21AIE201-INTRODUCTION TO ROBOTICS

REVISION MCQs

1) The term: robot came from the Czech word: robata, which was introduced by

a. Isaac Asimov
b. Karel Capek
c. Joseph Engelberger
d. Victor Scheinman

- a.
- b.
- c.
- d.

Asimo Humanoid Robot was developed by

a. Honda
b. Unimation
c. Odetics
d. NASA, USA

- a.
- b.
- c.
- d.

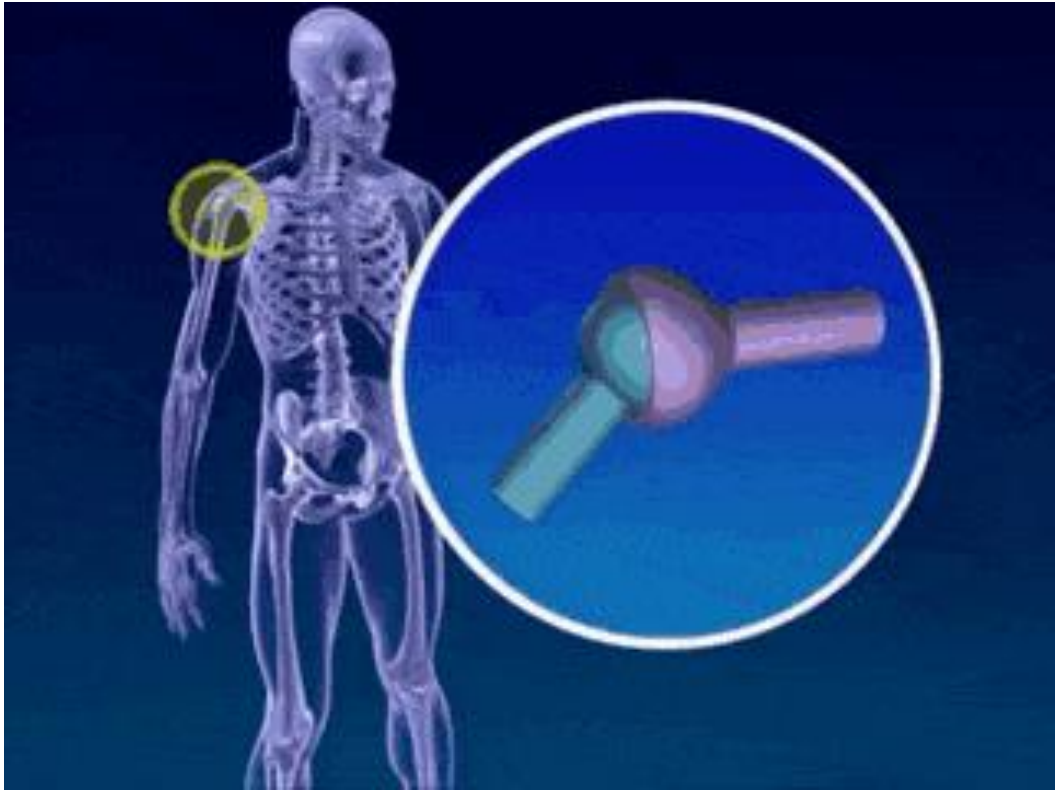
Ball and Socket joint or Spherical joint used in robots consists of

