview of the triangle will appear. After the third click, the current preview will transform into the final triangle.

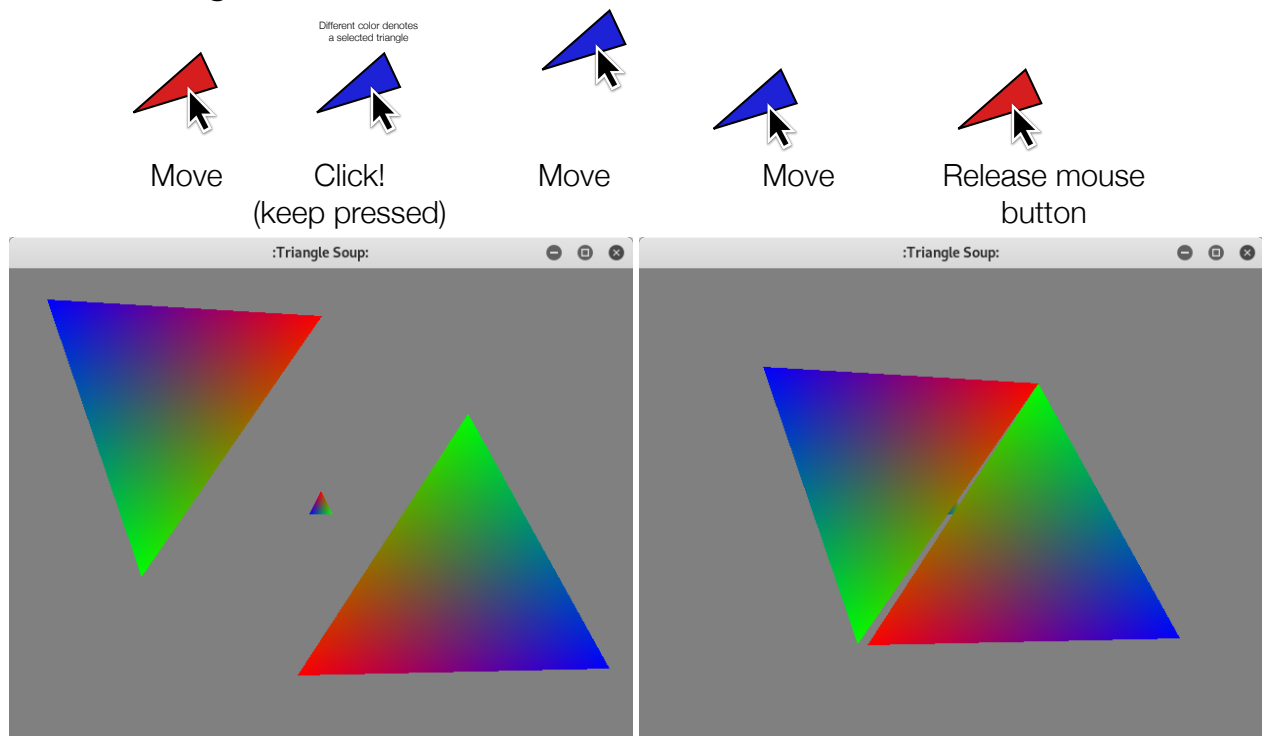
Every click adds a new vertex to the vertex array, and when there aren't 3 vertices then it creates one at the current cursor location until a vertex is finalized. If there is a mode change before a full triangle is made, then the uncompleted triangle is deleted.



- The key 'o' will enable triangle translation mode. Each mouse click will select the triangle below the cursor (which will be highlighted), and every movement of the mouse (while keeping the button pressed) will result in a corresponding translation of the triangle. Note that the triangle should move on screen by the same amount as the cursor.

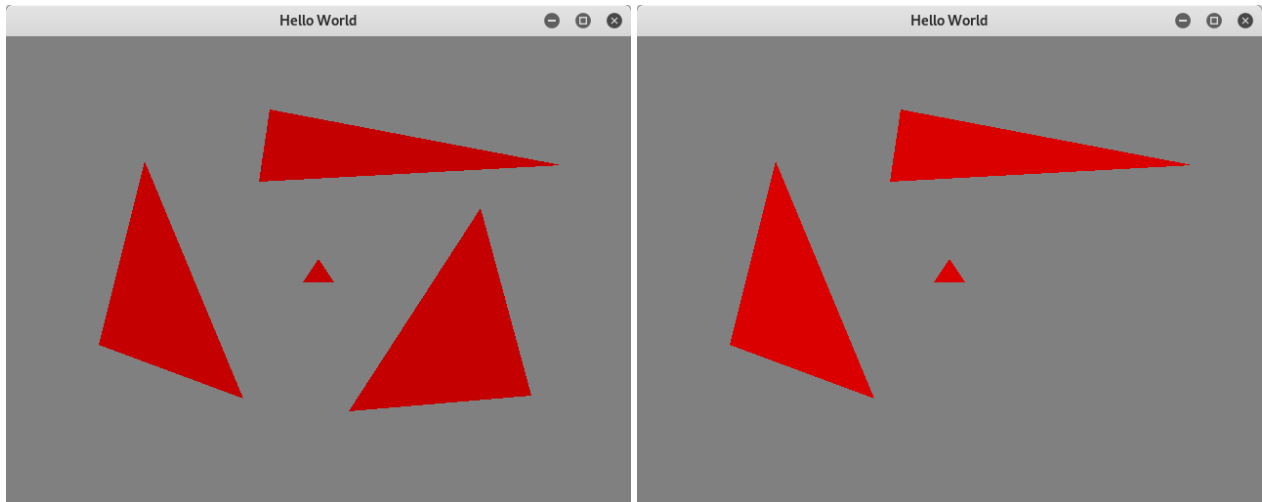
Translated the triangle based on the difference between current cursor position and last cursor position

