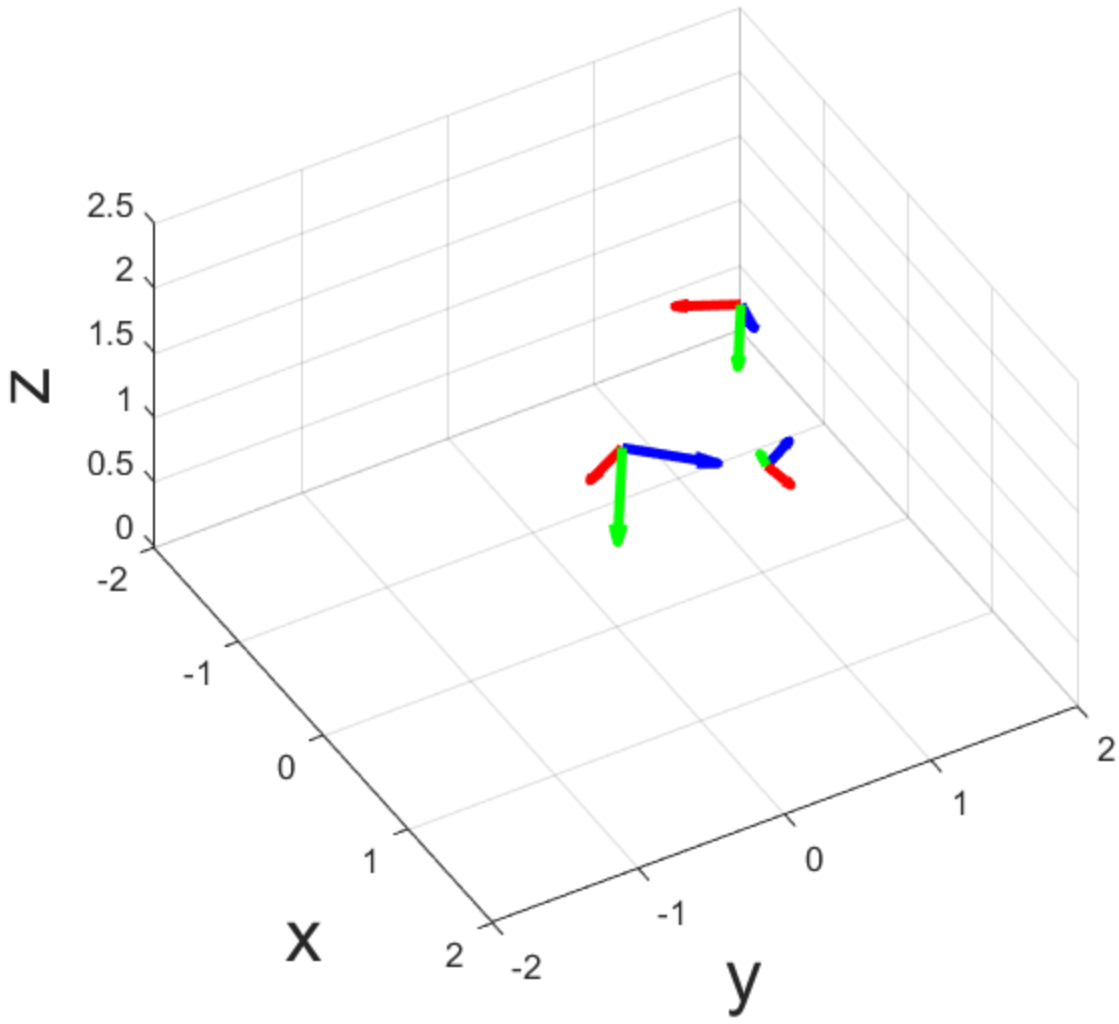
```
Ryan Dewsnap
32000408
CS403 HW#3

#1: Euler Angle to Orientation Matrix

[0.3, 0.2, 0.5]

a =

    0.9363   -0.1684    0.3082
    0.2896    0.8665   -0.4065
   -0.1987    0.4699    0.8601

[0.7, pi, pi/2]

b =

   -0.7648    0.0000    0.6442
   -0.6442    0.0000   -0.7648
   -0.0000   -1.0000   -0.0000

[pi/3, 0, 0]

c =

    0.5000   -0.8660         0
    0.8660    0.5000         0
         0         0    1.0000

#2: Transformation Matrices

T03 =

   -0.5708    0.3721    0.7319    1.0706
   -0.0378    0.8785   -0.4762   -0.5756
   -0.8202   -0.2995   -0.4874    2.4024
         0         0         0    1.0000


T30 =

    0.3715   -0.5062    0.7784    0.0091
   -0.9161   -0.0637    0.3958   -0.2284
   -0.1507   -0.8601   -0.4874    3.5745
         0         0         0    1.0000

>>
```


2.5
2
1.5
1
0.5
0
z
-2
-1
0
1
2
x
-2
-1
0
1
2
y

```
% Ryan Dewsnap
% 32000408
% CS403 Homework 3

clear all
close all
clc

addpath('C:/Matlab/matlab_utils')

% #1: Function to convert Euler Angle to Orientation Matrix
fprintf('Ryan Dewsnap\n32000408\nCS403 HW#3\n\n#1: Euler Angle to Orientation Matrix\n\n')

eul1 = [0.3, 0.2, 0.5]; % ZYX Euler Angle
eul2 = [0.7, pi, pi/2];
eul3 = [pi/3, 0, 0];

disp('[0.3, 0.2, 0.5]')
a = eul2matrix(eul1)
disp('[0.7, pi, pi/2]')
b = eul2matrix(eul2)
disp('[pi/3, 0, 0]')
c = eul2matrix(eul3)

% #2, #3: SE(3) function & transformation matrix/plotting frames
fprintf('#2: Transformation Matrices\n')

figure('position', [550, 200, 750, 450])

clf;

T00 = SE3(eul2rotm([0, 0, 0]), [0; 0; 0]);                % frame{0}: global frame
T01 = SE3(eul2rotm([0.3, 0.2, 0.5]), [0.4; 0.8; 1.2]);    % frame{1}: first transformation = T00*T01
T12 = SE3(eul2rotm([0.7, pi, pi/2]), [-0.4; 0.5; 1.0]);   % frame{2}
T23 = SE3(eul2rotm([pi/3, 0, 0]), [0.5; -0.8; 1.2]);      % frame{3}

T02 = T01*T12;
T03 = T02*T23
T30 = T23*T02 % inverse matrix for going from frame 3 to 0

drawCoordinate3DScale(T01(1:3,1:3), T01(1:3,4), 0.2);    % first tranformation drawn smallest
