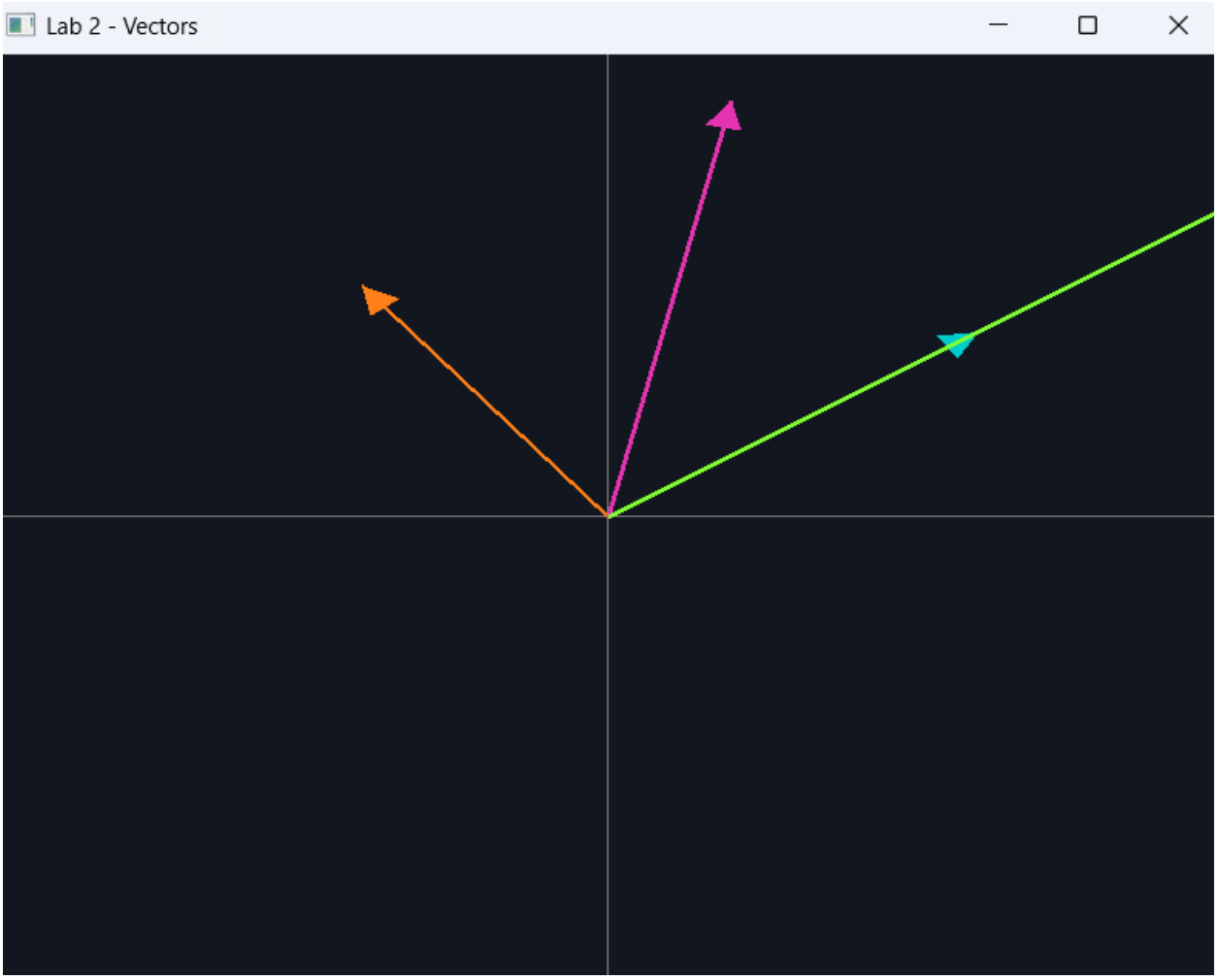
Computer Graphics

Labs Report (C++ with OpenGL / GLFW)

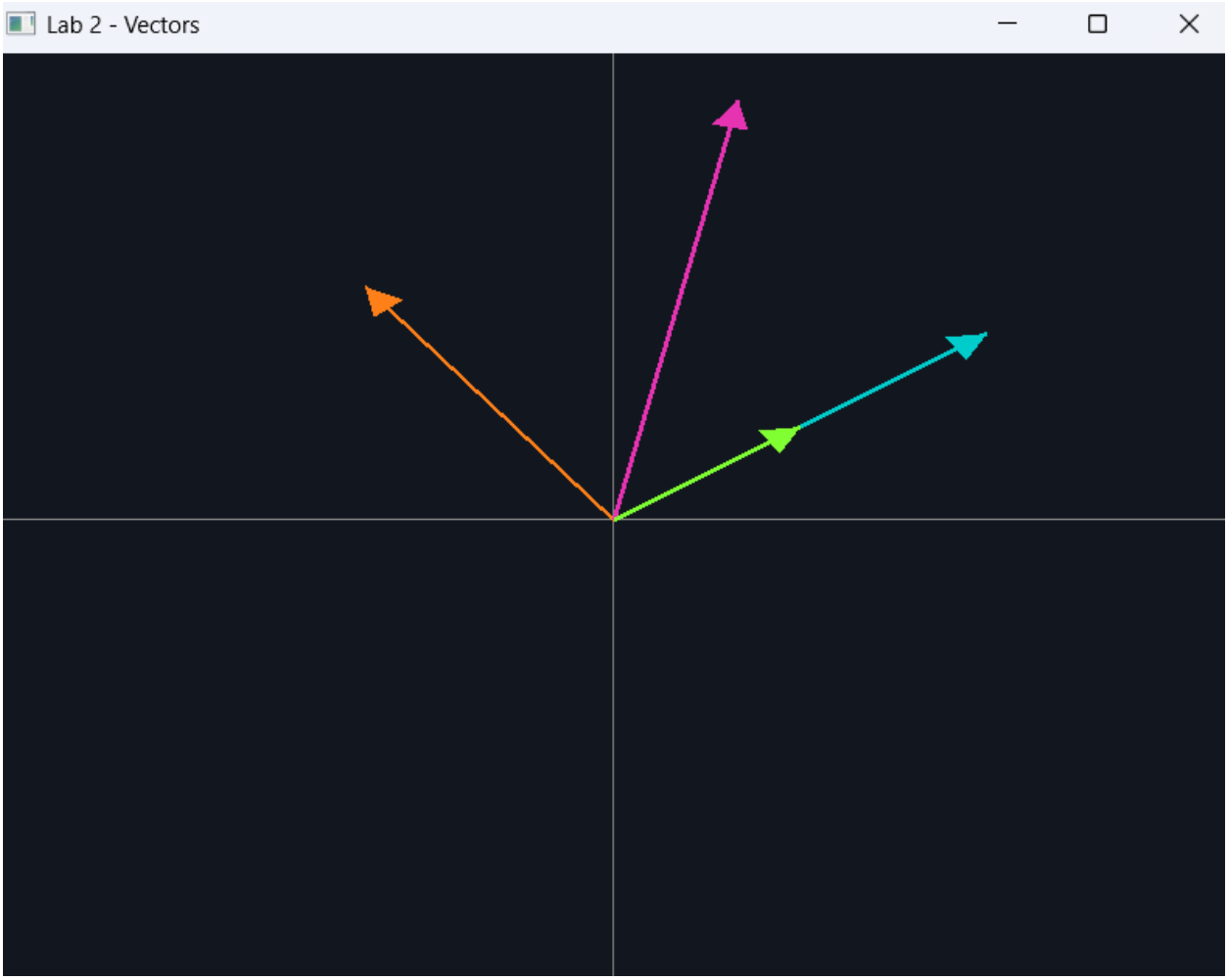
Lab 2: Vectors, Matrices and Transformations

Part A - Vectors

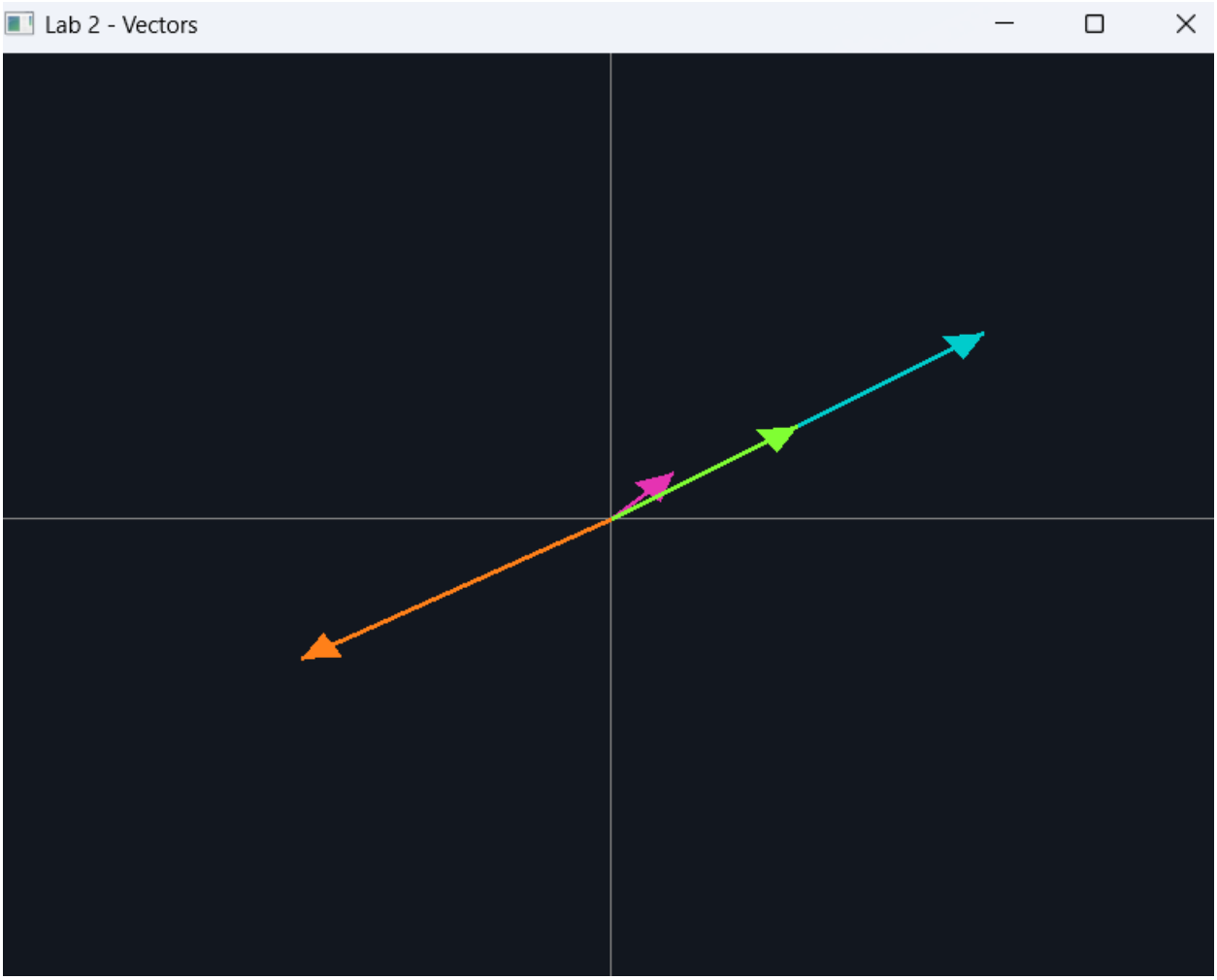
Task 1: Change the values of u and v, then run again.



