CS3241 Tutorial 1: Geometry and OpenGL

Geometry

"*Let no one ignorant of geometry enter here*". (Plato, this was inscribed above the door of his academy)

"*There is geometry in the humming of the strings, there is music in the spacing of the spheres*" Pythagoras.

Question 1

What is the difference between a *point* (or position) like (x,y) and a *vector* v = (x,y)?

Question 2

Given a point x = (3,1,10). What is its now position after translating it with a vector (4,1,2)?

Question 3

Following with the above question, what is the translation (vector) to bring the point from the new position back to the origin position?

Question 4

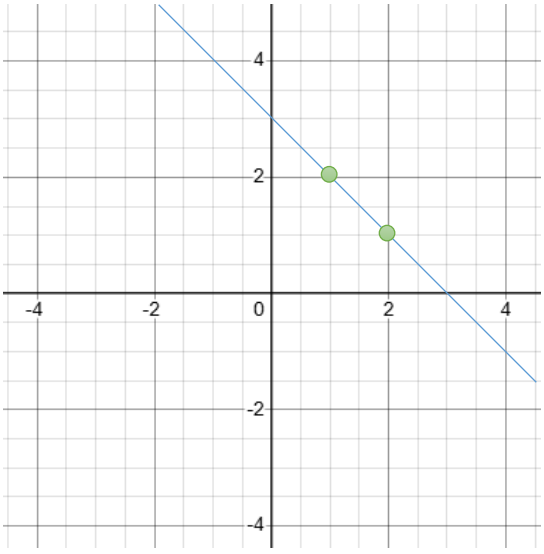
How do I represent the point x = (3,1,10) in Question 2 in homogeneous coordinates?

Question 5

What is the 4 x 4 matrix M that I can use to perform the translation in Question 2? Show the calculation that how can we use this matrix to do the translation.

Question 6

Imagine there are two points a = (1,2) and b = (2,1). What is the infinite line the pass through this two points? Express your answer in the form of an equation.

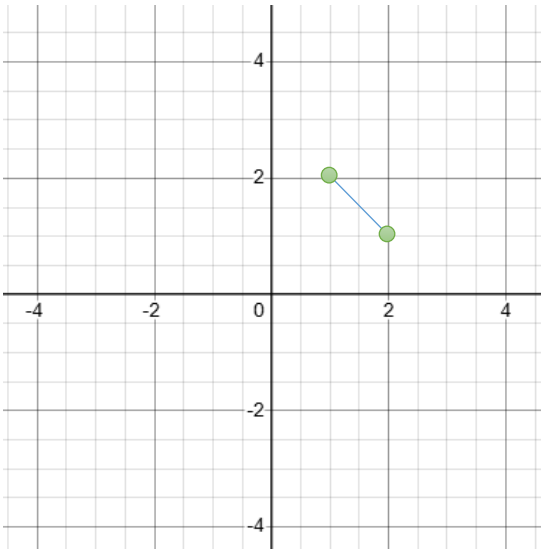


Question 7

For any infinite line like the above, how do we find the intersection of the line with another horizontal line y = c? E.g. what is the intersection of the line in the previous question with y = 10?

Question 8

How do we express the line segment with a and b as the end points? We do not want the infinite line but only the line segment between the two points. (Hint: You need to use a *parametric* equation.)



OpenGL

Question 9

Briefly explain why OpenGL is called a state machine.

Question 10

Write the minimal OpenGL program to display a white square on a black background.

Question 11

Explain the difference between primitive generating functions and state changing functions in OpenGL.

Question 12

Given the OpenGL command `glColor3f(0.5, 0.0, 1.0)`, what is the resulting color?

Question 13

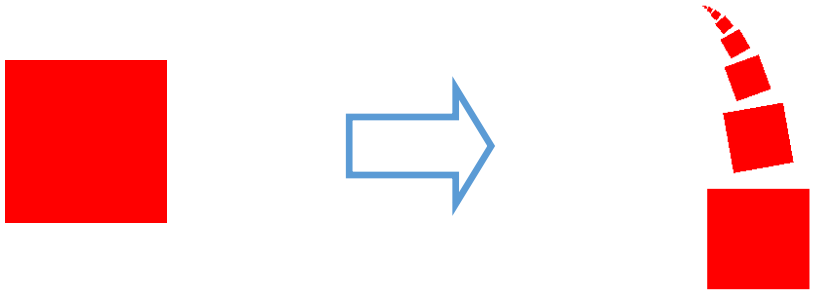
What is the purpose of `glClear(GL_COLOR_BUFFER_BIT)` and how does it differ from `glClearColor()`?

Question 14

Why triangles are considered the safest polygon primitive in OpenGL rendering?

Question 15

Step 1: Assuming a function **`drawAUnitSquare()`** that can draws a square with corners $(\pm 1, \pm 1)$, suggest how you can use it to construct the structure on the right using transformations.



Step 2: With the "tentacle" you constructed above, next discuss how you can form the "sun" drawn below.