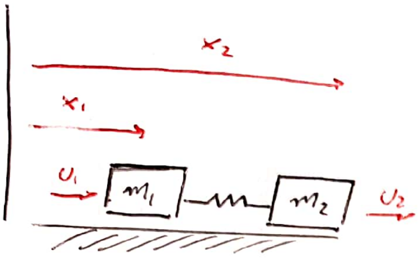

$$\Rightarrow \quad \bar{x} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$$

$$\delta = x_1 - x_2$$

↳ Para o sistema dinâmico: $\ddot{\bar{x}} = \frac{m_1 \ddot{x}_1 + m_2 \ddot{x}_2}{m_1 + m_2} = \frac{u_1 + u_2}{m_1 + m_2}$

$$\ddot{\delta} = -\frac{K(m_1 + m_2)}{m_1 \cdot m_2}\delta + \frac{u_1}{m_1} - \frac{u_2}{m_2}$$

↳ Vetor de estados: $z = [\bar{x} \ \ \delta \ \ \dot{\bar{x}} \ \ \dot{\delta}]_T$

$$\dot{z} = [\dot{\bar{x}} \ \ \dot{\delta} \ \ \ddot{\bar{x}} \ \ \ddot{\delta}]_T$$

$$u = [u_1 \ \ u_2]_T$$

$$\boxed{\begin{aligned} \dot{z} &= \bar{A} z + \bar{B} u \\ y &= \bar{C} z \end{aligned}}$$

$$\begin{bmatrix} \dot{\bar{x}} \\ \dot{\delta} \\ \ddot{\bar{x}} \\ \ddot{\delta} \end{bmatrix} = \underbrace{\begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & -\frac{K(m_1+m_2)}{m_1 \cdot m_2} & 0 & 0 \end{bmatrix}}_{\bar{A}} \begin{bmatrix} \bar{x} \\ \delta \\ \dot{\bar{x}} \\ \dot{\delta} \end{bmatrix} + \underbrace{\begin{bmatrix} 0 & 0 \\ 0 & 0 \\ \frac{1}{m_1+m_2} & \frac{1}{m_1+m_2} \\ \frac{1}{m_1} & \frac{1}{m_2} \end{bmatrix}}_{\bar{B}} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

Fazendo $y = [x_1 \ \ x_2]_T$:

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \underbrace{\begin{bmatrix} 1 & \frac{m_2}{m_1+m_2} & 0 & 0 \\ -1 & \frac{m_1}{m_1+m_2} & 0 & 0 \end{bmatrix}}_{\bar{C}} \begin{bmatrix} \bar{x} \\ \delta \\ \dot{\bar{x}} \\ \dot{\delta} \end{bmatrix}$$