Ommited Formulations in Column Generation Algorithm

1 Column Generation Algorithm

In our paper, the formal formulations of column generation algorithm is omitted. Here, we present the formal formulation of pattern generation and cutting stock formulation of RASA problem.

1.1 Pattern Generation Formulation

A pattern $p \in \mathbb{N}^N$ is a combination of service containers, which represents a feasible placement of containers on a machine (i.e., p_s is the number of containers that service s places on the machine). The formulation below generates one possible pattern of a machine m:

$$
\begin{aligned}
\text{max.} \quad & \sum_{s \in \mathcal{S}} \hat{\pi}_s \cdot p_s + \sum_{(s,s') \in E} a_{s,s'} && && (1)\\
\text{s.t.} \quad & w_{s,s'} \cdot \frac{p_s}{d_s} \leq a_{s,s'}, && \forall \left(s, s'\right) \in E && (2)\\
& w_{s,s'} \cdot \frac{p_{s'}}{d_{s'}} \leq a_{s,s'}, && \forall \left(s, s'\right) \in E && (3)\\
& \sum_{s \in \mathcal{S}} p_s \cdot R^S_{r,s} \leq R^M_{r,m}, && \forall r \in \mathcal{R} && (4)\\
& \sum_{s \in A_k} p_s \leq h_k, && \forall A_k \in \mathcal{A} && (5)\\
& 0 \leq p_s \leq b_{s,m} \cdot d_s, && \forall s \in \mathcal{S} && (6)\\
& p_s \in \mathbb{N}, && \forall s \in \mathcal{S}. && (7)
\end{aligned}
$$

Here, p_s's and $a_{s,s'}$'s are the decision variables, $\hat{\pi}_s$'s are the optimal solution of the dual variables for constraints in the cutting stock formulation.

1.2 Cutting Stock Formulation

Given a pattern set $\mathcal{P}_m$ of machine m, which consists of feasible patterns on machine m. Let $p^{(l)} = \left[p_1^{(l)}, p_2^{(l)}, \ldots, p_N^{(l)}\right] \in \mathcal{P}_m$ be the l^{th} pattern of machine

m, and $\sigma_{m,l}$ be the gained affinity of the pattern $p^{(l)}$
The formal cutting stock formulation of RASA is

$$\text{max.} \quad \sum_{m \in \mathcal{M}} \sum_{p^{(l)} \in \mathcal{P}_m} \sigma_{m,l} \cdot y_{m,l} \tag{8}$$

$$\text{s.t.} \quad \sum_{m \in \mathcal{M}} \sum_{p^{(l)} \in \mathcal{P}_m} p_s^{(l)} \cdot y_{m,l} \leq d_s, \qquad \forall s \in \mathcal{S} \tag{9}$$

$$\sum_{p^{(l)} \in \mathcal{P}_m} y_{m,l} \leq 1, \qquad \forall m \in \mathcal{M}. \tag{10}$$