Task 2: Change 2u to 0.5u and then to 3u, and compare the length.



Task 3: Make v almost equal to -u and look at the result of u + v.



Part B - Matrices (Console)

Task 1: A matrix that scales the Y value.

```
Matrix A = [ 1 0 ; 0 3 ]
Vector v = ( 2, 3 )
A * v    = ( 2, 9 )
det(A)   = 3
```

Task 2: A rotation-like matrix.

```
Matrix A = [ 0 -1 ; 1 0 ]
Vector v = ( 2, 3 )
A * v    = ( -3, 2 )
det(A)   = 1
```

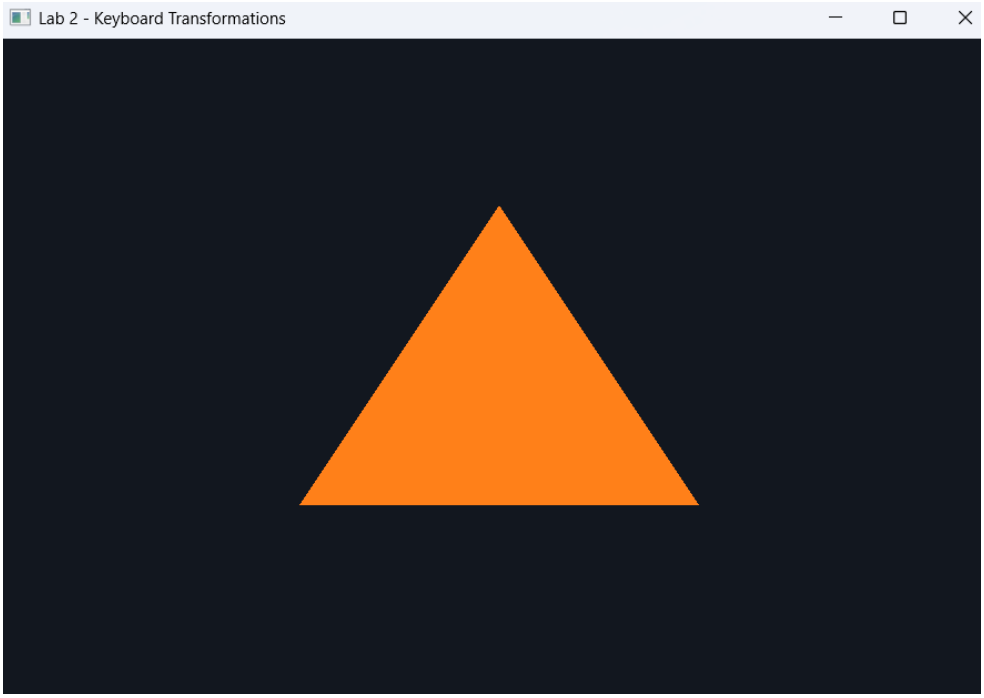
Task 3: A matrix with det(A) = 0.

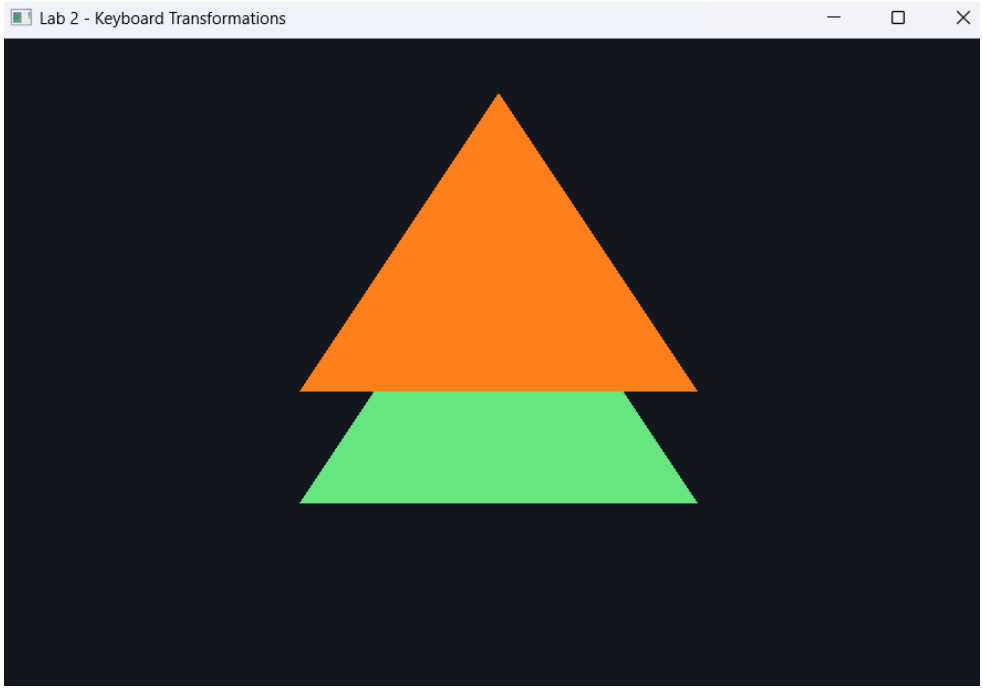
```
Matrix A = [ 2 4 ; 1 2 ]
Vector v = ( 2, 3 )
A * v    = ( 16, 8 )
det(A)   = 0
----------------------------
When det(A) = 0 the matrix is singular.
It maps the plane onto a line so it cannot be reversed.
```

Part C - 2D Transformations

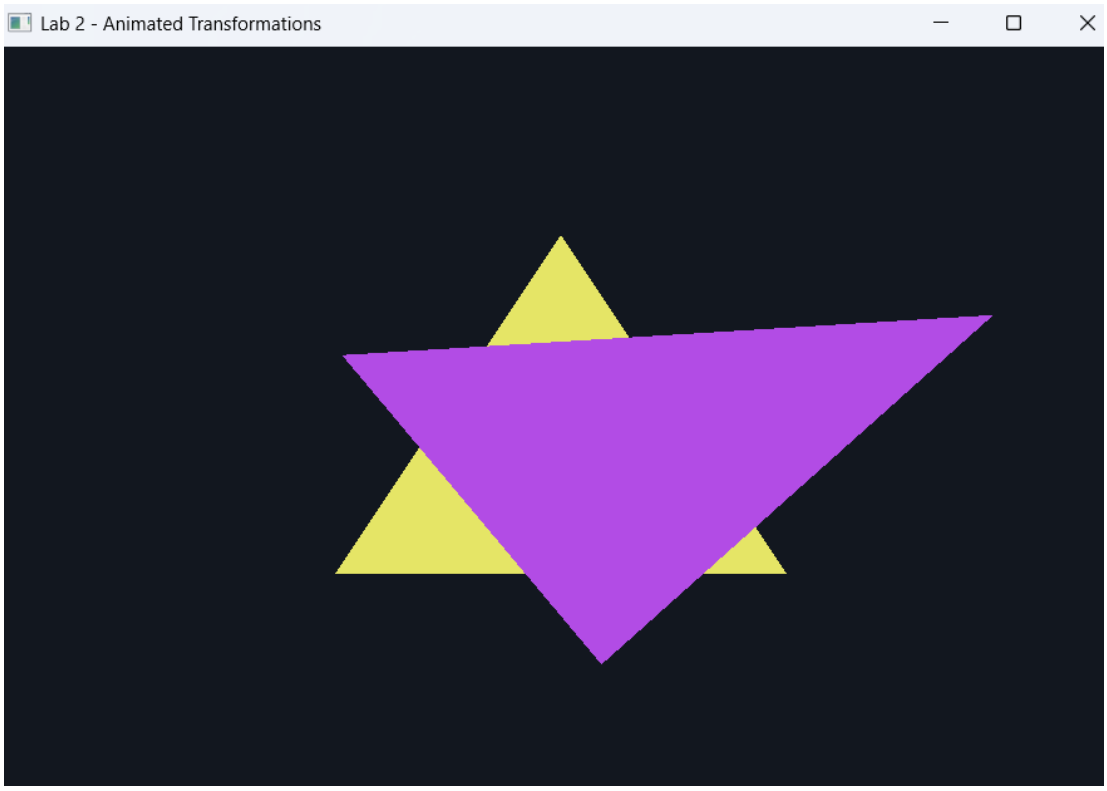
transform_keyboard.exe - control the triangle with the keyboard.

