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MAE 280A Homework 3

```
% David Lim
% A16398479
clear
clc

% Define A matrix
A = [-0.045  0.036    -32     -2; ...
       -0.4     -3   -0.3    250; ...
          0      0      0      1; ...
          0      0      1      0];

% Define B matrix
B = [  0  0.1; ...
     -30    0; ...
       0    0; ...
     -10    0];
```

Exercise 1.1

```
% Define B matrix only with input mu
B_mu = B(:,2)

% Compute controllability matrix and rank
C_AB_mu = [B_mu A*B_mu A^2*B_mu A^3*B_mu]
rank(C_AB_mu)

% Define B matrix only with input delta
B_delta = B(:,1)

% Compute controllability matrix and rank
C_AB_delta = [B_delta A*B_delta A^2*B_delta A^3*B_delta]
rank(C_AB_delta)
```

```
B_mu =
   0.100000000000000
                   0
                   0
                   0
C_AB_mu =
  Columns 1 through 3
   0.100000000000000  -0.004500000000000  -0.001237500000000
                   0  -0.040000000000000   0.121800000000000
```

```
                    0                    0                    0
                    0                    0                    0
  Column 4
   0.004440487500000
  -0.364905000000000
                    0
                    0
ans =
     2
B_delta =
     0
   -30
     0
   -10
C_AB_delta =
   1.0e+04 *
  Columns 1 through 3
                    0   0.001892000000000   0.023238860000000
  -0.003000000000000  -0.241000000000000   0.722543200000000
                    0  -0.001000000000000                    0
  -0.001000000000000                    0  -0.001000000000000
  Column 4
   0.026965806500000
  -2.426925144000000
  -0.001000000000000
                    0
ans =
     4
```

Exercise 1.2

```
% Define C matrix only with output q
C_q = [0 0 0 1]

% Compute observability matrix and rank
O_AC_alpha = [    C_q; ...
                C_q*A; ...
              C_q*A^2; ...
              C_q*A^3]
rank(O_AC_alpha)

% Define C matrix only with output alpha
C_alpha = [0 1 0 0]

% Compute observability matrix and rank
O_AC_alpha = [    C_alpha; ...
                C_alpha*A; ...
              C_alpha*A^2; ...
              C_alpha*A^3]
rank(O_AC_alpha)

C_q =
     0     0     0     1
```

```
O_AC_alpha =
     0     0     0     1
     0     0     1     0
     0     0     0     1
     0     0     1     0
ans =
     2
C_alpha =
     0     1     0     0
O_AC_alpha =
   1.0e+03 *
  Columns 1 through 3
                    0   0.001000000000000                    0
  -0.000400000000000  -0.003000000000000  -0.000300000000000
   0.001218000000000   0.008985600000000   0.263700000000000
  -0.003649050000000  -0.026912952000000  -0.791171680000000
  Column 4
                    0
   0.250000000000000
  -0.749500000000000
   2.507664000000000
ans =
     4
```

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