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INTRODUCTIONS TO AI ROBOTOCS

22AIE214 – Labsheet 3

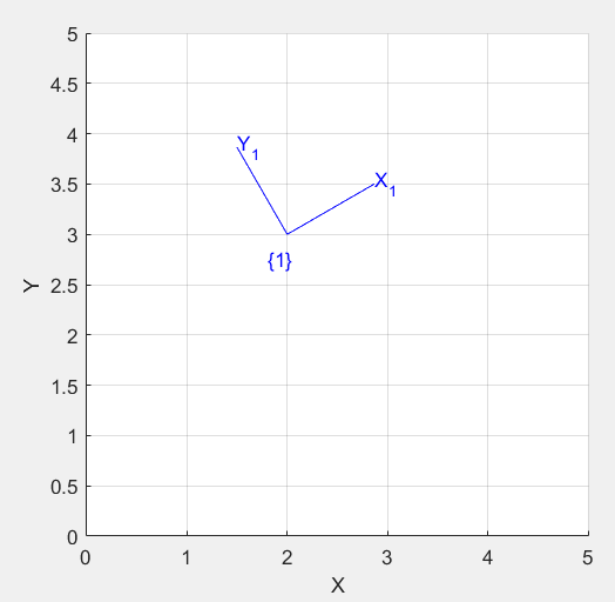
Q1)

(a) What is the significance of Homogeneous transformation (HT) in 2D space?

(b) Configure the H.T. of *frame{B}* for translation (2, 3) and rotation angle of 30◦ with respect to *frame{A}* [in matlab]

- ➔ simplify and unify the representation of various geometric transformations such as translation, rotation, and scaling.
- ➔ translation involves adding a translation vector to the coordinates of a point.
- ➔ Rotation and Scaling transformations, which are linear, can be naturally expressed as matrix multiplications in homogeneous coordinates.

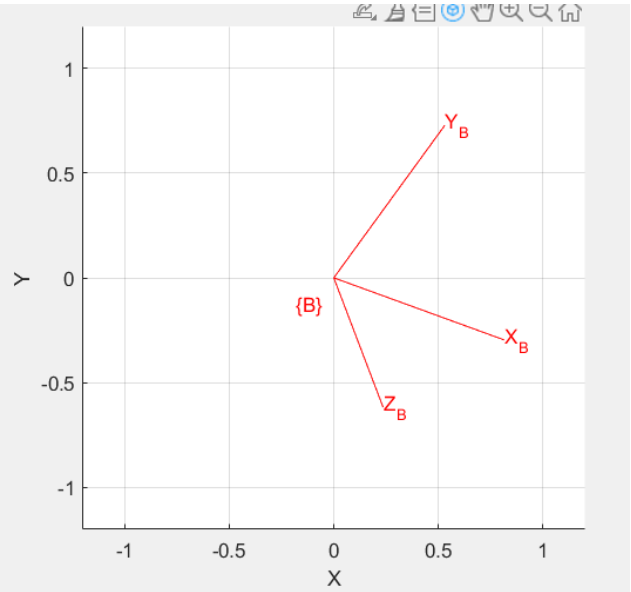
```
B = transl2(2, 3)*trot2(30, 'deg');
disp(B);
plotvol([0 5 0 5]);
trplot2(B, 'frame', '1', 'color', 'b');
```




```
0.8660   -0.5000    2.0000
0.5000    0.8660    3.0000
     0         0    1.0000
```

Q2)The set of roll-pitch-yaw angles (30, 90, -20)° can be converted to a rotation matrix. Find the result if the matrix is converted back to roll-pitch-yaw angles. Plot the points using matlab.

```
R=rpy2r(30,30,-20,'deg');
disp(R);
trplot(R, 'frame', 'B', 'color', 'r');
disp(tr2rpy(R,'deg'));
```




```
    0.8138    0.5311    0.2359
   -0.2962    0.7283   -0.6179
   -0.5000    0.4330    0.7500

   30.0000   30.0000  -20.0000
```

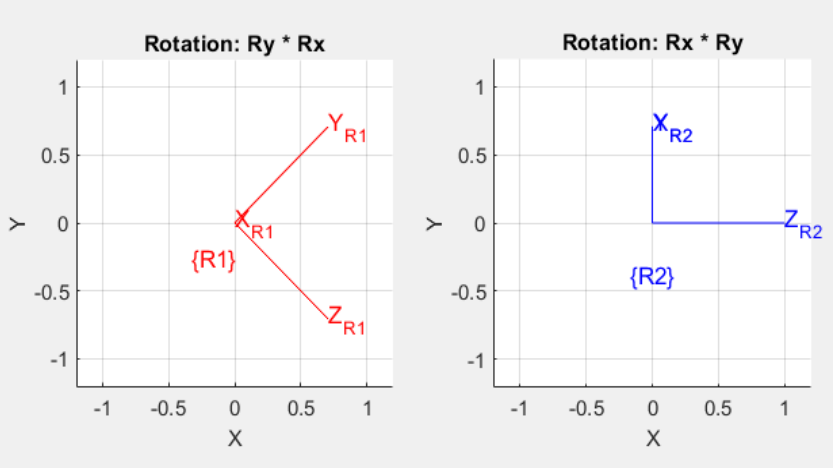
3) Justify the statement that "Rotations are non-commutative in 3D".

Instruction: Show the matlab operations with example. You can put snapshots in your answer sheet and give relevant explanation.

```
Rotation matrix R1 (Ry * Rx):
         0    0.7071    0.7071
         0    0.7071   -0.7071
   -1.0000         0         0

Rotation matrix R2 (Rx * Ry):
         0         0    1.0000
    0.7071    0.7071         0
   -0.7071    0.7071         0

Are the rotation matrices equal?
    0
```



```
Rx = rotx(45, 'deg');
Ry = roty(90, 'deg');

R1 = Ry * Rx;
R2 = Rx * Ry;

disp('Rotation matrix R1 (Ry * Rx):');
disp(R1);

disp('Rotation matrix R2 (Rx * Ry):');
disp(R2);

isEqual = isequal(round(R1, 10), round(R2, 10));
disp('Are the rotation matrices equal?');
disp(isEqual);

figure;
subplot(1,2,1);
trplot(R1, 'frame', 'R1', 'color', 'r');
title('Rotation: Ry * Rx');

subplot(1,2,2);
trplot(R2, 'frame', 'R2', 'color', 'b');
title('Rotation: Rx * Ry');
```