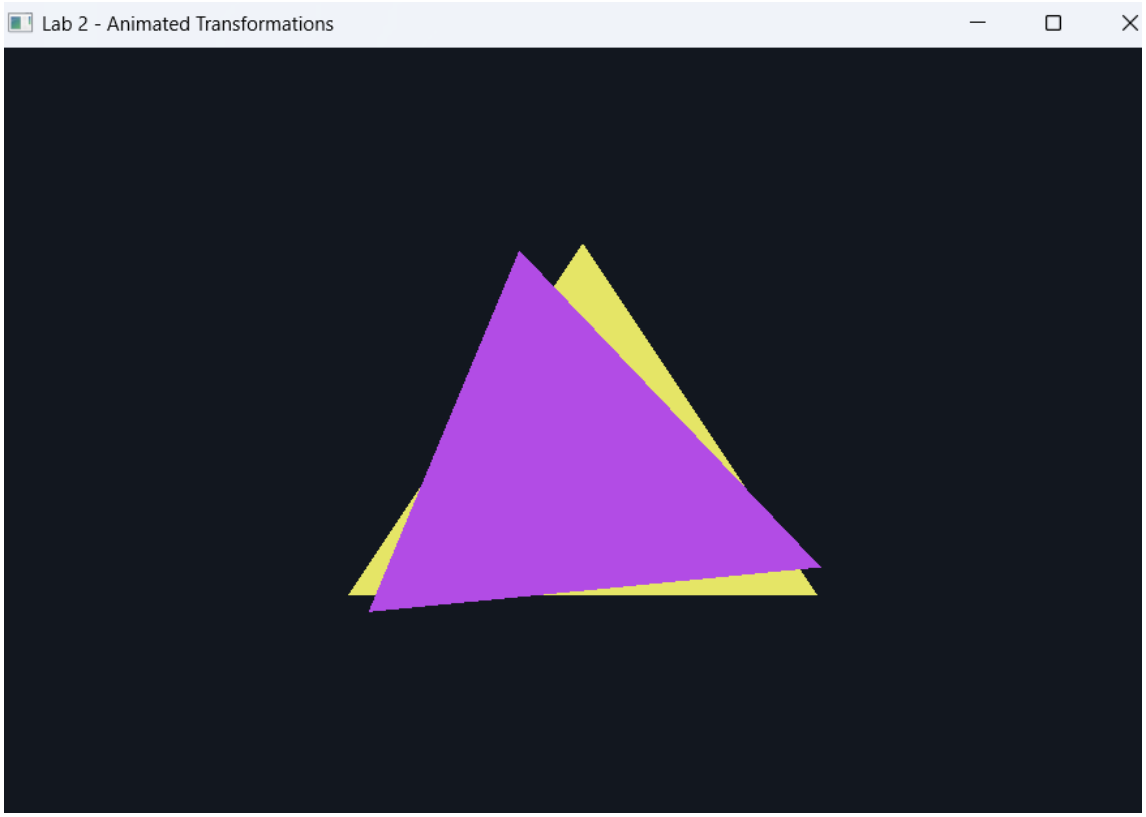
- W A S D move the triangle
- Q and E rotate it
- Z and X scale it
- R resets, ESC quits





transform_animated.exe - the triangle moves, rotates and scales automatically.

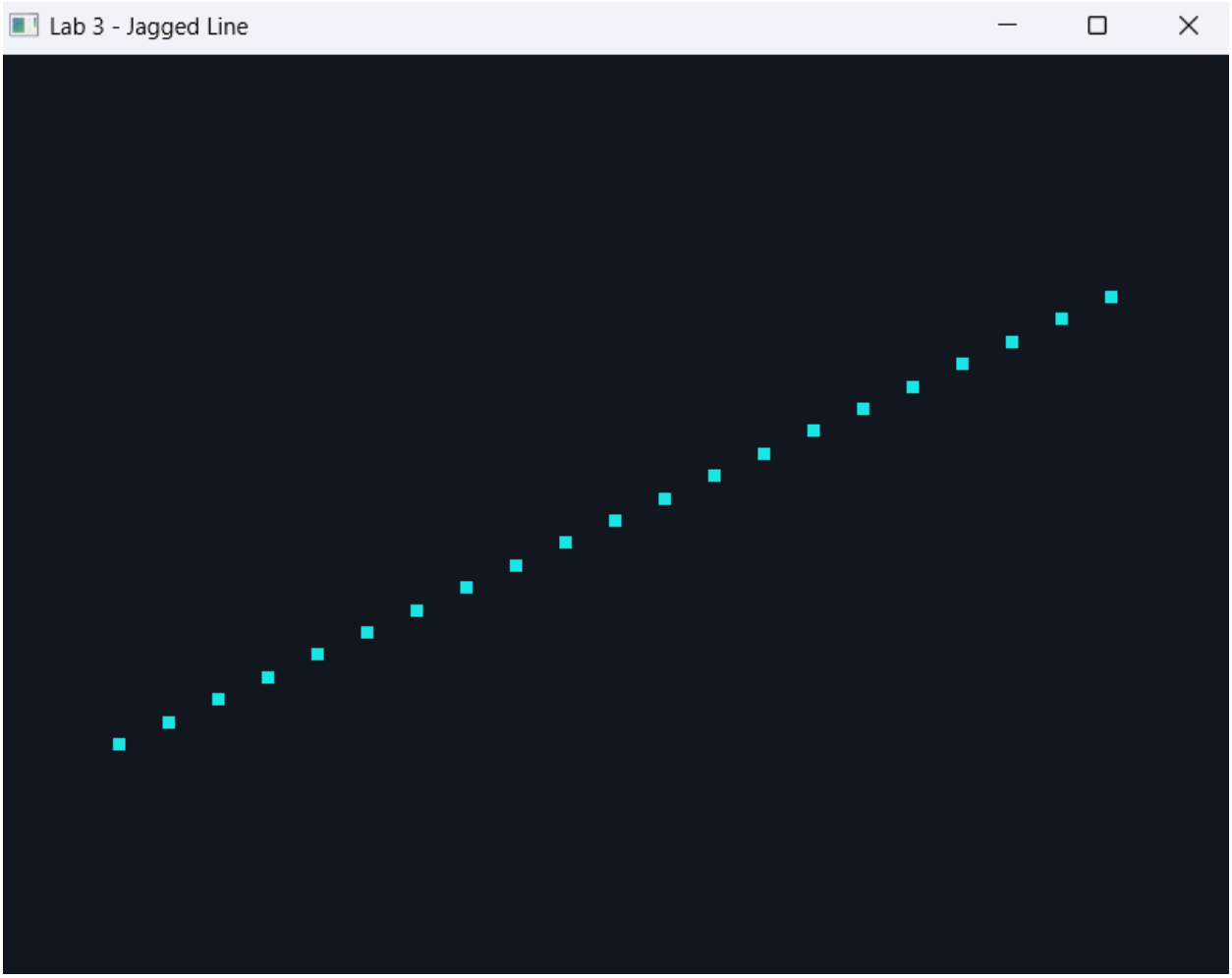




Lab 3: Drawing Points (Jagged Line and Circle)

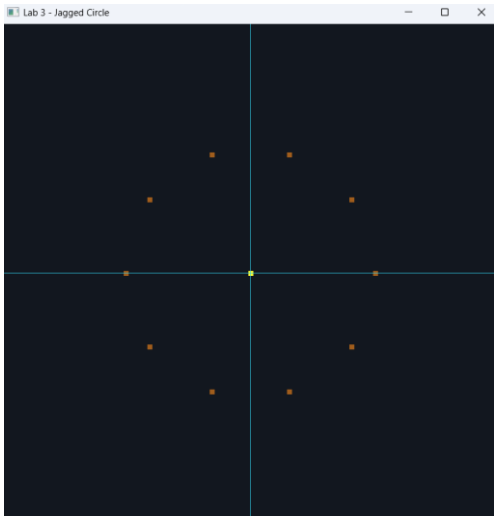
Jagged Line

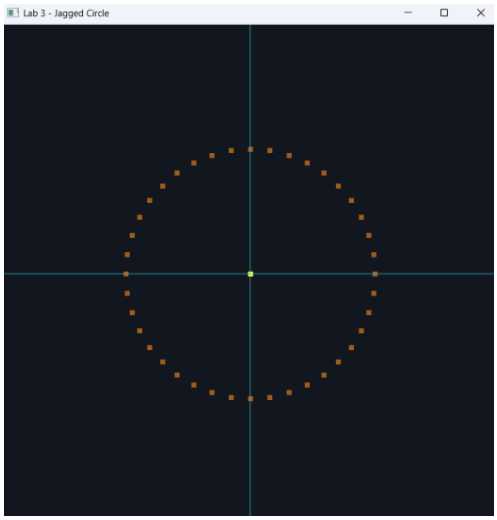
A straight line drawn as a set of points.

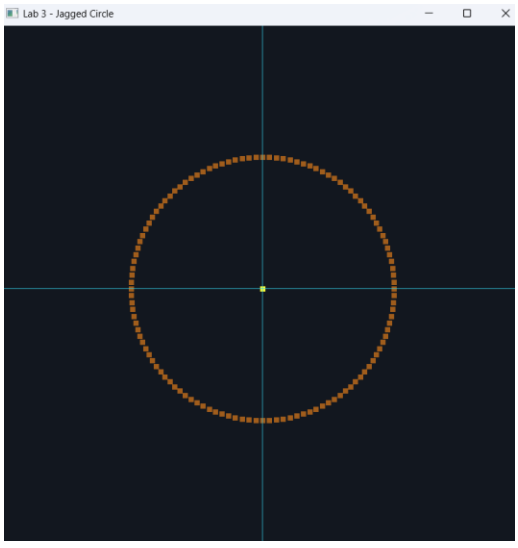


Jagged Circle

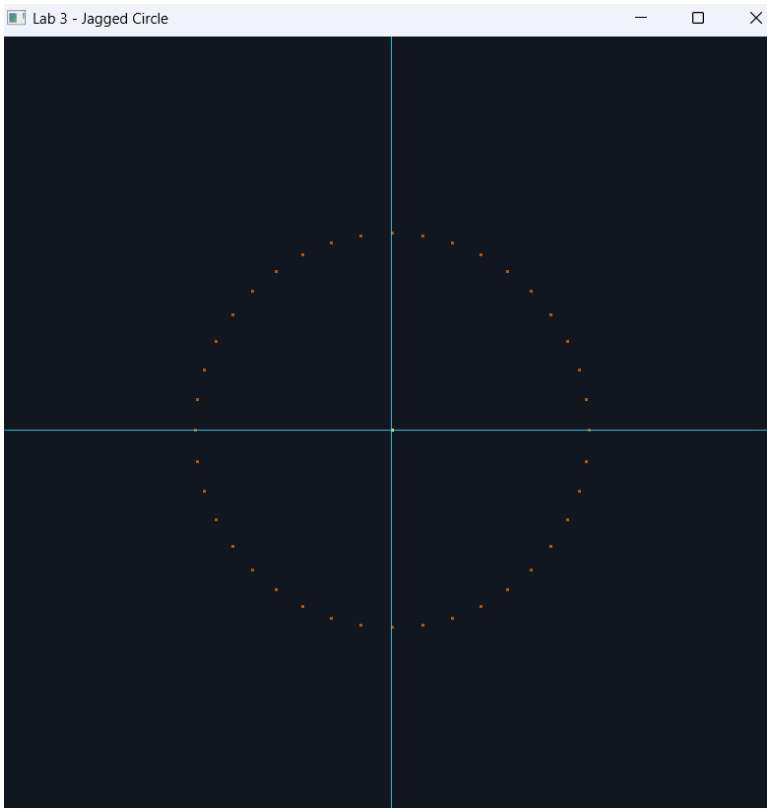
Task 1: Number of points. Try N = 10, then 40, then 120.

