**Written Assignment 4**

ID 204818181 Maya Kerem

**Question 1)**

Write the matrices of the following transformations. For each transformation, write its most specific type (Linear/Rigid/Similarity/Affine/Projective).

1. Rotate by  **counter-clockwise** around the -axis, translate the origin to and scale uniformly by factor .

**Answer:**

Consider a transformation of a counterclockwise rotation around z axis.

Now consider the translation of the origin to , and a scaling matrix by 2.

and

All together, we computer

This is a similarity transformation.

1. Reflect about the plane, then scale by in -direction.

**Answer:**

Consider a matrix that is reflected over plane

Now we will scale by 0.5 in   direction. Let

Then we have

And now we consider scaling by

And we get

This is rigid transformation.

1. ]], then reflect about the line.

**Answer:**

Consider a matrix that is reflected over plane

1. Rotate by clockwise around the line , and then translate by 2 in all directions.

**Answer:**

**Question 2)**

1. Prove that 2D reflection about the line , where is the angle between the line and the axis is given by:   
   Recall the identities:

**Answer:**

Let . Note that , then we can also say that . Clearly as lays on the line , and as and are orthogonal, we can infer that represents a 2D reflection over ,

1. Show that a rotation matrix, can be factorized into three shear matrices:

Furthermore, precisely draw a step by step result of the above shear operations on a 2-length square centered at in case . Meaning, first draw the transformed square when is applied and then draw the transformed square when is applied. Indicate the values of the square points in your drawing.

**Answer:**

1. Find the reflection matrix about the plane:

Where is a point on the plane and is a unit normal vector of the plane.

**Answer:**

**Question 3)**

Given a cube with vertices at:

For each of the following diagrams, find the parallel projection matrix that will project the cube upon the given shape, in the plane (in which ).

*1*

*2*

*3*

*4*

*5*

**Answer:**

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**Question 4)**

1. Find the matrix of the perspective projection with the following properties:
   * The center of projection (COP) is (0,3,2).
   * The projection plane passes through the origin and has a normal vector (0,3,2).

**Answer:**

1. Find the vanishing point of the line that passes through the points (-4,0,-5) and (0,0,-8) w.r.t a perspective projection with COP at (0,0,0) and a projection plane perpendicular to the z-axis at z=-5.

**Answer:**