a. three rotary joints → R-1

b. two rotary and one translating joints

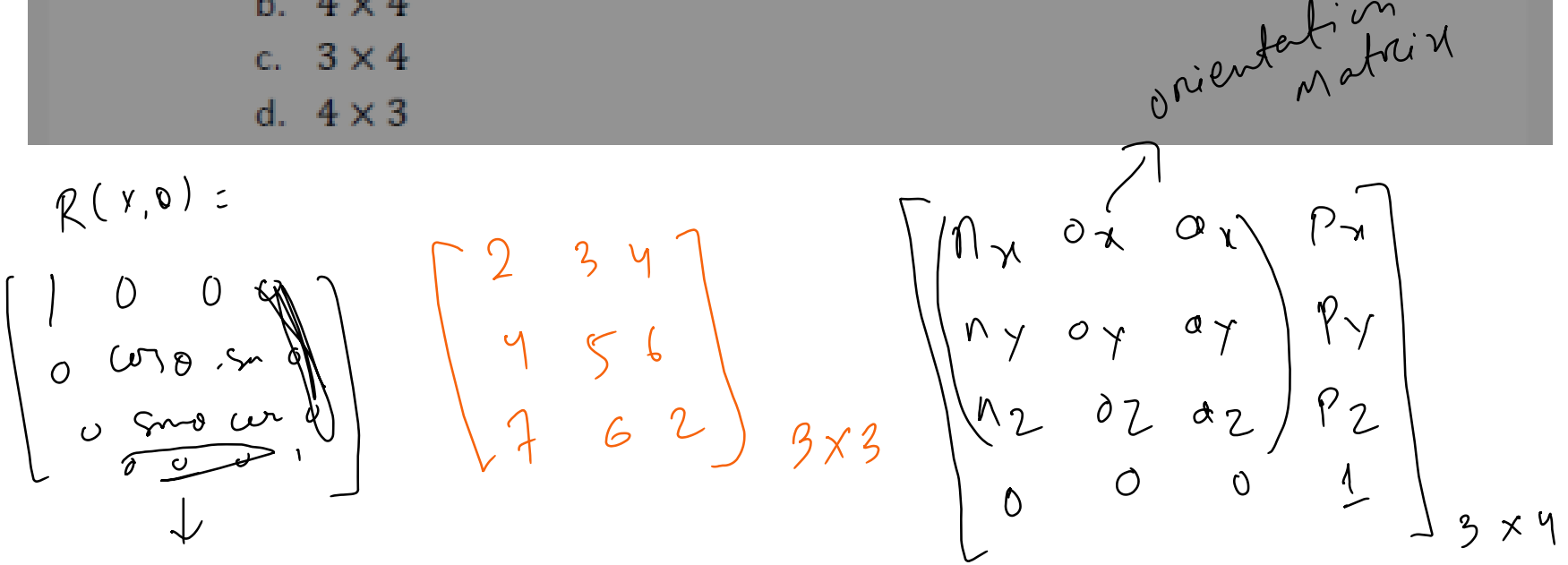
c. one rotary and two translating joints

