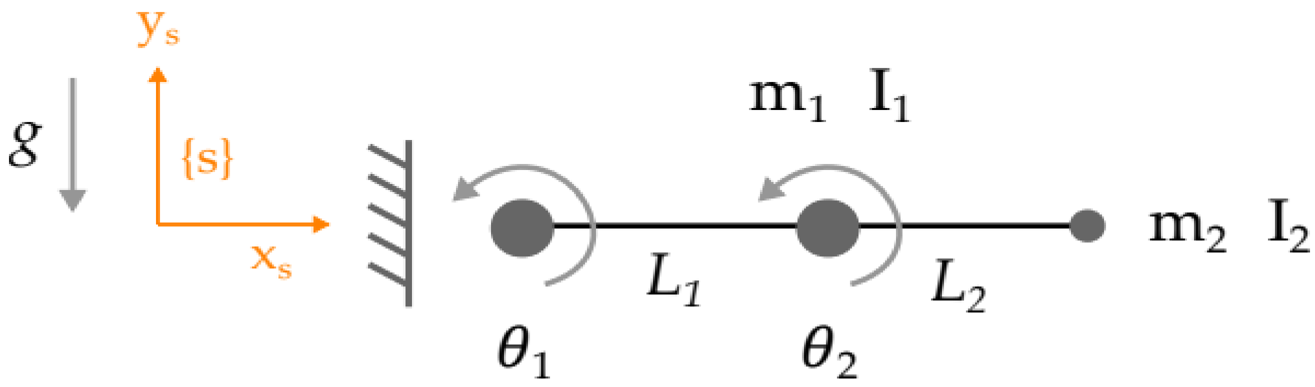


Here we will simulate the dynamics of the planar robot shown above.

We will need to get the (x, y) position of each link to plot the robot. And we will use the the given simulation parameters and frame rates below:

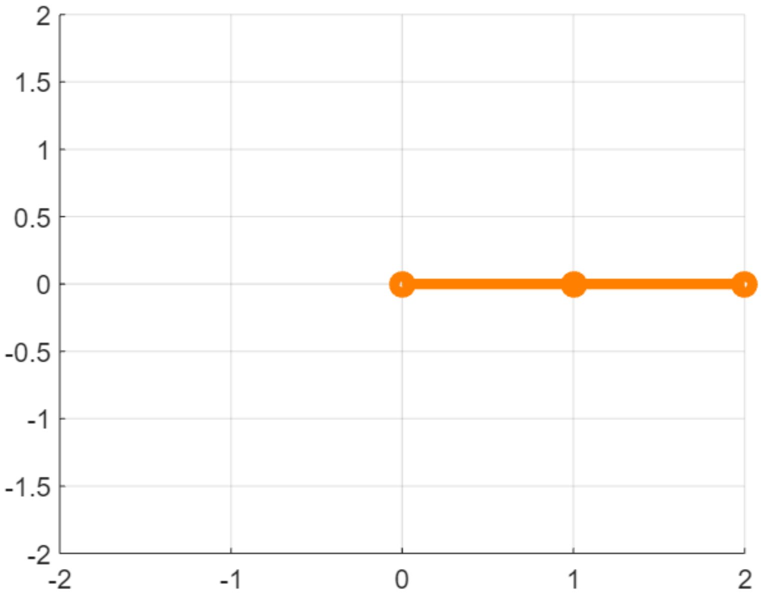
- **Case 1**: Make a simulation where $\tau = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ and the robot has no friction, B = 0

```
% CASE 1: ( tau = [0;0] and B=zeros(2))

close all
clear
```

```
Warning: No video frames were written to this file. The file may be invalid.
```

```
clc


% create figure
figure
axis([-2, 2, -2, 2])
grid on
hold on

% save as a video file
v = VideoWriter('Case_1.mp4', 'MPEG-4');
v.FrameRate = 100;
open(v);

% pick your system parameters
L1 = 1;
L2 = 1;
m1 = 1;
m2 = 1;
I1 = 0.1;
I2 = 0.1;
```

```
g = 9.81;
tau = [0;0]; % Case 1

% Initial conditions
theta = [0;0]; % joint position
thetadot = [0;0]; % joint velocity
thetadotdot = [0;0]; % joint acceleration

masses = [m1,m2];
omega = [0;0;1];

Inertia_1 = [0 0 0;0 0 0;0 0 I1];
Inertia_2 = [0 0 0;0 0 0;0 0 I2];

q1 = [0;0;0]; % Position of Joint 1
q2 = [L1;0;0]; % Position of Joint 2
q3 = [L1+L2;0;0]; % end effector position

S1 = [omega; -cross(omega,q1)];
S2 = [omega;-cross(omega,q2)];
S_eq1 = [S1,[0;0;0;0;0;0]];
S_eq2 = [S1, S2];

M1 = [eye(3),q2; 0 0 0 1];
M2 = [eye(3), [L1+L2;0;0]; 0 0 0 1];

gravity_vector = (zeros(length(theta),1));
Coriolis_Matrix = (zeros(2,2));
Mass_Matrix = [I1 + I2 + L1^2*m1 + L1^2*m2 + L2^2*m2 + 2*L1*L2*m2*cos(theta(2)),
m2*L2^2 + L1*m2*cos(theta(2))*L2 + I2; m2*L2^2 + L1*m2*cos(theta(2))*L2 + I2,
m2*L2^2 + I2];


for idx = 1:1000

    % plot the robot
    % 1. get the position of each link
    p0 = [0; 0];
    T1 = fk(M1,S_eq2(:,1:1),theta(1:1,:));
    p1 = T1(1:2,4); % position of link 1 (location of joint 2)
    T2 = fk(M2,S_eq2,theta);
    p2 = T2(1:2,4); % position of link 2 (the end-effector)
    P = [p0, p1, p2];
    % 2. draw the robot and save the frame
    cla;
    plot(P(1,:), P(2,:), 'o-', 'color',[1, 0.5, 0],'linewidth',4);
    drawnow;
    frame = getframe(gcf);
    writeVideo(v,frame);
    % integrate to update velocity and position
    % your code here
    deltaT = 0.01;
    thetadot = thetadot + deltaT * thetadotdot;
    theta = theta + deltaT * thetadot;


    Mass_Matrix =[I1 + I2 + L1^2*m1 + L1^2*m2 + L2^2*m2 + 2*L1*L2*m2*cos(theta(2)),
m2*L2^2 + L1*m2*cos(theta(2))*L2 + I2; m2*L2^2 + L1*m2*cos(theta(2))*L2 + I2,
m2*L2^2 + I2];

    Coriolis_Matrix = [-
L1*L2*m2*thetadot(2)*sin(theta(2)),  -L1*L2*m2*sin(theta(2))*(thetadot(1) +
thetadot(2));L1*L2*m2*thetadot(1)*sin(theta(2)), 0] ;

    gravity_vector = [(g*(m1+m2)*L1*cos(theta(1))) + g*m2*L2*cos(theta(1) +
theta(2)); g*m2*L2*cos(theta(1) + theta(2))];

    B = [[0 0]
        [0 0]]; % Case 1

    thetadotdot = (inv(Mass_Matrix)) * (tau - Coriolis_Matrix * thetadot
-B*thetadot - gravity_vector);

    % tau = Mass_Matrix * thetadotdot + Coriolis_Matrix * thetadot + B * thetadot +
gravity_vector;

end
```



```
Warning: The video's width and height has been padded to be a multiple of two as required by the H.264 codec.
```

```
close(v);
```

```
close all
```