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```
%lyap_fdbk
% solution of the inverted pendulum problem of Example 8.3 using
% the Lyapunov method of section 8.2.1
```

define original system matrices

```
A = [0 1 0 0; 0 0 -1 0; 0 0 0 1; 0 0 5 0]
b = [0 1 0 -2]'
```

```
A =

     0     1     0     0
     0     0    -1     0
     0     0     0     1
     0     0     5     0


b =

     0
     1
     0
    -2
```

define the F matrix to be observable canonical form

```
F = [-5 1 0 0; -10.5 0 1 0; -11 0 0 1; -5 0 0 0]
kb = [1 0 0 0]

% alternate way to define F
%coeffs = poly(A); %get characteristic equation coefficients this is
 lenght 5
%Fa = [-5 1 0 0; -10.5 0 1 0; -11 0 0 1; -5 0 0 0]
```

```
F =

   -5.0000    1.0000         0         0
  -10.5000         0    1.0000         0
```

```
  -11.0000         0         0    1.0000
   -5.0000         0         0         0


kb =

     1     0     0     0


           X = LYAP(A,B,C) solves the Sylvester equation:

               A*X + X*B + C = 0
        we need to solve AT - TF = bk_bar

T = lyap(A, -F, -b*kb)

k = kb*inv(T)


T =

    0.5057   -0.2207    0.2211   -0.3081
   -1.1034    0.5057   -0.2207    0.2211
   -2.5287    1.1034   -0.5057    0.2207
    5.5172   -2.5287    1.1034   -0.5057


k =

   -1.6667   -3.6667   -8.5833   -4.3333
```

check eigenvalues

```
eig(A -b*k)


ans =

  -1.0000 + 1.0000i
  -1.0000 - 1.0000i
  -1.5000 + 0.5000i
  -1.5000 - 0.5000i
```

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