drawCoordinate3DScale(T02(1:3,1:3), T02(1:3,4), 0.4);
drawCoordinate3DScale(T03(1:3,1:3), T03(1:3,4), 0.6);    % last transformation drawn largest

grid on
```

```
46 axis equal
47 view(60, 40);
48
49 xlim([-2,2]);
50 ylim([-2,2]);
51 zlim([0,2.5]);
52
53 xlabel('x', 'fontsize',22);
54 ylabel('y', 'fontsize',22);
55 zlabel('z', 'fontsize',22);
56
57 % #4: animation of frame 3
58
59 num_step = 20;
60 % for i = 1:num_step
61 %     clf;
62 %
63 %     drawCoordinate3DScale(eye(3), zeros(3,1), 0.3);
64 %
65 %
66 %     T00 = SE3(eul2rotm([0, 0, 0]), [0; 0; 0]);               % frame{0}: global ↙
frame
67 %     T01 = SE3(eul2rotm([0.3, 0.2, 0.5]), [0.4; 0.8; 1.2]);   % frame{1}: first ↙
transformation = T00*T01
68 %     T12 = SE3(eul2rotm([0.7, pi, pi/2]), [-0.4; 0.5; 1.0]);  % frame{2}
69 %     T23 = SE3(eul2rotm([pi/3, 0, 0]), [0.1*sin(i)+0.05; 0.3*cos(i)+0.08; sin(i) ↙
+0.5]);     % frame{3}
70 %
71 %     drawCoordinate3DScale(T23(1:3,1:3), T23(1:3, 4),0.5);
72 %     drawCoordinate3DScale(T02(1:3,1:3), T02(1:3, 4),0.8);
73 %     drawCoordinate3DScale(T03(1:3,1:3), T03(1:3, 4),0.3);
74 %
75 %     grid on
76 %     axis equal
77 %
78 %     xlim([-2,2]);
79 %     ylim([-2,2]);
80 %     zlim([0,2.5]);
81 %
82 %     xlabel('x', 'fontsize',22);
83 %     ylabel('y', 'fontsize',22);
84 %     zlabel('z', 'fontsize',22);
85 %     view(60, 40);
86 %     pause(0.01);
87 % end
88 %
89
90
91
```

```
 92
 93
 94 % functions
 95
 96 function x = SE3(R, t)
 97     row3 = [0 0 0 1];
 98     x = [R t; row3];
 99 end
100
101 function matrix = eul2matrix(eul)
102     s = sin(eul);
103     c = cos(eul);
104
105     matrix = zeros(3,3);
106
107     matrix(1,1) = c(2)*c(1);     % build ZYX matrix from identities
108     matrix(1,2) = s(2)*s(3)*c(1) - s(1)*c(3);
109     matrix(1,3) = s(2)*c(3)*c(1) + s(1)*s(3);
110     matrix(2,1) = c(2)*s(1);
111     matrix(2,2) = s(1)*s(2)*s(3) + c(1)*c(3);
112     matrix(2,3) = s(1)*s(2)*c(3) - c(1)*s(3);
113     matrix(3,1) = -s(2);
114     matrix(3,2) = c(2)*s(3);
115     matrix(3,3) = c(2)*c(3);
116 end
117
118
```