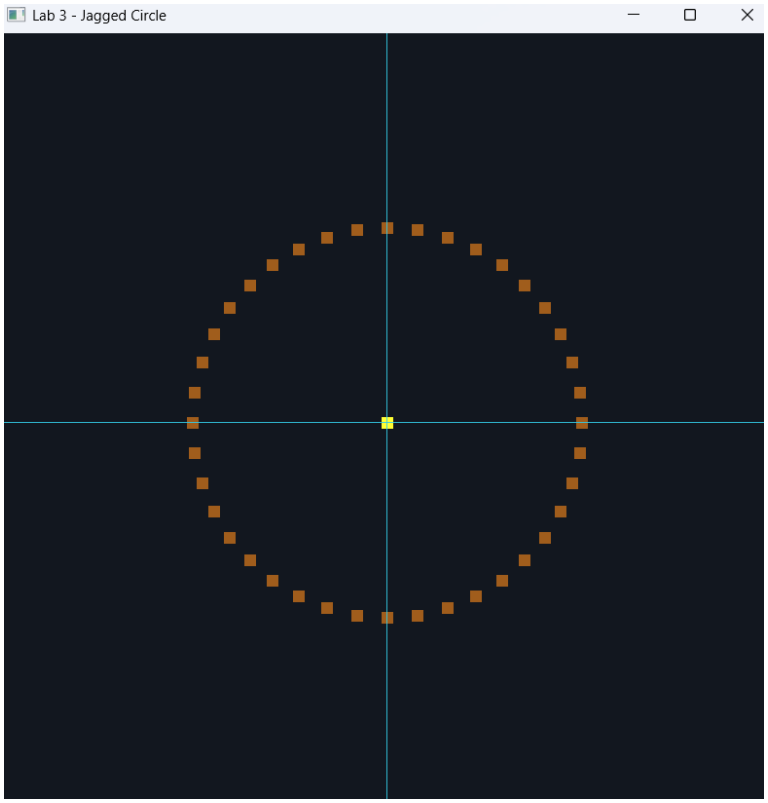




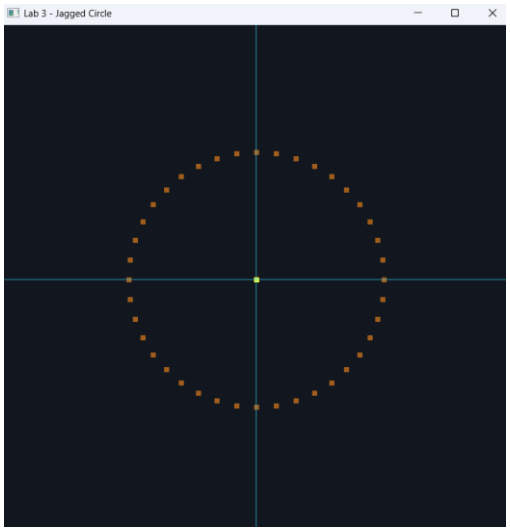


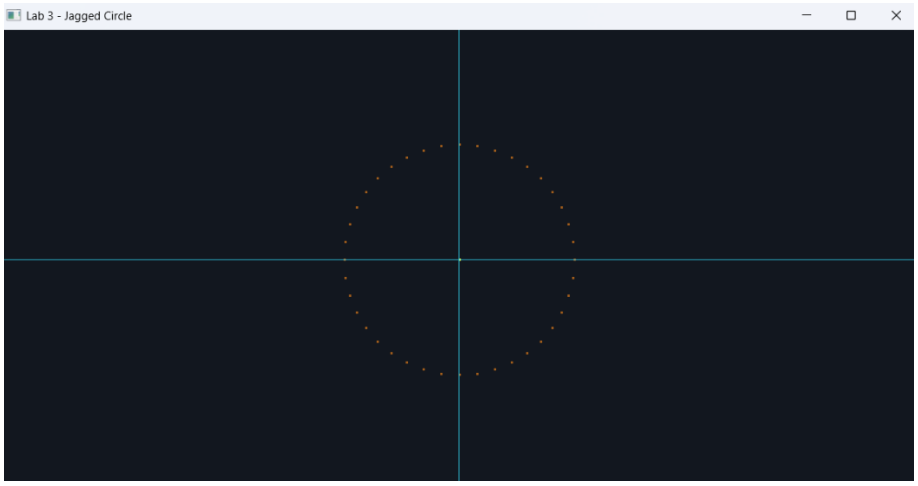
Task 2: Point size. Try pointSize = 3, then 12.

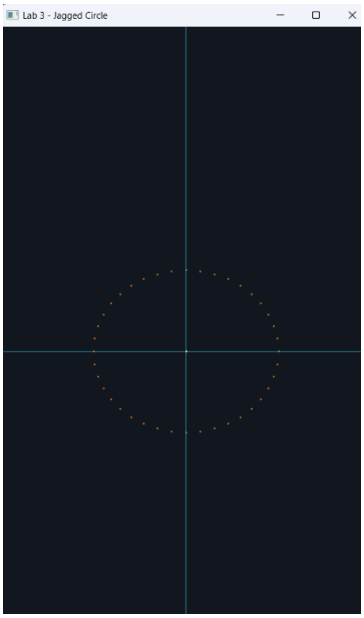




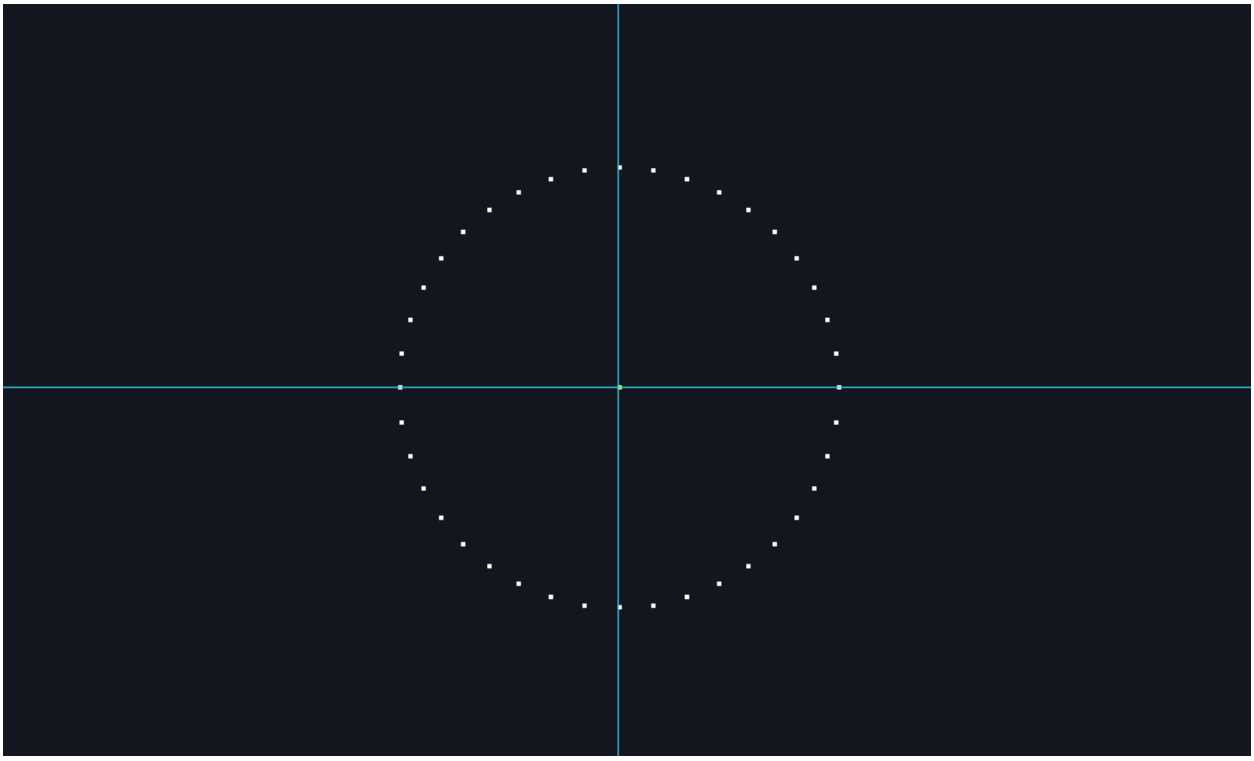
Task 3: Window size. Try 800x800, 1200x600, 600x1200 (winWidth and winHeight).