'o': Triangle Translation Mode



- The key 'p' will enable delete mode. When the mouse is pressed, the triangle below the cursor is deleted.

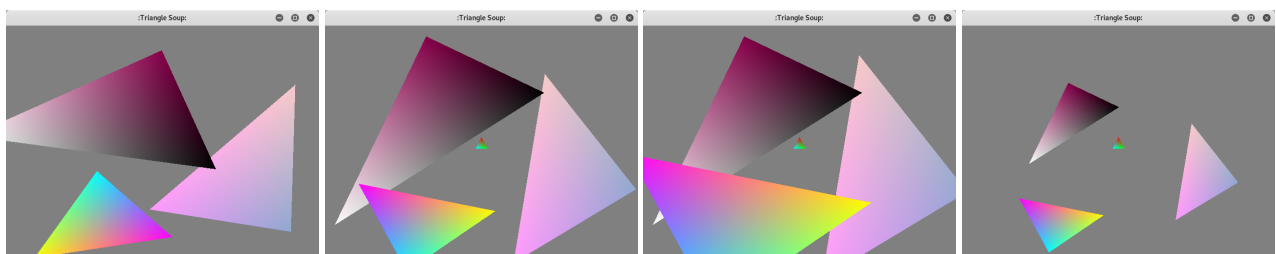
Check if click is inside triangle. If it is, delete that triangle, else don't.



1.2 Rotation/Scale

When triangle translation mode is enabled, keep the current primitive selected after the mouse is released. If a primitive is selected and you press the keys 'h' and 'j', the triangle will rotate by 10 degree clockwise or counter-clockwise, respectively. The rotations should be done around its barycenter, i.e. the barycenter of the triangle should not change. When the keys 'k' or 'l' are pressed, the primitive should be scaled up or down by 25%. Similarly to before, the barycenter of the triangle should not move due to the scaling. For this task, you can directly edit the position of the vertices of the triangles on the CPU side, and re-upload them to the GPU after every change. If you do it directly in the vertex shader, you can gain additional points (see Task 1.8)

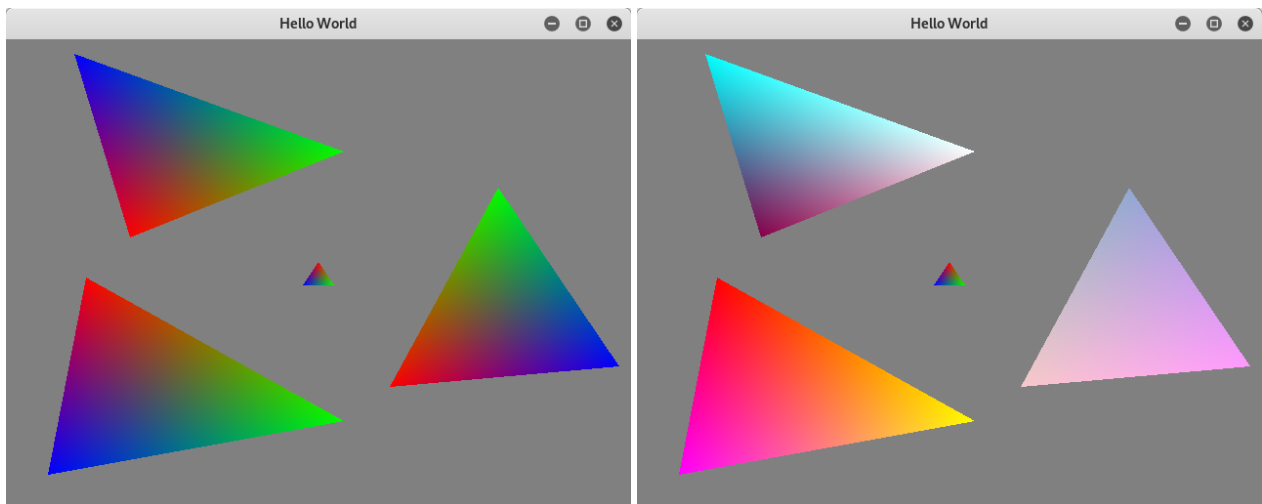
For both scaling and rotation, I found the centroid of the selected triangle and then translated it so that the center was at the origin, and then rotated or scaled it up and down before translating it back to the original centroid.



