```
clear all
close all
clc

% Parameters and initial states
tf = 45;

m = 1;
M = 1;
L = 1;
g = 9.81;
x0 = 0;
theta1_0 = pi/4;
theta2_0 = pi/2;
q = [x0; theta1_0; theta2_0];
dq = zeros(3, 1);

state = [q;dq];
parameters = [m;M;L;g];

% Simulation
try

    %%%%%% MODIFY THE CODE AS YOU SEE FIT

    [tsim,xsim] = ode45(@(t,x)PendulumDynamics(x, parameters),
[0,tf],state);

catch message
    display('Your simulation failed with the following message:')
    display(message.message)
    display(' ')

    % Assign dummy time and states if simulation failed
    tf = 0.1;
    tsim = [0,tf];
    xsim = 0;
end
```

3D animation

```
DoublePlot = true;
FS = 30;
scale = 0.1;

% Create Objects
% Cube
vert{1} = 3*[ -1, -1, 0;  %1
               1, -1, 0;  %2
               1,  1, 0;  %3
              -1,  1, 0;  %4
              -1, -1, 2;  %5
```

```
                1, -1, 2;  %6
                1,  1, 2;  %7
               -1,  1, 2]/2; %8
fac{1} = [1 2 3 4;
          5 6 7 8;
          1 4 8 5;
          1 2 6 5;
          2 3 7 6;
          3 4 8 7];
Lrail = 1.2*max(abs(xsim(:,1)))/scale;
% Rail
a = 1.5;
vert{2} = [-Lrail,-a,-0.1;
           -Lrail, a,-0.1;
            Lrail, a,-0.1;
            Lrail,-a,-0.1];
fac{2} = [1,2,3,4];
% Sphere
[X,Y,Z] = sphere(20);
[fac{3},vert{3},c] = surf2patch(3*X/2,3*Y/2,3*Z/2);
% Animation
tic
t_disp = 0;
SimSpeed = 1;
if run_sim
 while t_disp < tf/SimSpeed
    % Interpolate state
    x_disp   = interp1(tsim,xsim,SimSpeed*t_disp)';

    % Unwrap state. MODIFY
    x = x_disp(1); % position cart
    [p1, p2] = PendulumPosition(x_disp, parameters);

    % Input argument for DrawPendulm
    pos_disp = [x(1);p1(1);0;p1(2);p2(1);0;p2(2)];

    figure(1);clf;hold on
    if DoublePlot
        subplot(1,2,1);hold on
        DrawPendulum( pos_disp, vert, fac, scale);
        campos(scale*[15    15     -70])
        camtarget(scale*[0,0,1.5])
        camva(30)
        camproj('perspective')
        subplot(1,2,2);hold on
    end
    DrawPendulum( pos_disp, vert, fac, scale);
    campos(scale*[1    70     20])
    camtarget(scale*[0,0,1.5])
    camva(30)
    camproj('perspective')
    drawnow
    if t_disp == 0
        display('Hit a key to start animation')
```

```
        pause
        tic
    end
    t_disp = toc;
 end
end
```

```
Undefined function or variable 'run_sim'.

Error in PendulumSimulation (line 75)
if run_sim
```

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