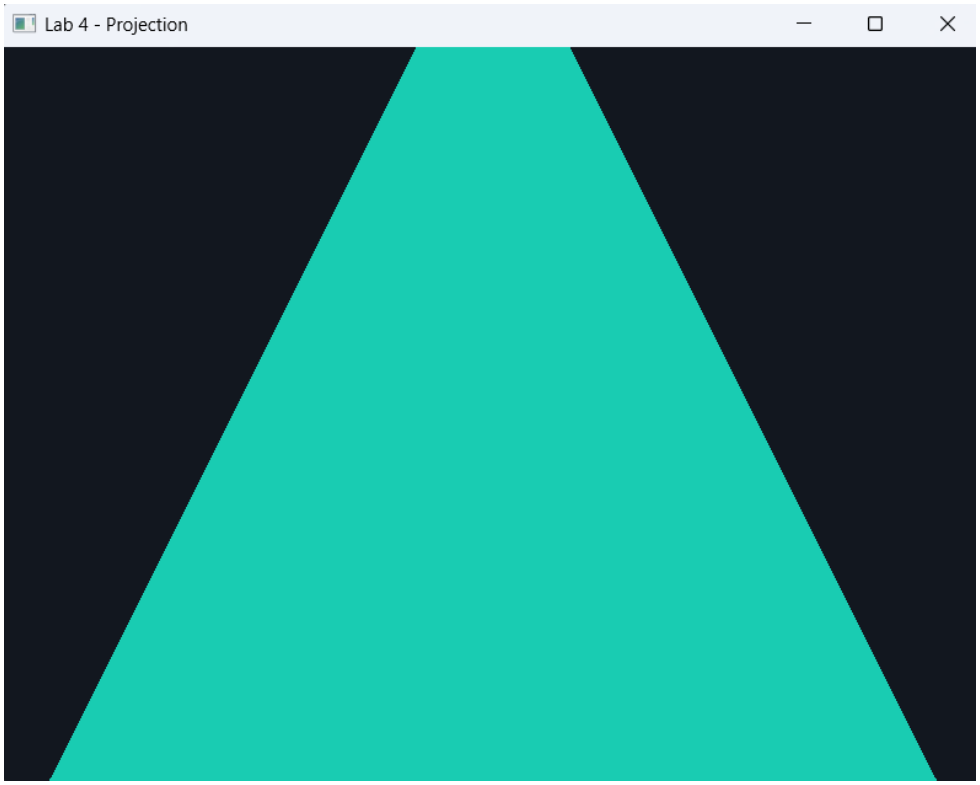


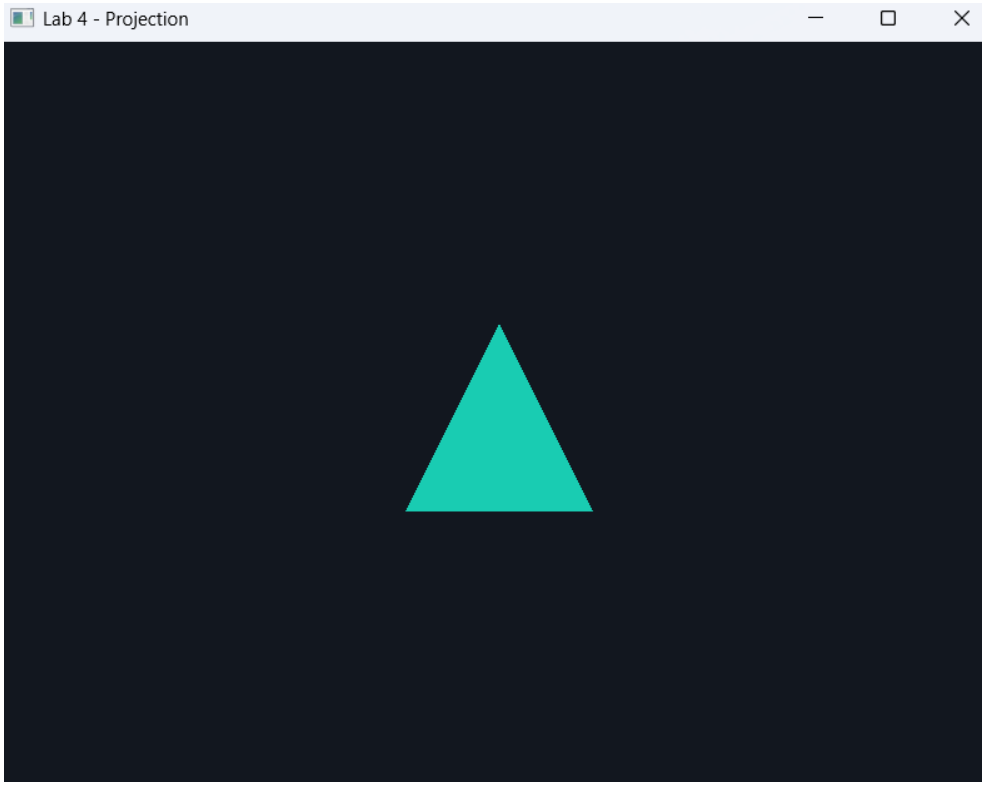
Task 5: Color and transparency (alpha blending).



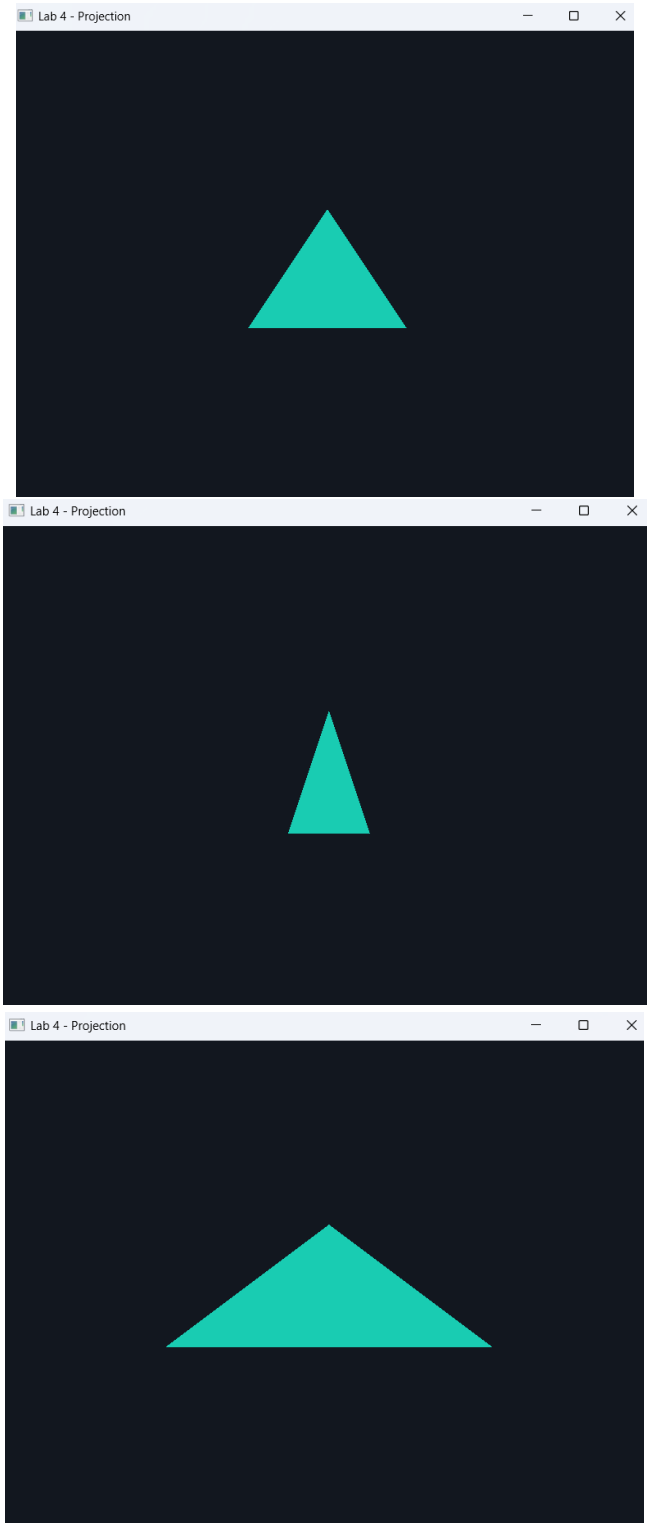
Lab 4: Viewing and Projection

Task 1: Field of view. Try fov = 20, then fov = 90.

