From State-Space to Transfer Function

$$\dot{x} = Ax + Bu$$
$$y = Cx + Du$$

$$x = \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix}, \quad u = \begin{pmatrix} u_1 \\ u_2 \\ \vdots \\ u_m \end{pmatrix}, \quad y = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_p \end{pmatrix}$$

Recall matrix-vector multiplication:

$$\dot{x}_i = (Ax)_i + (Bu)_i \qquad\qquad y_\ell = (Cx)_\ell + (Du)_\ell$$
$$= \sum_{j=1}^{n} a_{ij} x_j + \sum_{k=1}^{m} b_{ik} u_k \qquad\qquad = \sum_{j=1}^{n} c_{\ell j} x_j + \sum_{k=1}^{m} d_{\ell k} u_k$$