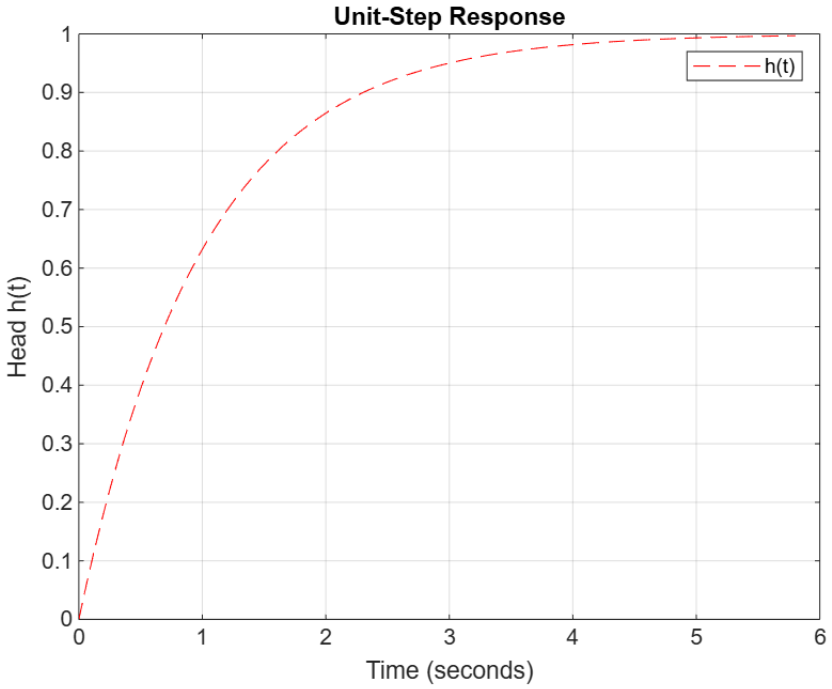
Water Tank Liquid Level: Tank 1:

```
clearvars;
% Specifications of Tank:
% Define parameters
R = 1;
Cap = 1;

% transition matrix:
A = -1/(R*Cap);

% command matrix:
B = 1/Cap;

% output matrix:
C = 1;

%
D = 0;
```

```
% Simulation results:
t = linspace(0,12,100);     % simulation time, t
u = ones(size(t));          % input to tank (u)
x0 = 0.5;                   % initial condition
```

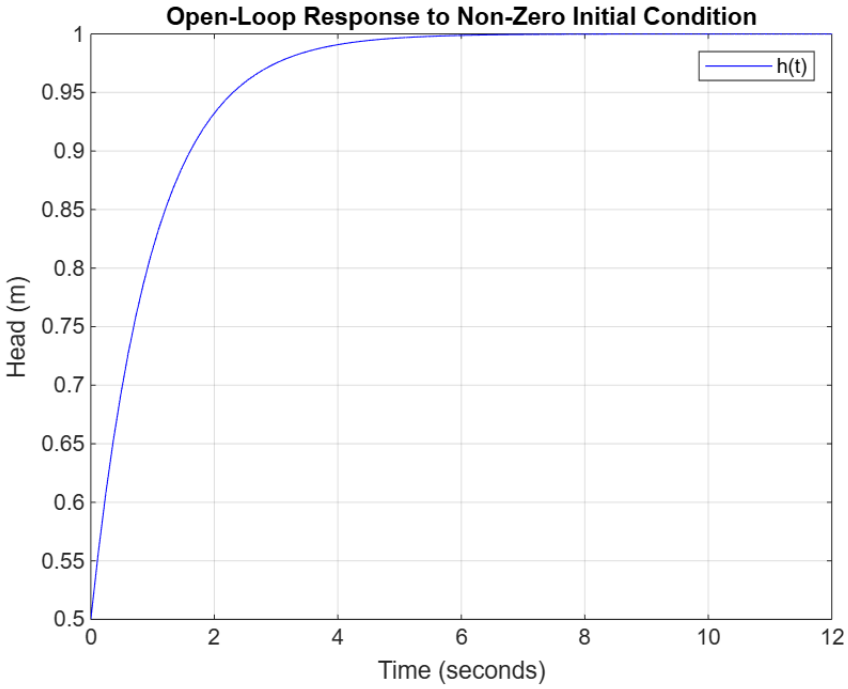
```
% output matrix usig step():
figure
[y,~,t] = step(A,B,C,D);    % y = output head (h)
plot(t,y, 'r--')
grid on
title('Unit-Step Response')
xlabel('Time (seconds)');
ylabel('Head h(t)');
legend('h(t)');
```




```
fprintf('Steady-State Head = %4.2f\n', y(end))
```

```
Steady-State Head = 1.00
```

```
% Another way using lsim():
% Plot the response of the system:

% Create the State-Space Model:
sys = ss(A, B, C, D);       % state-space model
t = linspace(0,12,100);     % simulation time, t
u = ones(size(t));          % input to tank (u)
x0 = 0.5;                   % initial condition

% Plot the response on your own:
figure
[y,t] = lsim(sys,u,t,x0);   % output head (h)
plot(t,y, 'b-'); grid on
title('Open-Loop Response to Non-Zero Initial Condition')
xlabel('Time (seconds)')
ylabel('Head (m)')
legend('h(t)')
```




```
fprintf('Steady-State Head = %4.2f\n', y(end))
```

```
Steady-State Head = 1.00
```