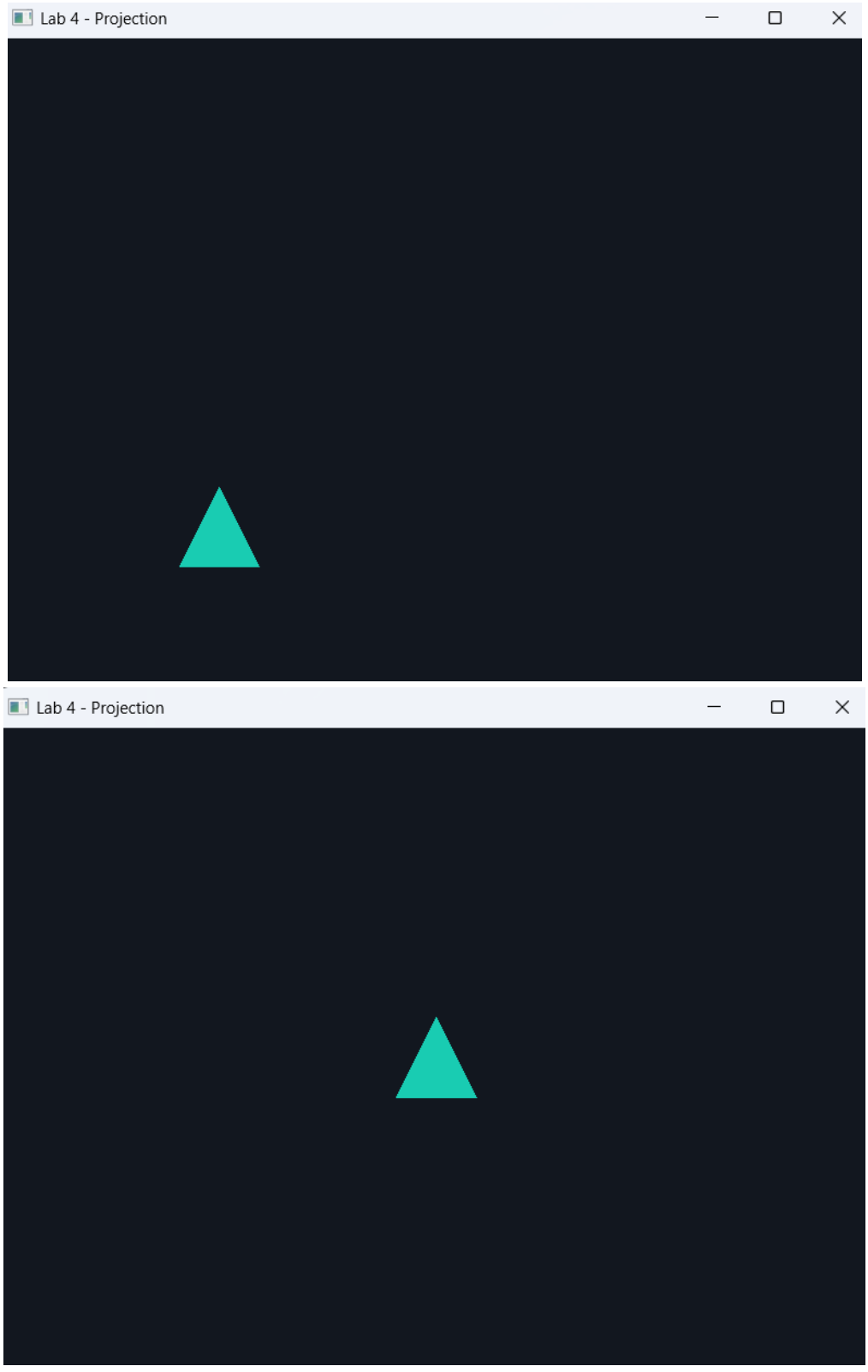




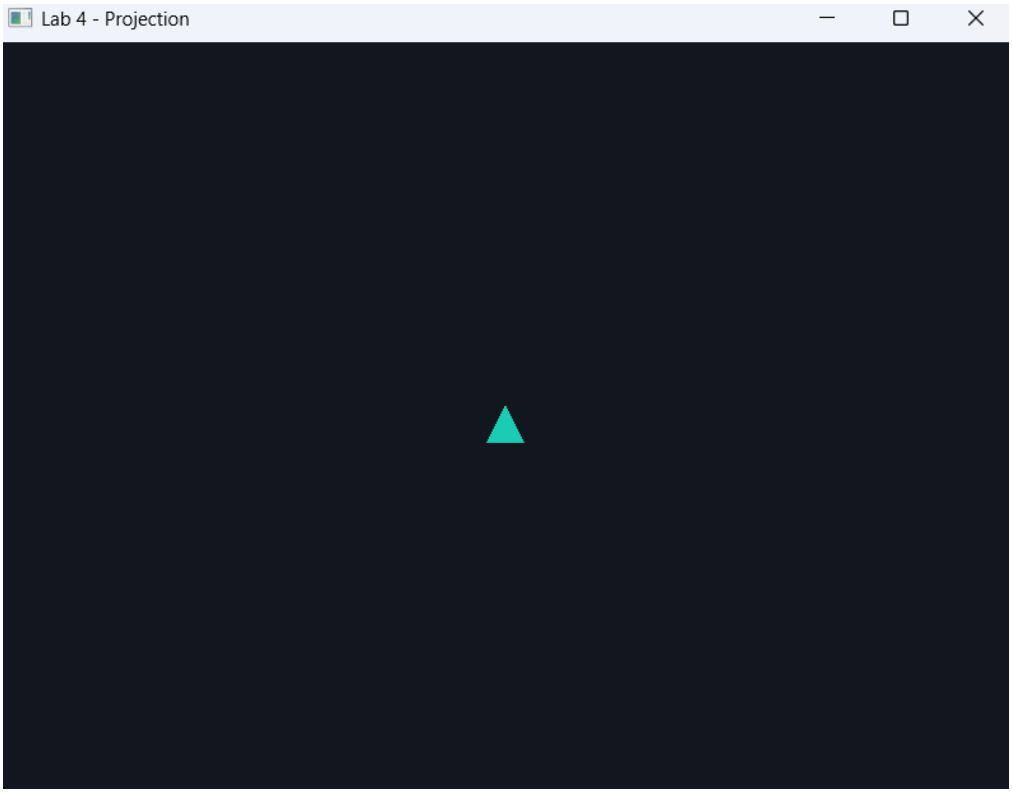
Task 2: Aspect ratio. Try aspect = 1.0, then 2.0, then 0.5.

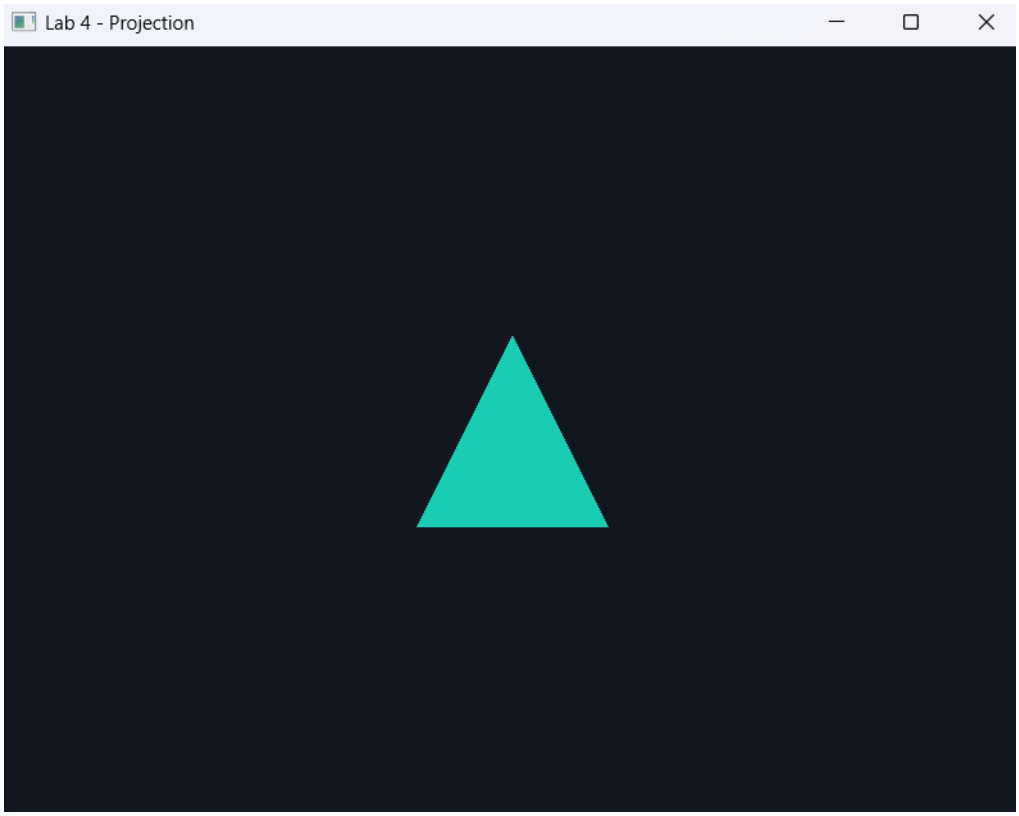


Task 3: Viewport. Add glViewport(0, 0, 400, 300); then glViewport(200, 150, 400, 300); after glClear.

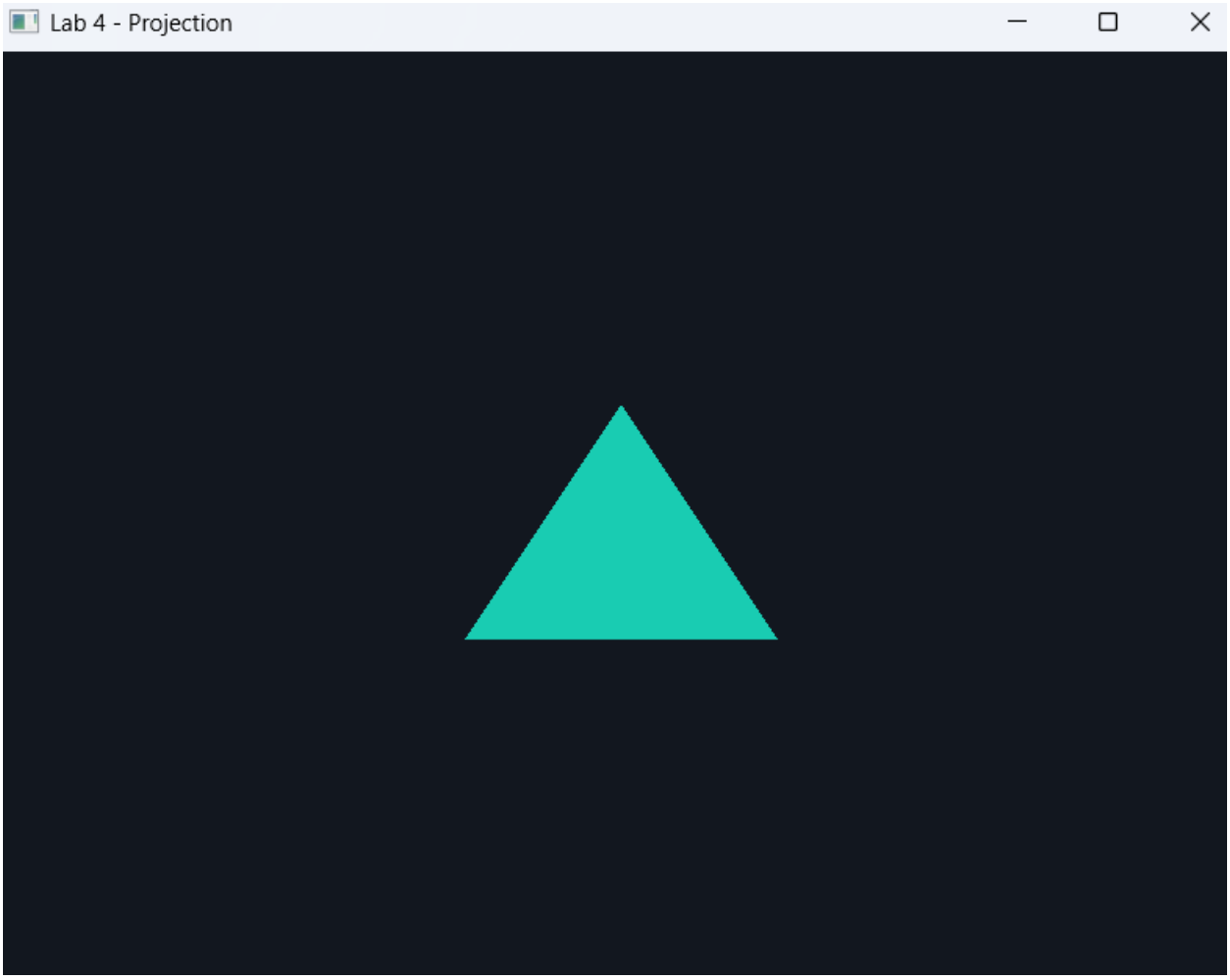


Task 4: Move the object. Set objectZ = -5, then objectZ = -1.



