Triangle coverage calculation
Triangle with points A(1,1) B(4,1) C(2,5) in screen space, determine which of the points are covered using point in triangle test
(2,2) (3,2) (1,4)

Point: (2, 2)
(2 - 4) * (1 - 1) - (1 - 4) * (2 - 1) = 3
(2 - 2) * (1 - 5) - (4 - 2) * (2 - 5) = 6
(2 - 1) * (5 - 1) - (2 - 1) * (2 - 1) = 3
(3 < 0) or (6 < 0) or (3 < 0) = False
(3 > 0) or (6 > 0) or (3 > 0) = True
not (False and True) = True
Point: (2, 2) is inside

Point: (3, 2)
(3 - 4) * (1 - 1) - (1 - 4) * (2 - 1) = 3
(3 - 2) * (1 - 5) - (4 - 2) * (2 - 5) = 2
(3 - 1) * (5 - 1) - (2 - 1) * (2 - 1) = 7
(3 < 0) or (2 < 0) or (7 < 0) = False
(3 > 0) or (2 > 0) or (7 > 0) = True
not (False and True) = True
Point: (3,2) is inside

Point: (1, 4)
(1 - 4) * (1 - 1) - (1 - 4) * (4 - 1) = 9
(1 - 2) * (1 - 5) - (4 - 2) * (4 - 5) = 6
(1 - 1) * (5 - 1) - (2 - 1) * (4 - 1) = -3
(9 < 0) or (6 < 0) or (-3 < 0) = True
(9 > 0) or (6 > 0) or (-3 > 0) = True
not (True and True) = False
Point: (1,4) is outside

Nyquist-Shannon theorem
Aliasing will occur as the sampling frequency is 1. For there to be no aliasing, that means the information contained would have to be less than 0.5 in frequency, however we know that it is 1.2 units, thus there will be aliasing. The minimum to avoid aliasing would be 2.4 units for the sampling frequency

Linear and affine transformations
A linear transformation is a form of multiplication such as 5 * x. A affine transformation on the other hand is something like x + 5. One is multiplicative, the other is additive. Translation is not multiplicative and inherently has to be addition, while rotation is able to be a multiplication on the input points. Using homogeneous coordinates such as 3d-h (4x4 matrix) solves this however by making the translation into a shear in the 4th dimension of the space, and then reducing that

back down to a 3 dimensional point, making the transformation still linear as shears are also a linear transformation

Composing Transformations

Scale by 2 along x, 3 along y

2	0	0
0	3	0
0	0	1

Rotate by 45 degrees counter clockwise

Cos 45	-Sin 45	0
Sin 45	Cos 45	0
0	0	1

Translate by 5,2

1	0	5
0	1	2
0	0	1

Combined Transformation Matrix

$\sqrt{2}$	$\sqrt{2}$	$3\sqrt{2}$
$\frac{3\sqrt{2}}{2}$	$\frac{3\sqrt{2}}{2}$	$\frac{21\sqrt{2}}{2}$
0	0	1

Quaternion rotation

Point P(1,0,0) Rotate around the axis V which is (0,0,1)

Quaternion:

	w	x	y	z
Equation	$cos(90/2)$	$sin(90/2) * v.x$	$sin(90/2) * v.y$	$sin(90/2) * v.z$
Final	$\frac{\sqrt{2}}{2}$	0	0	$\frac{\sqrt{2}}{2}$

