

```

1  %% prob_3.m
2  %
3  % this script is for HW5 problem 3
4  %
5  % - written by: Dimitri Lezcano
6
7      ;
8
9  %% Set-up
10     = 100;
11
12  % system
13     = [10; -5];
14     = (2);
15
16     = 0.04;
17     = 0.1;
18
19     = [1, . ; 0.2* . , 1 - 0.5* . ];
20     = [0; 1];
21     = [0; 0.1];
22
23  % Value function params
24     = (1, );
25     = (1, );
26     = (1, );
27
28     { } = . ;
29     { } = [0;0];
30     { } = 0;
31
32  % control law
33     = (1, );
34     = (1, );
35
36  % trajectory and control arrays
37     = (2, );
38     (:,1) = ;
39
40     = (1, );
41
42
43  %% Back integrate to get P_i, b_i, c_i, K_i, k_i
44  for = -1:-1:1
45
46      % get P_i+1, b_i+1, c_i+1
47      = . { + 1};
48      = . { + 1};
49      = . { + 1};
50
51      % determine K_i and k_i
52      = ( . + . ' * . ); % helper inverse
53
54      = - * . ' * * . ;
55      = - * . ' * ( * . + );
56
57      % determine P_i, b_i, c_i
58      = ( . + . * )' * * ( . + . * ) + ' * . * ;
59      = ( . + . * )' * ( * ( . + . * ) + ) + ' * . * ;
60      = 1/2 * ( . + . * )' * * ( . + . * ) + ' * ( . + . * ) + ...
61          + 1/2 * . ' * . * ;
62
63      % assign the values
64      . { } = ;
65      . { } = ;
66
67      . { } = ;
68      . { } = ;
69      . { } = ;
70
71  end
72
73
74
75  %% Forward integrate using dynamics and new control law

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76 for i = 1: -1
77     % get x_i to integrate to x_i+1
78     x_i = (x(:, i)); % i-th column
79
80     % get the control law
81     u_i = (u(:, i));
82
83     % get x_i+1
84     x_i+1 = (x(:, i+1));
85
86     % add x_i+1 and u_i to the array
87     x(:, i+1) = x_i+1;
88     u(:, i) = u_i;
89
90 end
91
92 %% Plotting
93 figure = figure(1);
94 hold on; plot(x(1,:), x(2,:), 'DisplayName', 'trajectory');
95 plot(x(1), x(2), 'r*', 'DisplayName', 'start');
96 title('Trajectory: R = %.3f', R);
97 legend('p', 'v');
98
99
100
101 figure = figure(2);
102 hold on;
103 plot(x(1), x(2), 'Control: R = %.3f', R);
104 legend('i', 'u');
105
106
107 %% Saving
108 filename = "prob3_s_" + R + ("R-%.3f_x0_d_d", R, (1), (2));
109
110 saveas(figure, filename, 'traj') + ".png";
111 ("Saved figure: " + filename, 'traj') + ".png";
112
113 saveas(figure, filename, 'ctrl') + ".png";
114 ("Saved figure: " + filename, 'ctrl') + ".png";
115
116 %% Functions
117 % dynamics
118 function dx = dynamics(x, u)
119     dx = A * x + B * u;
120
121 end
122
123 % control law
124 function u = control_law(x)
125     u = -K * x;
126
127 end
128
129
130
131
132
133

```