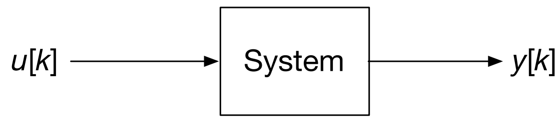
1. Open-Loop System



Consider the open-loop system shown above, with $A = \begin{bmatrix} 0.9 & 0.8 \\ 0.5 & 0.6 \end{bmatrix}$, $B = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$, and $C = \begin{bmatrix} 0 & 1 \end{bmatrix}$.

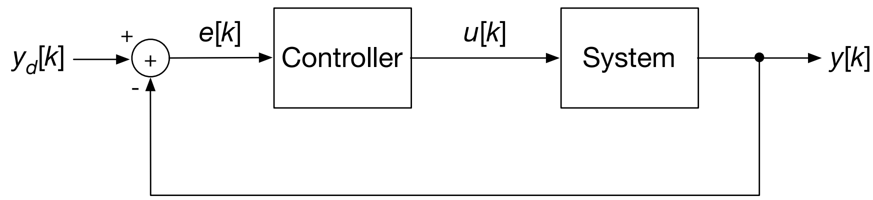
(a) What is the size of the state vector $x(k)$? The input vector $u(k)$? The output vector $y(k)$?

(b) Assuming $x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$, $u(k) = 0$ for all k, find the state $x(k)$ of the system for $k = 0$ to 3.

(c) Calculate the eigenvalues of matrix A.

(d) Would you consider this a "stable" system? Explain your answer.

2. Closed-Loop System



Consider the open-loop system shown above, with the same A, B, and C as in problem 1. The controller is implemented with parameter $K = 0.6$.

(a) Find the dimensions of the all of the vectors and matrices in the system.
Vectors: $x(k), y_d(k), e(k), u(k), y(k)$ Matrices: A, B, C, K, A_{CL}, and B_{CL}.

(b) Find A_{CL} and B_{CL}, the new state matrices that define the closed-loop system.

(c) Assuming $x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$, $y_d(k) = 0$ for all k, find the state $x(k)$ of the system for $k = 0$ to 3.

(d) Calculate the eigenvalues of matrix A_{CL}.

(e) Would you consider this a "stable" system? Explain your answer.