Water Tank Liquid Level: Interaction of Two Tanks (Tank 1 and Tank 2):

```
% Specifications of Tanks:
% Define parameters
R1 = 1;
C1 = 1;

R2 = 1;
C2 = 1;

% transition matrix
A = [-1/(R1*C1) 1/(R1*C1);
      1/(C2*R1) -(1/(C2*R1)+1/(C2*R2))]
```

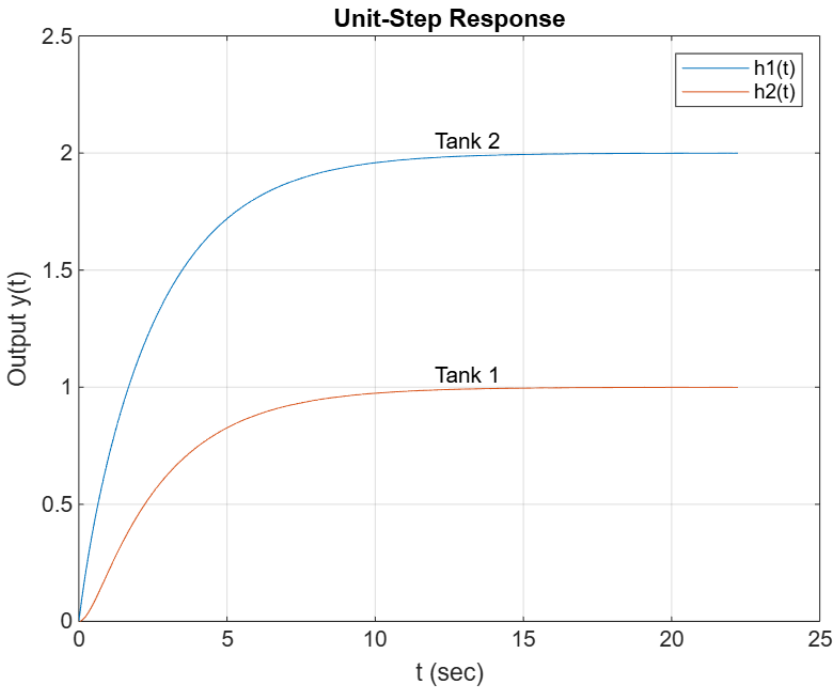
```
A = 2×2
    -1     1
     1    -2
```

```
% command matrix
B = [1/C1; 0]
```

```
B = 2×1
```

```
     1
     0
```