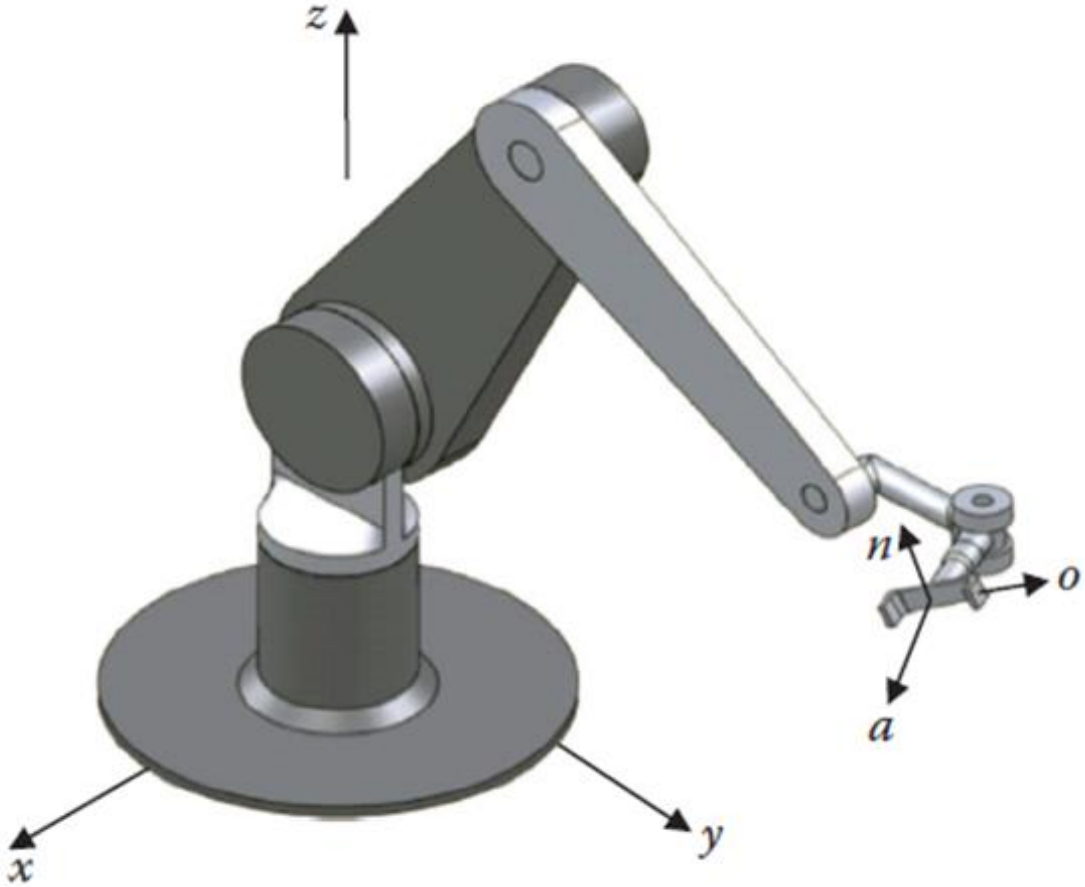
d. four rotary joints

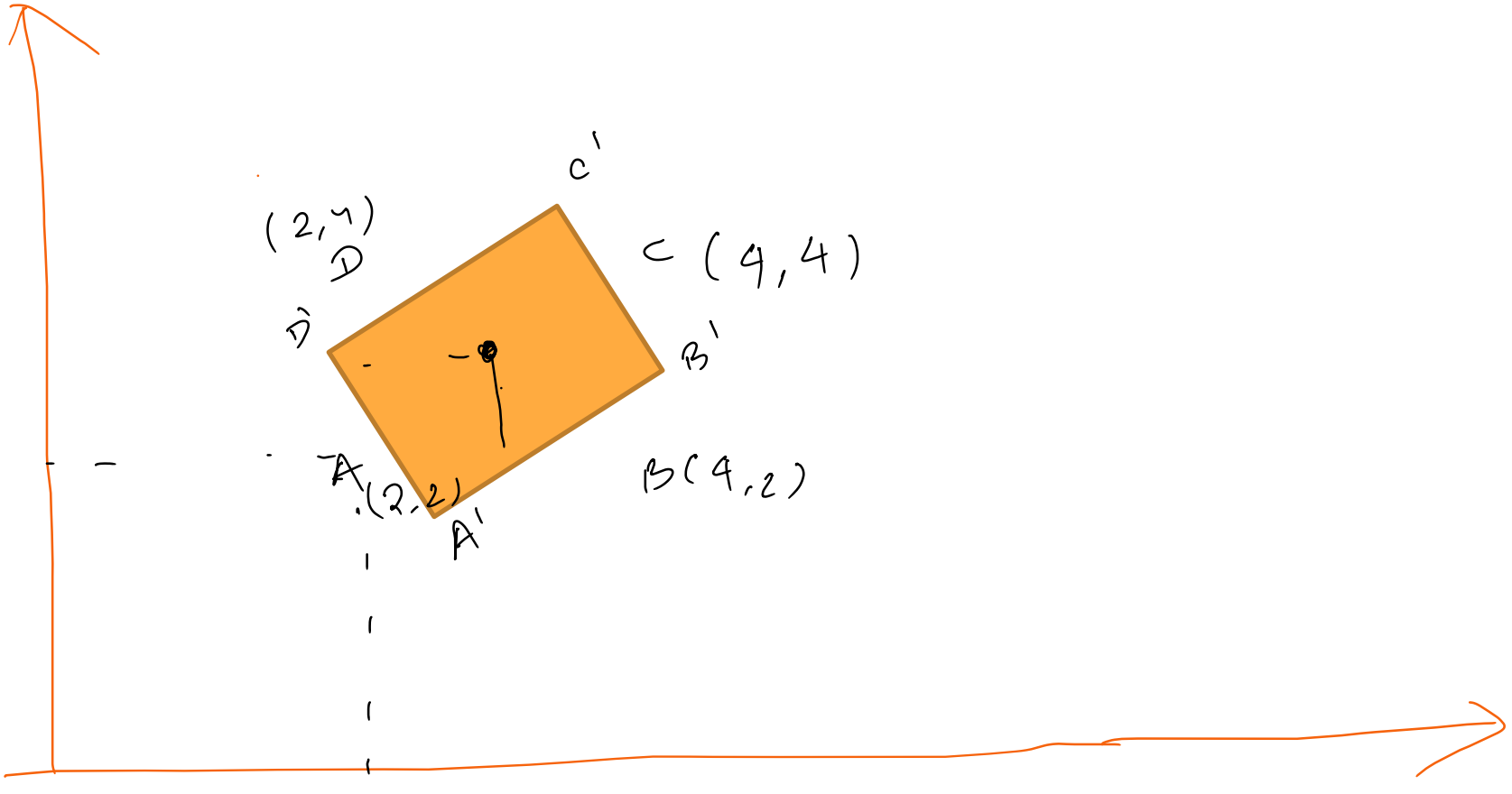


Homogeneous transformation matrix used in Robot Kinematics has the dimensions of

a. 3 x 3
b. 4 x 4
c. 3 x 4
d. 4 x 3




z
x
y
n
o
a


C'
(2,4)
D
C (4,4)
D'
B'
A
(2,2)
A'
B(4,2)

Homogeneous transformation matrix used in Robot Kinematics has the dimensions of

a. 3 x 3
b. 4 x 4
c. 3 x 4
d. 4 x 3

$$F_{object} = \begin{bmatrix} n_x & o_x & a_x & p_x \\ n_y & o_y & a_y & p_y \\ n_z & o_z & a_z & p_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Which one of the following statements is FALSE?

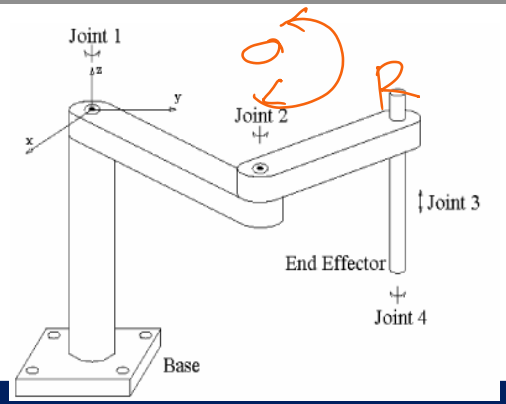
To represent the position and orientation of a $3-D$ object in $3-D$ space,

a. We need a set of four vectors.
b. We need a 4×4 matrix.
