```
function arames8_hw2()

%1(a) Compute v_hat for v = [5, 1, 2]T
    v_hat =hat(5, -1, -2)


v_hat =

     0     2    -1
    -2     0    -5
     1     5     0



%1(b) Compute R = e^(v_hat)
    R = expm(v_hat)


R =

    0.9487   -0.3147    0.0292
    0.2122    0.7027    0.6791
   -0.2343   -0.6381    0.7334



%1(c)Give the geometric interpretation (axis, angle) of R.
    angle_R = acos((trace(R)-1)/2)
    axis_R = (1/(2*sin(angle_R)))*[(R(3,2)-R(2,3)) ;(R(1,3)-R(3,1)) ;(R(2,1)-R(1,2))]


angle_R =

    0.8060


axis_R =

   -0.9129
    0.1826
    0.3651



%2. What vector do you get if you rotate the vector p = [5, 2, 4]T by 75 degrees around the
axis described by the vector  = [4, 1, 3]T?
    p=[5; 2; -4];
```

```
    w =[4; 1; -3];
    theta = 75;
    theta_radians = deg2rad(theta);

    %normalize w
    normalized_w = norm_vector(w)
    w1 = normalized_w(1); w2=normalized_w(2); w3=normalized_w(3);

    w_hat = hat(w1,w2,w3)

    %Find rotational matrix
     R_ppprime2 = expm(w_hat*theta_radians)

     %Find the vector coordinates after rotation
     p_prime = R_ppprime2* p

%       v0 = 1-cos(theta_radians); c0 = cos(theta_radians); s0 = sin(theta_radians);
%        R_ppprime1 = [(w1^2*v0)+ c0,    (w1*w2*v0)-(w3*s0), (w1*w3*v0)+(w2*s0);
%                   (w1*w2*v0)+(w3*s0),(w2^2*v0)+ c0,      (w2*w3*v0)-(w1*s0);
%                    (w1*w3*v0)-(w2*s0),(w2*w3*v0)+(w1*s0), (w3^2*v0)+ c0]
%       R_ppprime3 = eye(3) + w_hat*sin(theta_radians)+ transpose(w_hat)*w_hat*v0
%       p_prime = R_ppprime1* p
%       p_prime = R_ppprime3* p


normalized_w =

    0.7845
    0.1961
   -0.5883


w_hat =

         0    0.5883    0.1961
   -0.5883         0   -0.7845
   -0.1961    0.7845         0


R_ppprime2 =

    0.7149    0.6823   -0.1526
   -0.4543    0.2873   -0.8433
   -0.5315    0.6722    0.5154


p_prime =
```

```
   5.5499
   1.6763
  -3.3747
```

```
%3a. First rotate the object for 60 degrees around the x axis of the frame A. Next, rotate
     the object for 45 degrees around the z axis of the rotated frame B.

     Rab = gen_rot('x',degtorad(60));
     Rbc = gen_rot('z',degtorad(45));
     Rb = Rbc*Rab
```

```
 Rb =

     0.7071   -0.3536    0.6124
     0.7071    0.3536   -0.6124
          0    0.8660    0.5000
```

```
%3b. First rotate the object for 60 degrees around the x axis of the
frame A. Next, rotate the object for 45 degrees around the z axis of
the frame A.

     Rac = Rab*Rbc
```

```
   Rac =

       0.7071   -0.7071         0
       0.3536    0.3536   -0.8660
       0.6124    0.6124    0.5000
```

```
%4b)Give the geometric interpretation (axis, angle) of the rotation described by R.

R_4 =[0.4619, -0.1189, -0.8790;
    -0.5615, -0.8063, -0.1860;
    -0.6866, 0.5794, -0.4392];

angle_R4 = acos((trace(R_4)-1)/2)
axis_R4 = (1/(2*sin(angle_R4)))*[(R_4(3,2)-R_4(2,3)) ;(R_4(1,3)-R_4(3,1))
;(R_4(2,1)-R_4(1,2))]
```

```
angle_R4 =

    2.6721


axis_R4 =

    0.8459
   -0.2126
   -0.4891



%4a)Find the exponential coordinates of R
expo_coordinates = axis_R4*angle_R4


expo_coordinates =

    2.2603
   -0.5682
   -1.3070



%5 A rotation matrix between frames A and B is given by: A point q is described in
the frame A by a vector qa = [4, 3, 5]T. What is the description of in the frame B.

qa =  [-4; 3; 5];
Rab = [0.6325, 0.2533, -0.7319;
      -0.7074, 0.5737, -0.4128;
       0.3154 0.7789 0.5421];
  qb = inv(Rab)* qa


qb =

   -3.0758
    4.6025
    4.4000

    ********************************


    function hat = hat(a1,a2,a3)
     hat = [0, -a3, a2 ; a3, 0, -a1 ; -a2, a1, 0];
    end
```

```
    function norm_vector = norm_vector(M)
        if norm(M) ==1
            norm_vector =M;
        else
            norm_vector = normc(M);
        end
    end

    function rot_mat = gen_rot(axis,angle)
        if axis == 'x'
            rot_mat = [1,0,0; 0,cos(angle),-sin(angle);0,sin(angle),cos(angle)];
        elseif axis =='y'
            rot_mat = [cos(angle),0,sin(angle); 0,1,0; -sin(angle),0,cos(angle)];
        elseif axis == 'z'
            rot_mat = [cos(angle),-sin(angle),0; sin(angle),cos(angle),0; 0,0,1];
        end
    end

end
```