```
close all
clear
clc

%-----test for question (a)-------
axis = [0;1;0];
angle = pi/4;
Rot = AxisAngle_to_Rot(axis,angle);
disp(Rot);
%-----test ends-------------------

%-----test for question (b)-------
%take the rotation matrix obtained from test for (a) to see if we can get
%the same axis-angle representation that were the inputs for test (a)
[axis_b,angle_b] = Rot_to_AxisAngle(Rot);
disp("axis of rotation:  ");
disp(axis_b);
disp("angle of rotation: ");
disp(angle_b);
%-----test ends-------------------

%-----question (c)----------------
% assign the axis of rotation and angle of rotation in a reversed order as
% stated in the problem statement.
% rotation v (to frame v)
theta1 = pi/6;
axis1 = [0;1;0];
% rotation iv (to frame iv)
theta2 = -pi/7;
axis2 = [1;0;0];
% rotation iii (to frame iii)
theta3 = pi/4;
axis3 = [0;0;1];
% rotation ii (to frame ii)
theta4 = -5*pi/8;
axis4 = [0;1;0];
% rotation i (to frame i)
theta5 = 3*pi/8;
axis5 = [0;0;1];

% multiply the rotation matrix obtained from function in question (a) in a
% reversed order of the sequence of rotations specified in the problem
% statement or the order specified above. (This sequence of rotations
% are so-called Euler angles around the moving axis)
R_v_to_iv = AxisAngle_to_Rot(axis1,theta1);
R_iv_to_iii = AxisAngle_to_Rot(axis2,theta2);
R_iii_to_ii = AxisAngle_to_Rot(axis3,theta3);
R_ii_to_i = AxisAngle_to_Rot(axis4,theta4);
R_i_to_w = AxisAngle_to_Rot(axis5,theta5);
% w means the world frame.

% multiply the above elementary rotation matrices together
R_total = R_i_to_w*R_ii_to_i*R_iii_to_ii*R_iv_to_iii*R_v_to_iv;
disp(R_total);
% input the total rotation matrix into function in question (b) to get the
% axis-angle representation
[axis_c,angle_c] = Rot_to_AxisAngle(R_total);
disp("In question c, the axis of rotation is: ");
disp(axis_c);
disp("the angle of rotation is: ");
disp(angle_c);
```

```
%-----question (a)----------------
function R = AxisAngle_to_Rot(axis,angle)
% assign the variables for convenience
w1 = axis(1);
w2 = axis(2);
w3 = axis(3);
% create a template for the skew-symmetric matrix.
skew = zeros(3,3);
% create the skew-symmetric matrix
skew(2,1) = w3;
skew(1,2) = -1*skew(2,1);
skew(1,3) = w2;
skew(3,1) = -1*skew(1,3);
skew(3,2) = w1;
skew(2,3) = -1*skew(3,2);
% assign cosine and sine to variables
C = cos(angle);
S = sin(angle);
v = 1-C;
% compute the Rotation matrix using Equation (2.4) in lecture notes.
R = eye(3)+skew*S+skew*skew*v;
end
%-----question (a) ends------------


%-----question (b)-----------------
function [axis,angle] = Rot_to_AxisAngle(R)
% compute the trace of R
Trace = R(1,1)+R(2,2)+R(3,3);
% compute the angle of rotation
angle = acos((Trace-1)/2);
%compute the axis of rotation
axis = (1/(2*sin(angle)))*[R(3,2)-R(2,3); R(1,3)-R(3,1); R(2,1)-R(1,2)];
end
```

```
    0.7071         0    0.7071
         0    1.0000         0
   -0.7071         0    0.7071

axis of rotation:
         0
    1.0000
         0

angle of rotation:
    0.7854

   -0.3769   -0.3419   -0.8608
    0.2894    0.8394   -0.4601
    0.8799   -0.4225   -0.2174

In question c, the axis of rotation is:
    0.0203
   -0.9399
    0.3409

the angle of rotation is:
    1.9579
```

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