c. We can take the help of Cartesian coordinate system.
d. We need a 3×3 matrix.

$$\begin{bmatrix} n_x & o_x & a_x & p_x \\ n_y & o_y & a_y & p_y \\ n_z & o_z & a_z & p_z \\ 0 & 0 & 0 & 1 \end{bmatrix}_{4\times4}$$

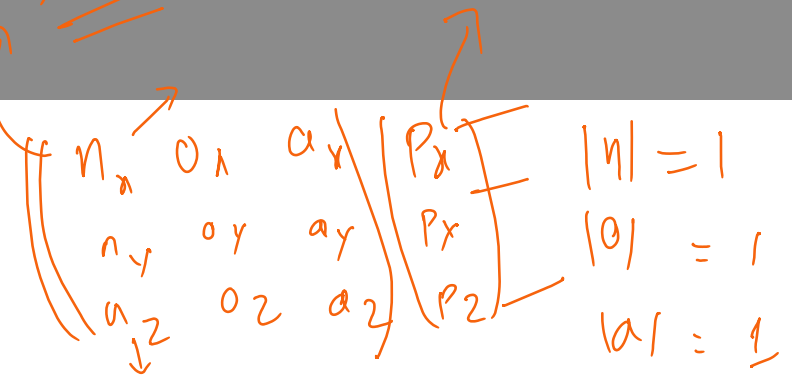
A SCARA Robot structure consists of:

- 4 DoF - Prismatic,Revolute,Revolute,Revolute
- 4 DoF - Revolute,Revolute,Prismatic,Revolute
- 4 DoF - Revolute,Prismatic,Revolute,Revolute
- 5 DoF - Revolute,Revolute,Revolute,Prismatic,Revolute



Position of a point in space is represented by three position coordinates whereas the orientation of a rigid body is expressed by a

- (3 X 3) Skew symmetric matrix
- (3 X 3) Orthonormal Matrix
- (4 X 4) Homogeneous transformation matrix
- (3 X 3) Identity matrix



