$$\min \sum_{k \in \mathcal{F}} c_k z_k$$

$$\sum_{S_k \in C_r} z_k \ge \gamma(C_r) \quad C_r \in \mathcal{C}$$

$$z_k \in \{0,1\}$$

$$\left[\bar{z}\right] \quad \bar{x}$$

$$\max \sum_{i \in V} y_i \pi_i$$

$$\text{s.t.} \quad y_i \le \sum_{k : i \in S_k} x_k, \ i \in V$$

$$x_k \le 1 - \bar{z}_k, \ S_k \in \mathcal{S}$$

$$\sum_{k \in S} x_k \le \alpha$$

$$x \in \{0,1\}^n, \ y \in \{0,1\}$$

Minimal:
if its minimal
w.r.t obj $\ge r$
(removing any x_k)

$$\mathcal{U} = \{1, \ldots, n\}$$

targets/elements

$$\mathcal{S} = \{S_1, \ldots, S_m\}$$

locations/subsets

$$S_k \subseteq \mathcal{U}$$

$$\mathcal{C} = \{C_1, \ldots \}$$

$\subseteq \mathcal{S}$

Power Set $\left(\mathcal{J}\right) \setminus \{\text{budget} > \alpha\} \setminus \{\text{reward} \leq r\}$

Separation options

- Non-minimal: find a minimal one → use $\gamma = 1$

- Solve prob (3) to find γ

$$\left(\min_{v,w} \sum_{k \in \hat{C}} w_k \right) = \gamma(\hat{C})$$

$f(i) \leftarrow$ all locations that surveil i

$U(\hat{C}) = \bigcup_{s_k \in \hat{C}} s_k$

$$\text{s.t.} \quad v_i \geq 1 - w_k \qquad i \in U(\hat{C}),\ s_k \in f(i) \cap \hat{C}$$

$$\sum_{i \in U(\hat{C})} v_i \pi_i \leq r$$

$$v_i \in \{0,1\}, \quad i \in U(\hat{C})$$

$$w_k \in \{0,1\}, \quad s_k \in \hat{C}$$