ALGORITHMS

Algorithm: 3D Cube Construction and Transformations

Step 1:

Define the vertices of a **unit cube** in 3D space using homogeneous coordinates

(x, y, z, 1)

Step 2:

Store all 8 vertices of the cube in a matrix form.

Step 3:

Define the cube edges by pairing the appropriate vertices.

Step 4:

Plot the original cube using a 3D plotting environment.

Algorithm: Scaling of a 3D Cube

Step 1:

Input scaling factors Sx, Sy, Sz

Step 2:

Form the scaling transformation matrix

$$S = \begin{bmatrix} s_x & 0 & 0 & 0 \\ 0 & s_y & 0 & 0 \\ 0 & 0 & s_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Step 3:

Multiply the scaling matrix with the cube vertices.

Step 4:

Store the scaled cube coordinates.

Algorithm: Rotation of 3D Cube about Z-Axis

Step 1:

Input rotation angle θ

Step 2:

Convert angle from degrees to radians.

Step 3:

Construct rotation matrix about Z-axis

$$R_z = \begin{bmatrix} \cos\theta & -\sin\theta & 0 & 0 \\ \sin\theta & \cos\theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Step 4:

Multiply rotation matrix with cube coordinates.

Algorithm: Translation of 3D Cube

Step 1:

Input translation values tx, ty, tz

Step 2:

Form translation matrix

$$T = \begin{bmatrix} 1 & 0 & 0 & t_x \\ 0 & 1 & 0 & t_y \\ 0 & 0 & 1 & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Step 3:

Apply translation to rotated and scaled cube.

Algorithm: Combined 3D Transformation

Step 1:

Multiply matrices in the order

M= T × R × S

Step 2:

Apply combined matrix to cube vertices.

Step 3:

Plot both original and transformed cubes together.

Algorithm: Changing Viewing Angles

Step 1:

Set elevation angle using elev.

Step 2:

Set azimuth angle using azim.

Step 3:

Render cube with updated viewing angles.

Step 4:

Observe changes in projection without modifying geometry.

Algorithm: 3D House Model (Cube + Pyramid)

Step 1:

Construct a cube to represent the house base.

Step 2:

Define pyramid roof vertices above the cube.

Step 3:

Connect roof apex with cube top vertices.

Step 4:

Plot cube and pyramid together to form a house.

Algorithm: Rotation about X, Y, and Z Axes

Step 1:

Input rotation angle θ

Step 2:

Form rotation matrices:

• **X-axis rotation**

Rx

• **Y-axis rotation**

Ry

• **Z-axis rotation**

Rz

Step 3:

Apply each rotation separately to cube vertices.

Step 4:

Plot rotated cubes side-by-side.

Step 5:

Compare effects of rotations about different axes.

Step 6:

Stop