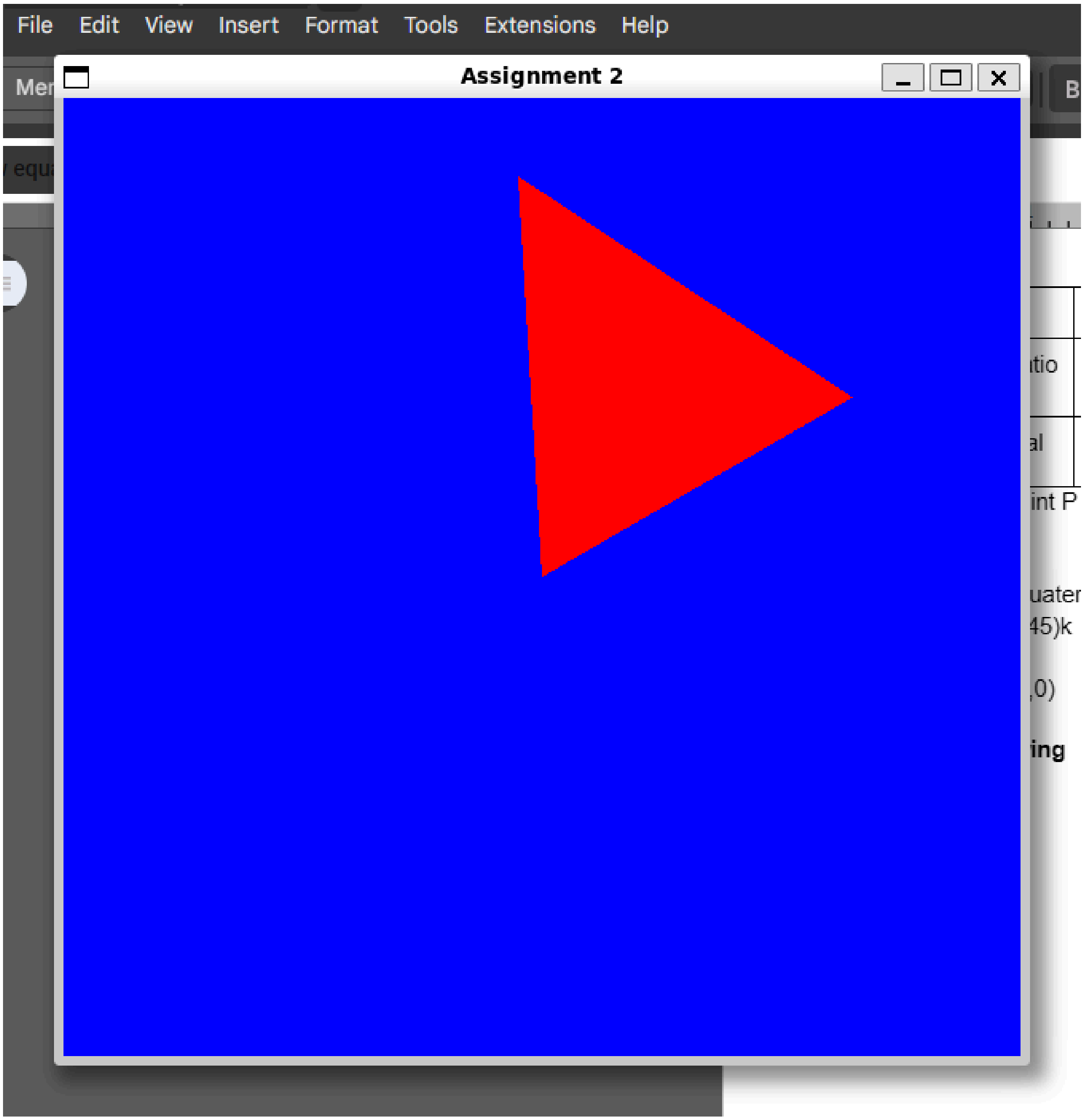
Convert the point P to a quaternion

1i+0j+0k

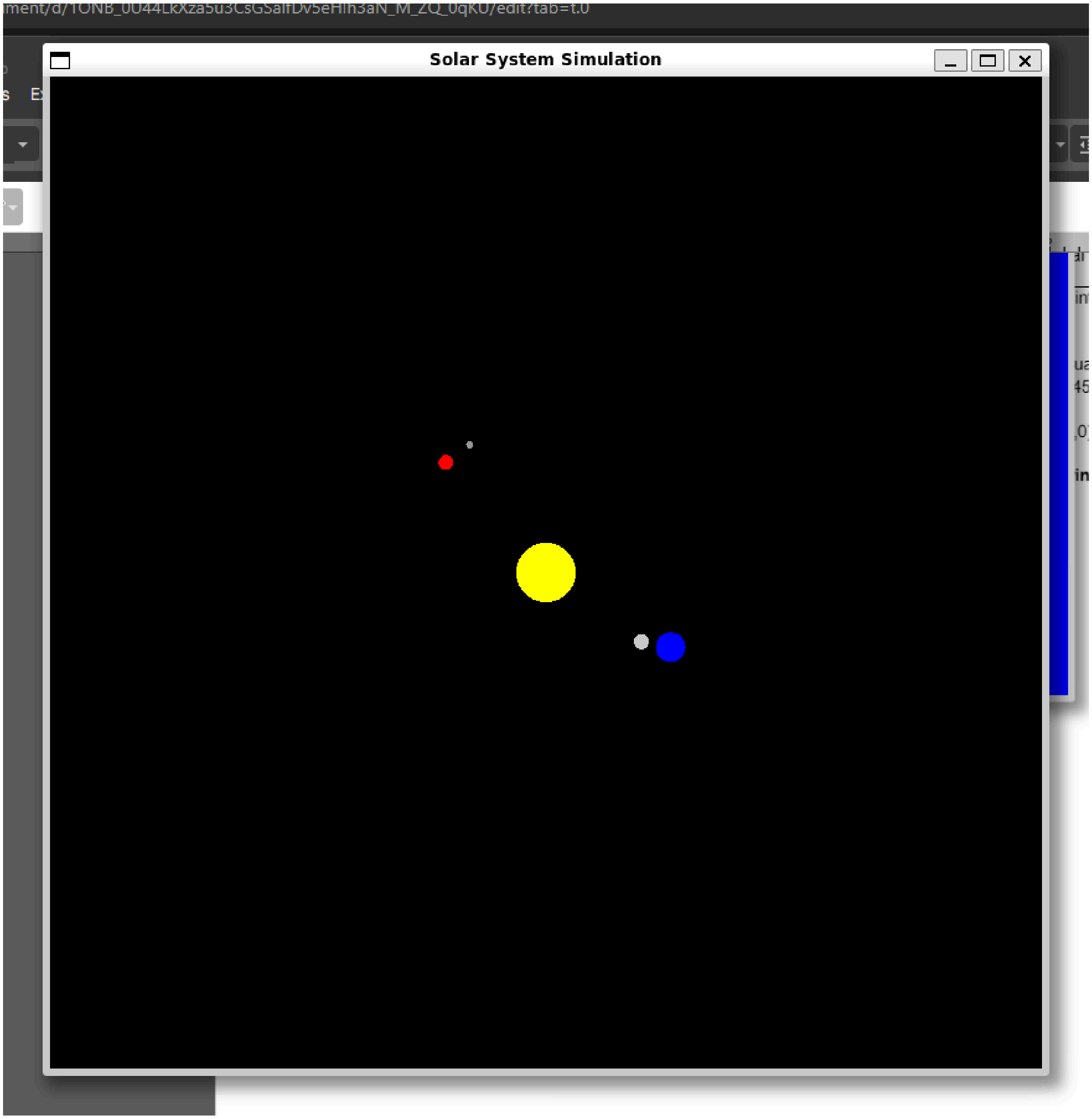
Conjugate of quaternion
-sin(45)j - cos(45)k

New point (0,1,0)

Triangle Drawing



Solar System


Solar System Simulation