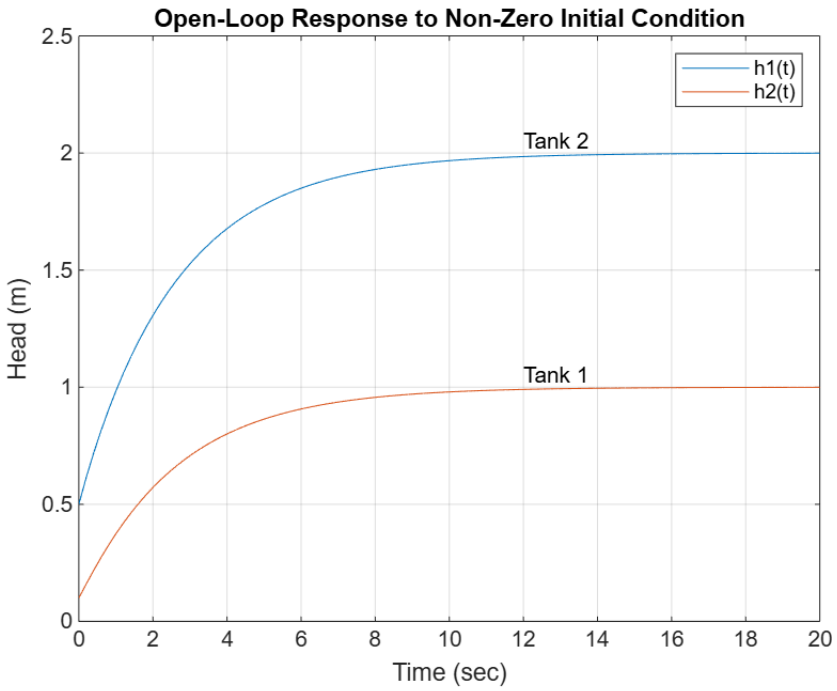
```
% output matrix
C = [1 0; 0 1];

%
D = 0;

% Simulation
t = linspace(0,10,100);    % simlation time, t
u = ones(size(t));          % input, q, to the tank #1
x0 = [0.5 0.1];             % initial conditions

% output matrix usig step():
[y,~,t] = step(A,B,C,D);

figure
plot(t,y)
yaxis([0,2.5]);
grid on
title('Unit-Step Response')
xlabel('t (sec)');
ylabel('Output y(t)')
legend('h1(t)', 'h2(t)')
text(12, 1.05,'Tank 1')
text(12, 2.05,'Tank 2')
```



```
% Another way using lsim():
% Simulation

% Create the State-Space Model:
sys = ss(A, B, C, D)        % state-space model
```

```
sys =

  A =
       x1  x2
   x1  -1   1
   x2   1  -2

  B =
       u1
   x1   1
   x2   0

  C =
       x1  x2
   y1   1   0
   y2   0   1

  D =
       u1
   y1   0
   y2   0

Continuous-time state-space model.
Model Properties
```

```
t = linspace(0,20,100);    % simlation time, t

% The system response to a step signal that
% starts at 0 at time t = 0, steps from 0
% at t = 1, and then holds steady at 1 is:

u = ones(size(t));          % input, q, to the tank #1
x0 = [0.5 0.1];             % initial conditions

[y,t] = lsim(sys,u,t,x0);   % y = output (head 1 & head 2)

figure

plot(t,y)
yaxis([0,2.5]);
grid on
title('Open-Loop Response to Non-Zero Initial Condition')
xlabel('Time (sec)')
ylabel('Head (m)')
legend('h1(t)', 'h2(t)')
text(12, 1.05,'Tank 1')
text(12, 2.05,'Tank 2')
```


Open-Loop Response to Non-Zero Initial Condition
h1(t)
h2(t)
Tank 2
Tank 1
Head (m)
Time (sec)
0
0.5
1
1.5
2
2.5
0
2
4
6
8
10
12
14
16
18
20