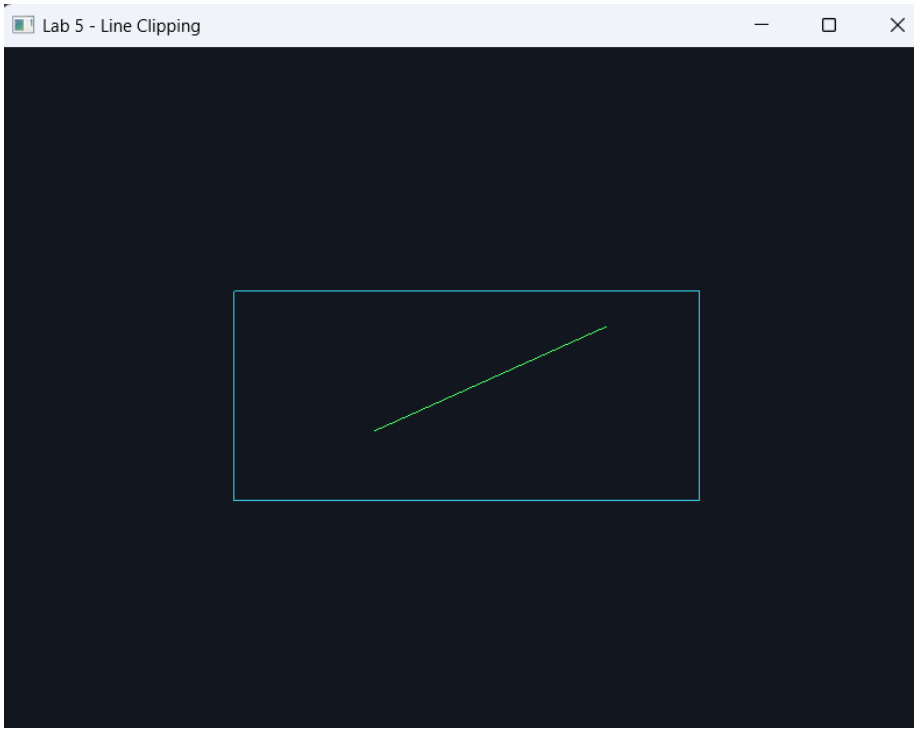


Task 5: Perspective vs Orthographic. Set useOrtho = true and repeat the depth test.

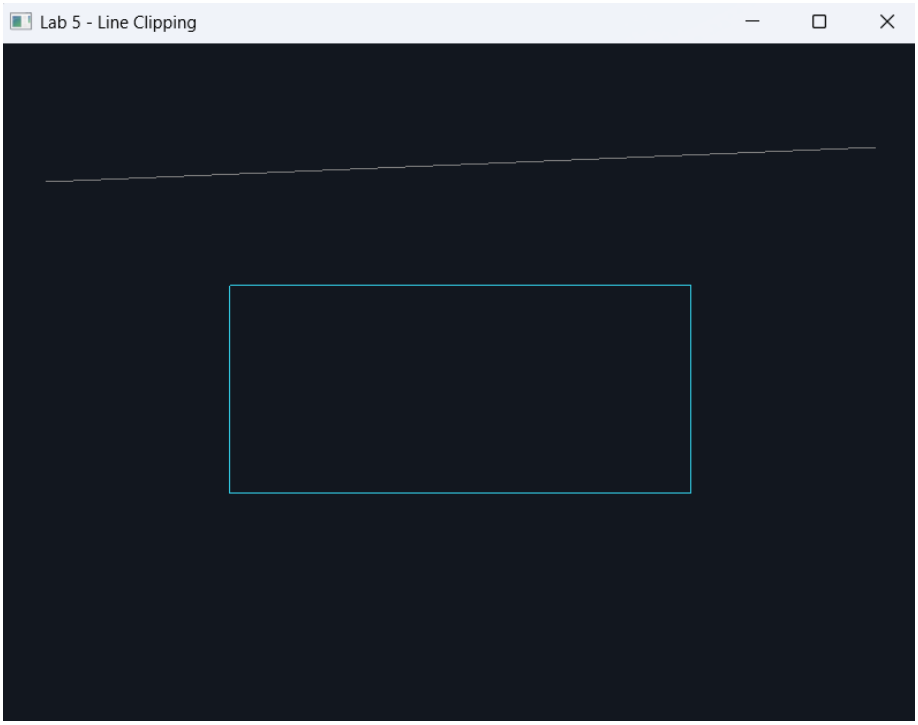


Lab 5: 2D Line Clipping

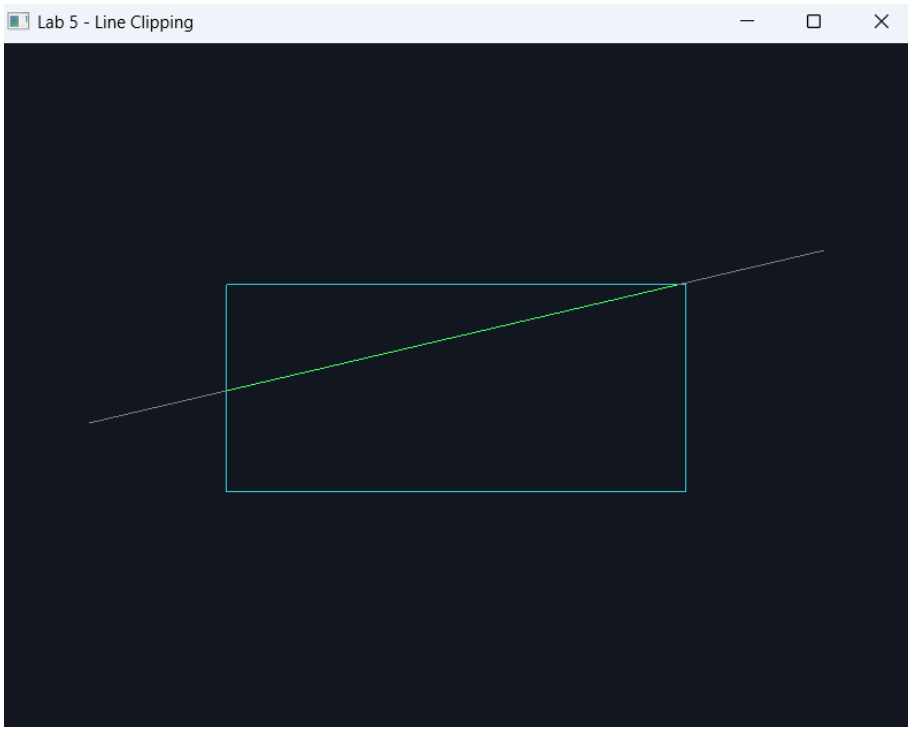
Task 1: Line completely inside the window.



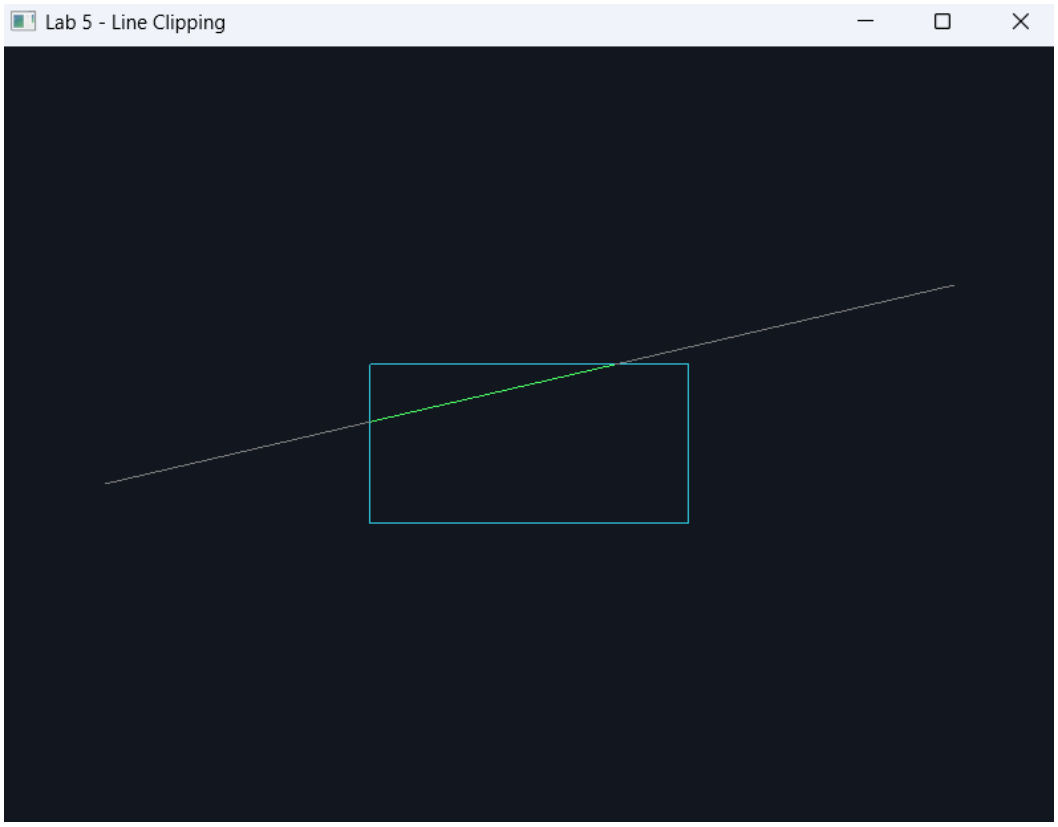
Task 2: Line completely outside the window.



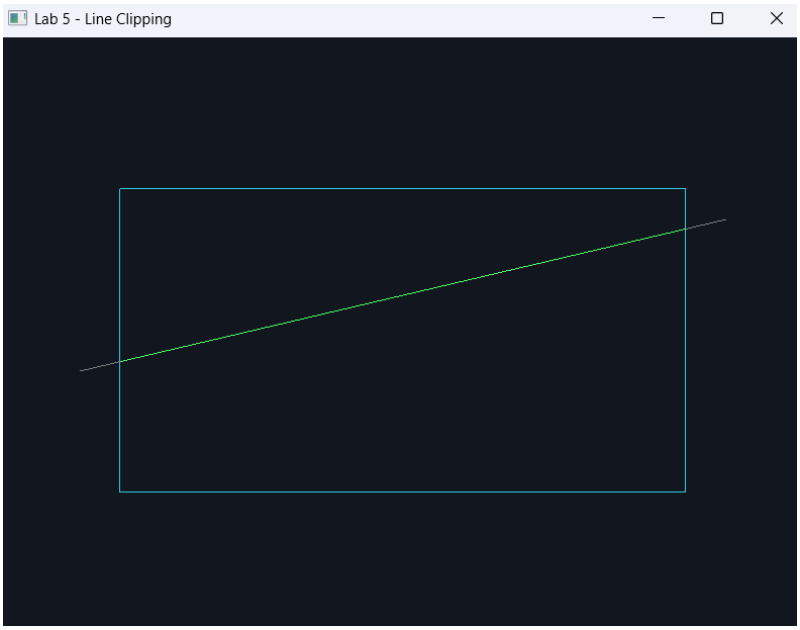
Task 3: Line partially inside the window.



