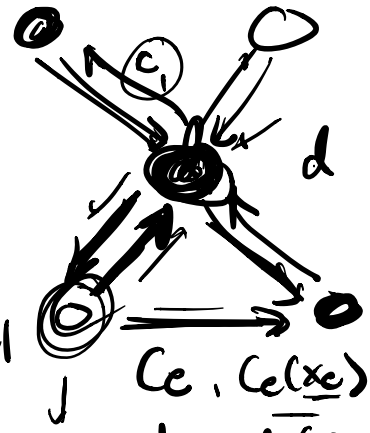
$$\min_x \; c^T x \leftarrow$$

$$\text{s.t.} \quad Ex = b, \; x \geq 0$$

$$E = (E_i - E_o)$$

$$d \in \mathbb{R}^{|S|} \qquad E \in \mathbb{R}^{|S| \times |\mathcal{E}|}$$

$$d^T E_o \in \mathbb{R}^{|\mathcal{E}|}$$



$c_e, c_e(x_e)$

$d_s, d_s(\rho_s) \leftarrow$

$$\min_x \; (c^T + d^T E_o) x \qquad \rho = E_o x$$

$$\text{s.t.} \quad Ex = b, \; x \geq 0$$

$c_e(x_e)$ equal travel time

$$f(x) = \sum_e \int_0^{x_e} c_e(u)\, du \leftarrow \leftarrow$$

$$\frac{\partial f}{\partial x_e} = c_e(x_e)$$

$$\frac{\partial f}{\partial x}^T C^T + v^T E + \mu^T = 0 \leftarrow \leftarrow$$

Routing Games

$$C(x)^T + v^T E + \mu^T = 0$$

$$\min_x \; f(x) \quad \text{s.t.} \quad Ex = b,\ x \geq 0$$

→ Wardrop Equilib.

→ $f(x) = \sum_e x_e c_e(x_e)$ ⇐ average/total travel time

$$\min_x \; f(x) \quad \text{s.t.} \quad Ex = b,\ x \geq 0$$

$$\min \; c^T(x_1 + x_2) \quad \text{s.t.} \quad Ex_1 = b_1 m_1, \quad Ex_2 = b_2 m_2$$

$x_1, x_2 \in \mathbb{R}^{|E|}$

$f(x_1 + x_2)$