

given:

- \mathcal{S} : set of superpixels
- \mathcal{P} : set of partitions
- $\gamma_s, \forall s \in \mathcal{S}$: color of superpixel
- k : number of partitions to select
- $\gamma_P = \sum_{s \in P} |c_P - \gamma_s|$: error that we make when selecting P , where c_P is the average color of P

variables:

- $x_P \in \{0, 1\}, \forall P \in \mathcal{P}$: P is selected

master problem:

$$\min \quad \sum_{P \in \mathcal{P}} \gamma_P \cdot x_P \quad (1)$$

$$\text{s.t.} \quad \sum_{\{P \in \mathcal{P}: s \in P\}} x_P = 1 \quad \forall s \in \mathcal{S} \quad (2)$$

$$\sum_{P \in \mathcal{P}} x_P = k \quad (3)$$

$$x_P \in [0, 1] \quad (4)$$

dual variables:

- $\mu_s, s \in \mathcal{S}$: corresponding to (2)
- λ : corresponding to (3)

dual problem:

$$\max \quad \sum_{s \in \mathcal{S}} \mu_s + k \cdot \lambda \quad (5)$$

$$\text{s.t.} \quad \sum_{s \in P} \mu_s + \lambda \leq \gamma_P \quad \forall P \in \mathcal{P} \quad (6)$$

$$\mu_s \text{ free} \quad (7)$$

$$\lambda \text{ free} \quad (8)$$

pricing problem:

$$\min \quad - \sum_{s \in \mathcal{S}} x_s \cdot \mu_s + \sum_{s \in \mathcal{S}} x_s \cdot |c_P - \gamma_s| \quad (9)$$

$$\text{s.t.} \quad \text{connectivity constraints} \quad (10)$$

becomes:

$$\min \quad - \sum_{s \in \mathcal{S}} x_s \cdot \mu_s + \sum_{s \in \mathcal{S}} x_s \cdot |c_P - \gamma_s| \quad (11)$$

$$\text{s.t.} \quad \text{connectivity constraints} \quad (12)$$

$$???? \quad (13)$$