

CS 302/352: Computer Graphics and Visualization

Assignment #6

1. Write a Python program to rotate a given point (4,6) by **90 degrees** using the 2D rotation matrix. Visualize the original and rotated points using Matplotlib. Explain how the rotation matrix is applied to achieve the transformation.
2. Write a Python program to apply a **2D shear transformation** on a given point (5,2) using shear factors of **0.7 along the X-axis** and **0.3 along the Y-axis**. Visualize the original and sheared points using Matplotlib. Explain how the shear matrix is applied to achieve the transformation.
3. Write a Python program to apply a **2D translation transformation** on a given point (6,3) using a translation vector of (-2,4). Visualize the original and translated points using Matplotlib. Explain how the translation vector is applied to shift the point.
4. Write a Python program to apply a **3D translation transformation using a homogeneous matrix** on a point (4,2,7,1) using translation values of (3,-2,5) along the X, Y, and Z axes, respectively. Visualize the original and translated points using Matplotlib's 3D plotting capabilities. Explain how the homogeneous coordinates and the 4x4 translation matrix are used to perform the transformation.
5. Write a Python program to apply **two sequential 3D translations using homogeneous matrices** on a point (4,2,6,1) using translation vectors (3,-2,1) and (-2,4,-3). Then, apply a combined translation using the sum of these vectors and verify if the result matches the sequential translation. Visualize all points using Matplotlib's 3D plotting capabilities and explain how homogeneous matrices perform these transformations.
6. Write a Python program to apply **two sequential 3D rotations using homogeneous matrices** on a point (5,3,7,1) using rotation angles 40° and 60° about the **z-axis**. Then, apply a combined rotation using the sum of these angles and verify if the result matches the sequential rotation. Visualize all points using Matplotlib's 3D plotting capabilities and explain how homogeneous matrices perform these transformations.
7. Given a point (6, 2, 7) in homogeneous coordinates [6, 2, 7, 1], perform the following transformations:
 1. Scaling: Factors (2.0, 0.5, 1.5) along x, y, and z axes.
 2. Rotation: 60° about the z-axis.
 3. Translation: By (4, -3, 5) along x, y, and z.

Tasks:

1. Create 4x4 matrices for scaling, rotation, and translation using NumPy.
2. Compute the composite transformation matrix.
3. Apply it to the point and print the result.
4. Visualize the original and transformed points using Matplotlib with dashed lines from the origin.
5. Plot intermediate points after each transformation.

Instructions

- Include comments in your code explaining each step.
- Provide hand written answers wherever required.
- Submit your answers in a pdf file with format: assignment4_<roll. no.>.pdf.