1.3 Colors

Add the possibility to paint the color of each vertex in the scene. Color mode is enabled by the key 'c'. In this mode, every mouse click will select the vertex closer to the current mouse position. After a vertex is selected, pressing a key from '1' to '9' will change its color (the colors that you use are not important, you can pick whatever colors you like). The color should be interpolated linearly inside the triangles.

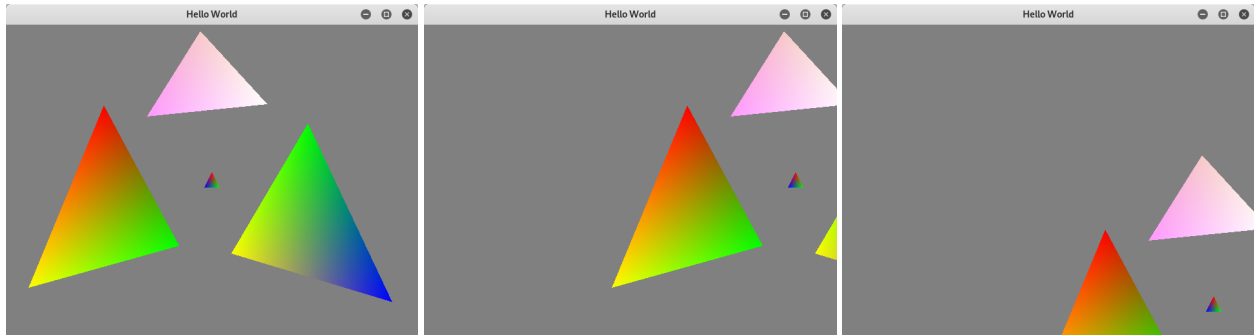
If a click is within a triangle, then get the euclidian distance between the click point and each vertex, the one with the smallest distance is the closest, and will be the one who's color changes.



1.4 View Control

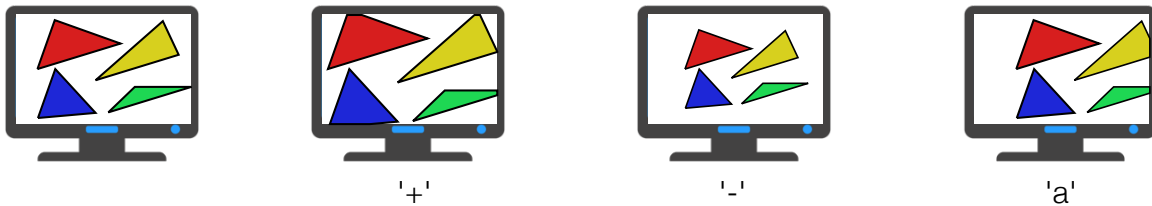
Add to the application the capability of changing the camera. The following actions should be supported:

- '+' should increase the zoom by 20% zooming in in the center of the screen
- '-' should decrease the zoom by 20% zooming out in the center of the screen
- 'w', 'a', 's', and 'd' should pan the view by 20% of the visible part of the scene, i.e. translate the entire scene, respectively down, right, up and left by 20% of the window size.



This should NOT be implemented by changing the coordinates of the objects in the scene. You must add a view matrix to the vertex shader (as a uniform) that is transforming the position of the vertices of the triangles before they are rendered. Note that you will also have to transform the screen coordinates using the inverse of the view matrix, to ensure that the user interaction will adapt to the current view.

Shifted the viewport left, right, up, and down wrt the height and width. While I got the zoom to work, I couldn't figure out how to transform the coordinates for object picking, nor center the zoom at the origin.



1.5 Add keyframing

Add the possibility to keyframe one property of an object (size, position, or rotation) and create an animation using linear interpolation between the keyframes. You can use a timer to make the animation automatic, or you could move to the next frame at the press of a button.

Optional Tasks

These tasks are optional. Each one of these tasks is worth 1.5% of the final grade. The optional points are added to the points of the other exercises, but the total sum of points that you gain with exercises cannot be more than 80%.

1.6 Additional primitive

Add a new mode that allows to add bezier curves and to move their control points.

1.7 Export in SVG format

Add the possibility to export the current drawing in SVG format https://en.wikipedia.org/wiki/Scalable_Vector_Graphics. The exported SVG should be compatible with <https://inkscape.org/>.

1.8 Shader translation/scaling/rotation

Upload every single triangle as a separate primitive in a separate VBO (or in a single VBO using offsets for drawing them one by one). For each primitive, upload to the GPU its model matrix (as a uniform) that transforms the triangle from its canonical position (defined at its creation) to the current position (obtained by combining translations, scaling and rotations). The transformation should be executed in the shader, and the content of the VBO storing the vertex positions never updated.