SSY281 - Model Predictive Control
Micro-Homework M04
MPC practice. Set points, disturbances and observers

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Question 1

Since there are more outputs than inputs (p>m), the optimization procedure of item 54 in lecture notes will be used. The tricky part now is to put the cost function in the Matlab standard, as can be seen below in the code.

```
A = [0.5 1; -1 0.5];
B = [0;1];
C = eye(2);
Q = eye(2);
ysp = [1;-1];

ST = [eye(2)-A -B;
      C         0*C*B];

m = size(B,2);
p = size(C,1);        %%% More outputs than inputs case (p>m)

% (C*xs-ysp)'*Q*(C*xs-ysp) = x'*(C'*Q*C)*x - xs'*C*Q*ysp - ysp'*Q*C*xs + ysp'*Q*ysp
H = blkdiag(C'*Q*C, zeros(m));
f = [ -2*(ysp'*Q*C)'; zeros(m,1)];
Aeq = [eye(2)-A -B];
beq = zeros(2,1);

options = optimoptions('quadprog','Display','none');
[xs_us,VN,exitflag] = quadprog(H,f, [],[], Aeq,beq, [],[], [],options)


ST*xs_us - [zeros(2,1); ysp]
```

Solution:

$$x_s = \begin{bmatrix} 0.8 \\ 0.4 \end{bmatrix} \qquad u_s = 1 \tag{1}$$

Question 2

If (A,C) is observable, then the eigenvalues of the error dynamics matrix (A-LC) can be assigned arbitrarily.