The modulus of each columns of the rotation matrix is

- 1
- 0.5
- 0.866
- 1.366

The determinant of a rotation matrix is

- -1
- 0.5
- -0.5
- 1

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

The inverse of the Rotation matrix 'R'is

- Transpose of the cofactor matrix of R
- Transpose of R
- Cofactor matrix of R
- Transpose of R^T

$A^{-1} = \frac{Adj\ A}{|A|}$ → T. of c. R

$Rot(x, 40)^{-1} = R^T$

A frame 'B' is rotated by 60 degree about Z-axis of A. If the coordinate of a point P in frame B has the coordinate (1,1,1), what is its coordinate in frame A?

- (-0.366,1.366,1)
- (1.366,-0.366,1)
- (-1.366,0.366,1)
- (0.366,-1.366,1)

Frame (B) is rotated by 60° about Z-axis of A.

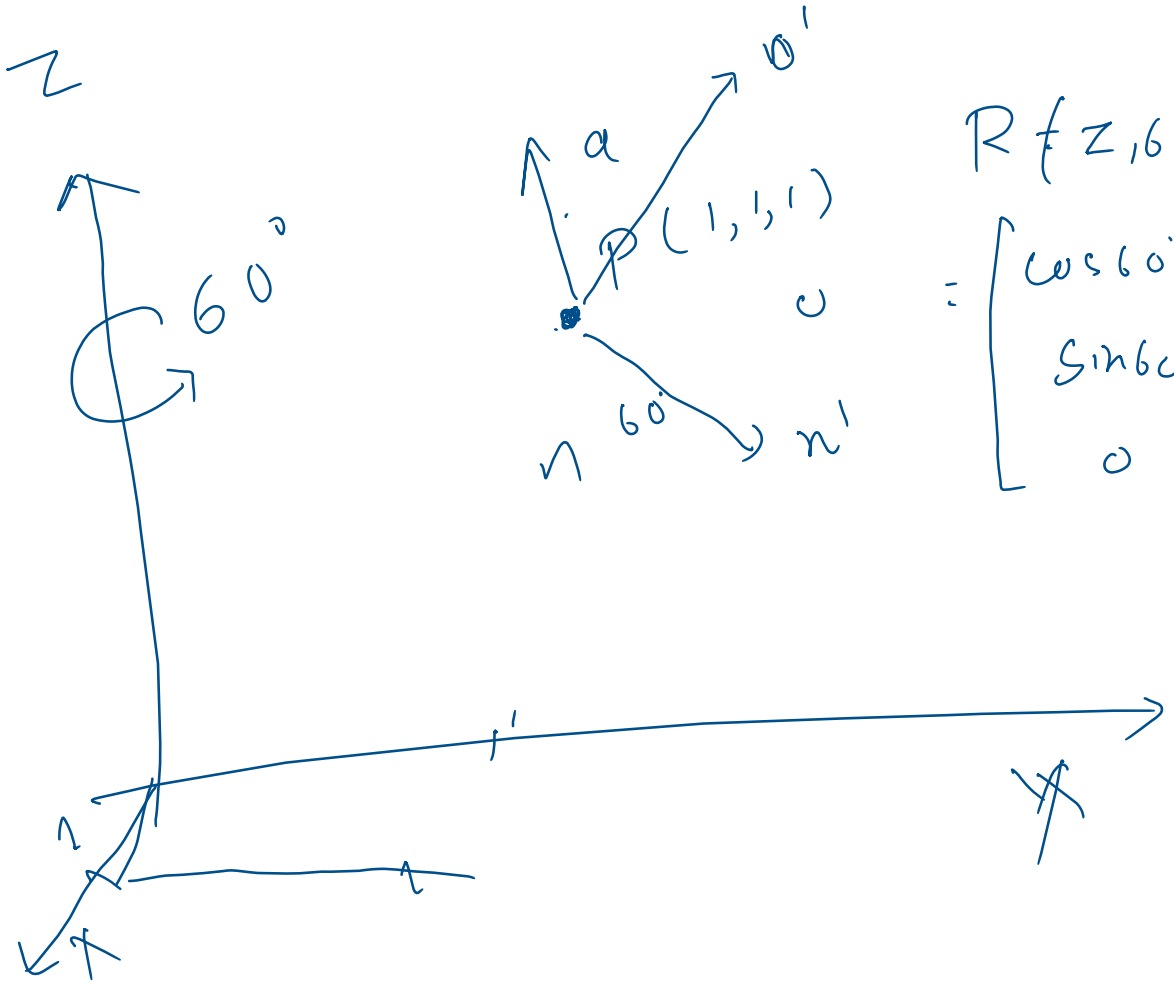
P in B → (1,1,1)

