CS 7/5382 – F23 – HW 3

Name:_____

Submit scanned HANDWRITTEN answer to the questions below as a file upload. You may download and print this assignment or provide on a separate sheet with label, name and clear numbering. SHOW YOUR WORK!

1. (34 points) Given the following two points A and B in 4D homogeneous coordinates,

   A: [1 1 1 1] B [2 -1 3 1]

   a) Define a ray,*.r*, that passes through A in the direction of B.

   b) Express the line that passes through A and B in parametric form.

   c) Sketch point A and ray, *r,* and show(generally) where the line that includes it intersects the XZ-plane.

   d) Express the point where the line intersects the XZ plan in homogeneous coordinates.

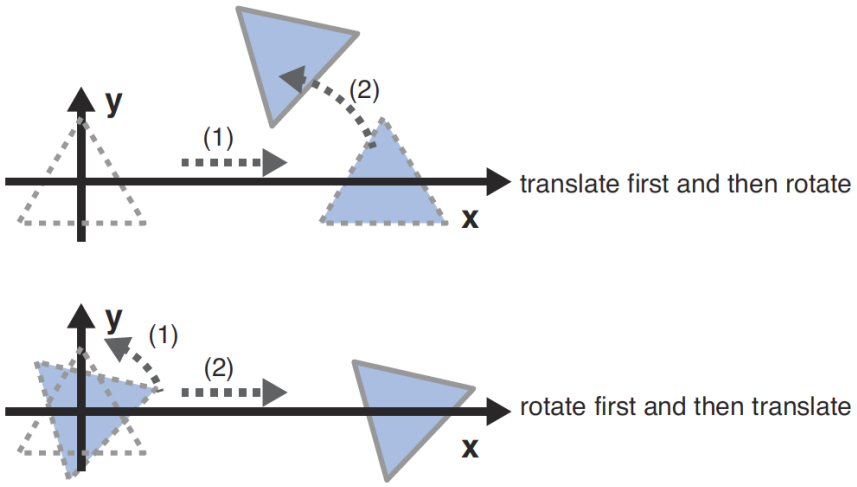
2. (16 points) Here, you see a triangle centered about the origin and the effect of applying transformations to the original vertices. For each (the top and the bottom) construct a <u>single transformation matrix</u> to achieve each of the following using 4D homogenous coordinates.
   Use a **horizontal translation of 8** and a rotation about the **Z-axis of 30 degrees to construct the matrics M_A and M_B.**

A) Vertices transformed as

$v' = M_A v$

B) Vertices transformed as

$v' = M_B v$



a. Construct the single matrix M_A

b. Construct the single matrix M_B

3. (50 points) Compute the transformed location, of the following 2 points and the following vector under the following series of transformations, expressed as functions.

   a. Rewrite the following series of transformations as concatenated 4x4 matrix multiplication using homogenous coordinates.

   $q' = R_z(90)\ S(2, 4,1)\ q$

   b. The points and vector are expressed below as two-element vectors representing x and y. Represent as 4-element homogeneous coordinates.

   Express as homogeneous coordinate q

   Points: (0.5, 0.5)

   Point. (0.5, -0.5)

   Vector (0.5, 0.5)

   c. Sketch and label all elements Show the 2D coordinate axes

   Is the vector normal to the line? **Verify using the proper vector operation.**

d. Apply the above transformations to each of the following points and vectors, replacing the values for q in the expression above to compute q'.

Transformed homogeneous coordinate q'

Points: (0.5, 0.5)

Point(0.5, -0.5)

Vector (0.5, 0.5)

e. Sketch and label transformed elements q', Show the 2D coordinate axes

f. Is the vector normal to the line? Verify using the proper vector operation.