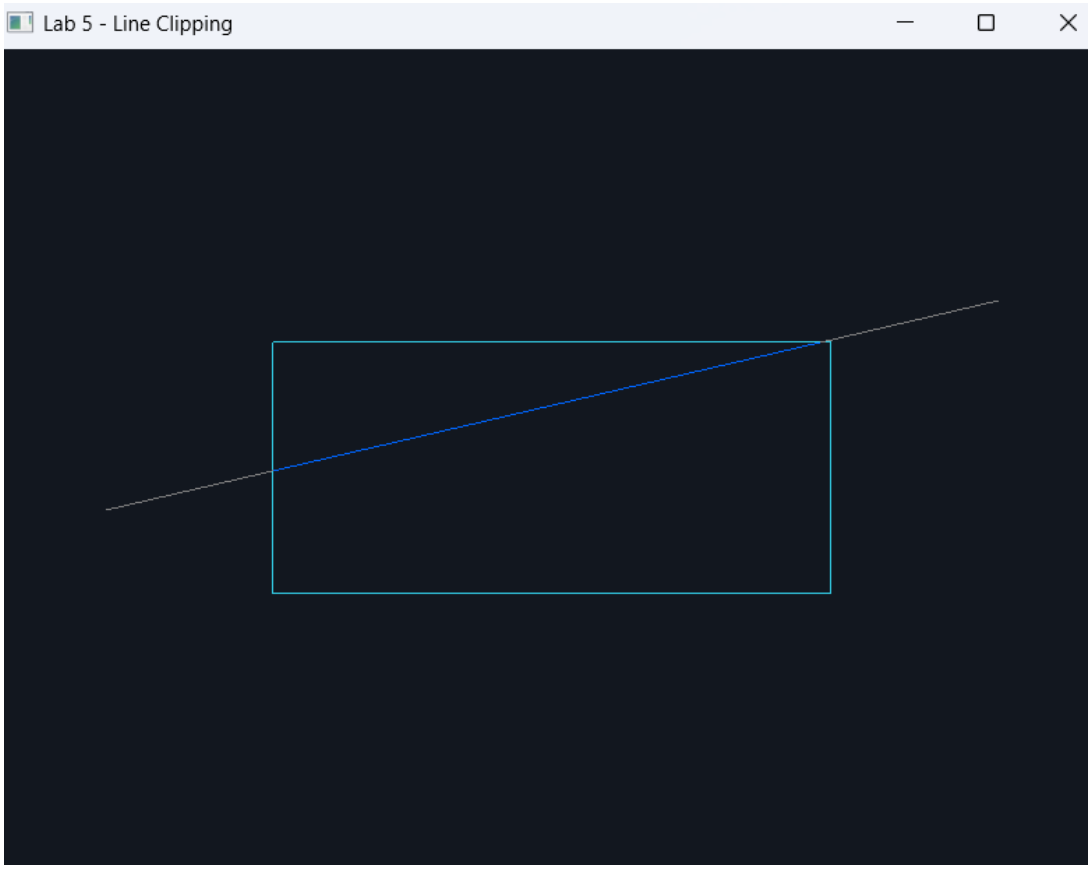
Task 4: Make the clipping window smaller.



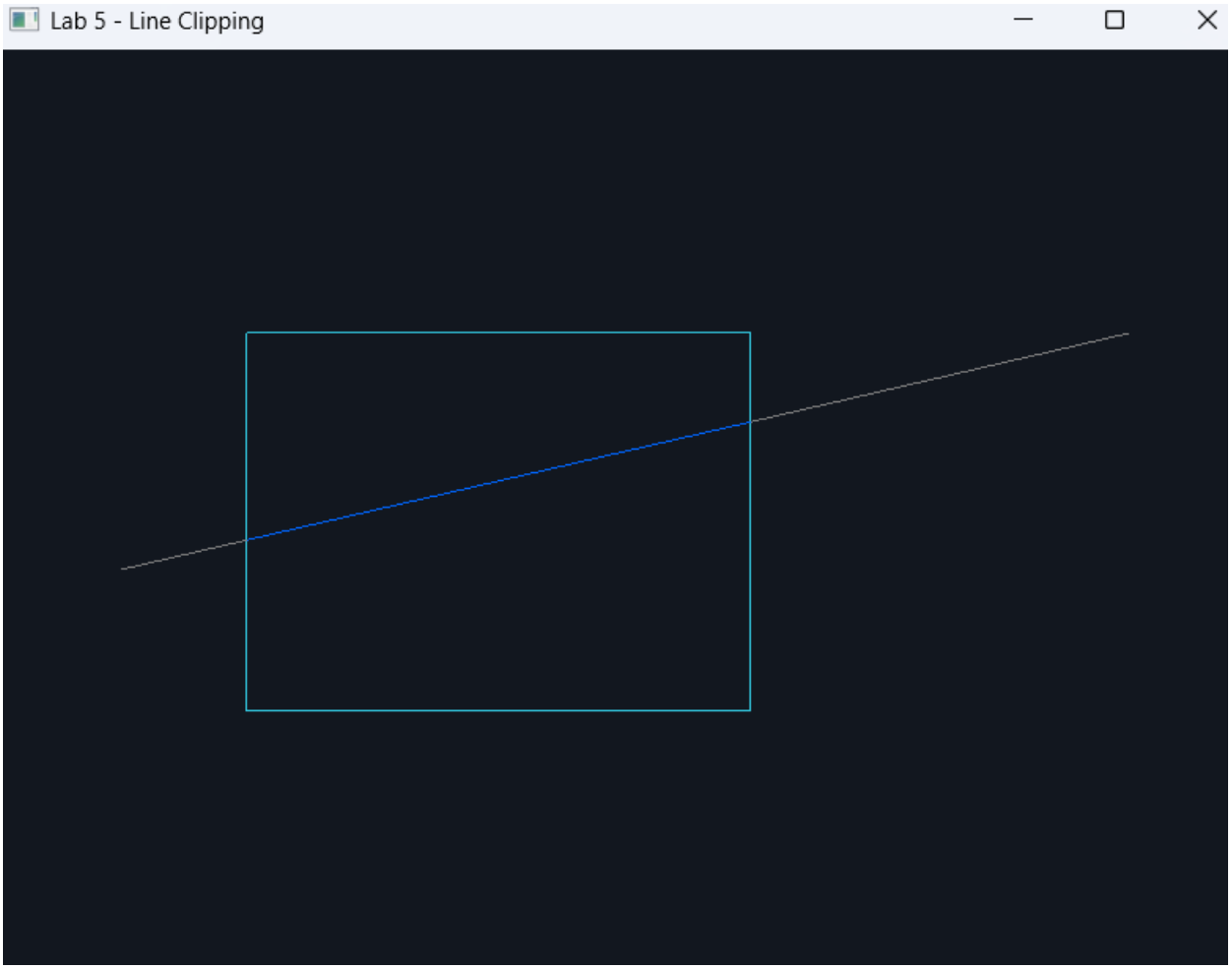
Task 5: Make the clipping window larger.



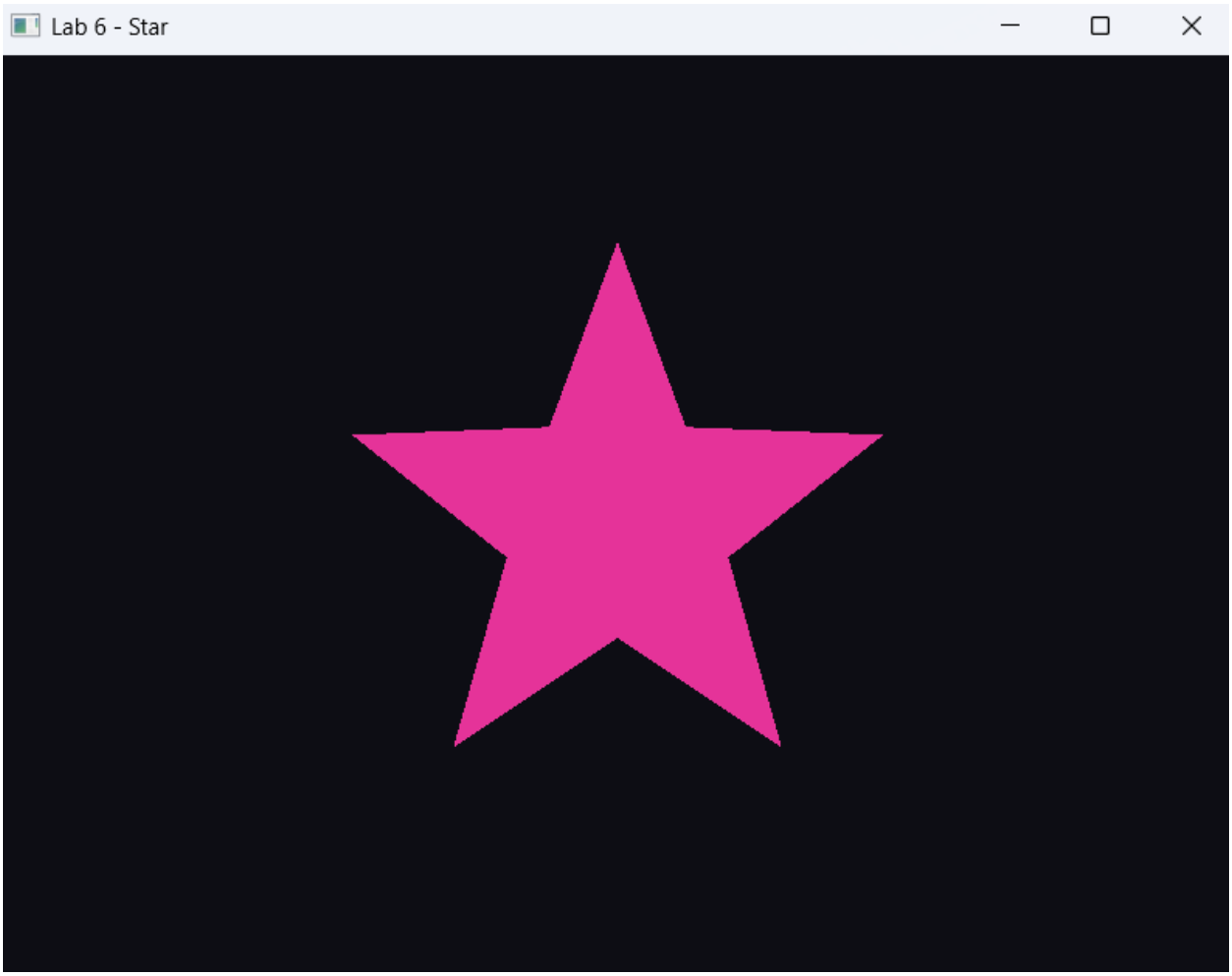
Task 6: Change the clipped line color.



Task 7: Move the clipping window and change its width.



Lab 6: Star



Lab 7: 3D Cube