(−0.366, 1.366, 1)

(1.366, −0.366, 1)

(−1.366, 0.366, 1)

(0.366, −1.366, 1)



$$R(z, 60^\circ) = \begin{bmatrix} \cos 60^\circ & -\sin 60^\circ & 0 \\ \sin 60^\circ & \cos 60^\circ & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

$3 \times 3 \quad 3 \times 1$

$\downarrow$

3×1

A frame 'B' is rotated by 30 degree about Z-axis of A. It is again rotated by 60 degree about X-axis of A.The combined rotation matrix is given by

- $R_{(X,60)}R_{(Z,30)}$
- $R_{(Z,30)}R_{(X,60)}$
- $R_{(Y,30)}R_{(Z,30)}$
- $R_{(Z,30)}R_{(Y,30)}$

X, Y, Z

(I) Rot(30, Z)

(II) Rot(X, 60°)

$Rot(X,I)\,Rot(Z,I)(P)$

$Rot(X,60)(Rot\ 30,Z)P$

$P\ (1,1,1) \rightarrow$

$Rot(Z,60°)$

$P_{NOW} = Rot(Z,60)\cdot(1,1,1) = (-0.366, 1, 1.$

$Rot(X,30)$

$P_{NOW}^{2} = P_{NOW}\ Rot(X,30°)\cdot P_{New}$

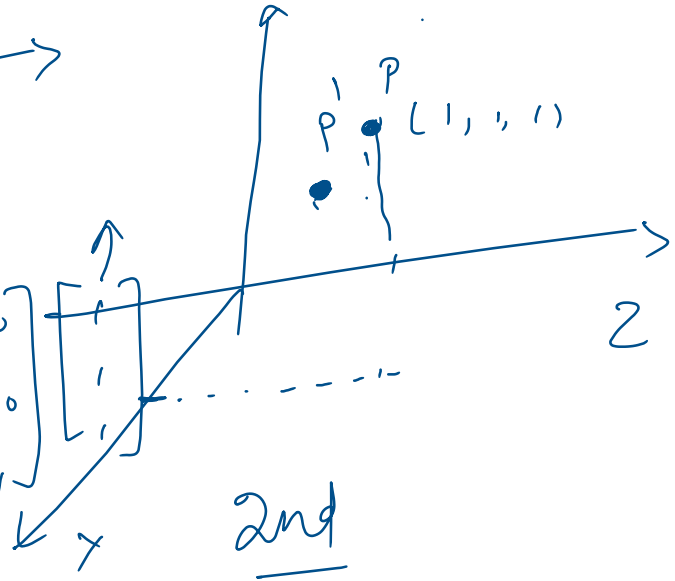
$P = [1, 1, 1]$

Rot(30, X)

Rot(Z, 30°) →

$P_{new} = Rot(Z, 30)\ P$

$= \begin{bmatrix} \cos 30^\circ & -\sin 30^\circ & 0 \\ \sin 30^\circ & \cos 30^\circ & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$



$= \begin{bmatrix} -0.366 \\ 1.366 \\ 1 \end{bmatrix}$ 2nd

2nd

$\begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos 30^\circ & -\sin \\ 0 & \sin & \cos \end{bmatrix} \begin{bmatrix} -0.366 \\ 1.366 \\ 1 \end{bmatrix}$

The scale parameter of a homogeneous transformation matrix is

- 0
- No scale
- 2
- 1

$$\begin{bmatrix} n_x & o_x & a_x & p_x \\ n_y & o_y & a_y & p_y \\ n_z & o_z & a_z & p_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Scale parameter

The perspective part of the homogeneous transformation matrix is

- 1 1 1
- 0 0 0 1
- 0 0 0
- 1 1 1 0

Time for Discussions

Thank You!