Arc selection by reduced cost

Paul Javal

Ecole Polytechnique - Franois Soumis

April 11, 2017

Optimization Problem

Master problem:

$$\min_X \sum_{j \in J} c_j \cdot X_j \qquad J = \{\text{Admissible paths}\}$$

$$\sum_{j \in J} a_{v,j} X_j = 1, \forall v \in V \qquad (\alpha_v) \quad \text{Flights covering}$$

$$\sum_{j \in J} b_j^k X_j \leq d^k, \forall k \in K \qquad (\beta_k) \quad \text{Supplementary constraints}$$

$$X_j \in \{0; 1\} \qquad \text{Decision variables}$$

Sub-problems:

- One per base & one per day
- Shortest Paths with Resource Constraints

What would we want?

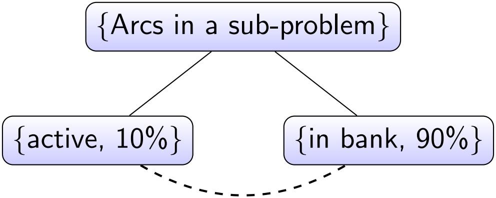


Figure: Naive idea

Focus on Sub-problems

For every arc (r, s)

- receive from MP reduced cost:

$$\overline{c}_{r,s} = c_{r,s} - \sum_{v \in V} a_{v,(r,s)} \cdot \alpha_v - \sum_{k \in K} b^k_{r,s} \cdot \beta_k$$

- compute a full Arc-Reduced cost WITH sub-problem dual values:

$$\overline{\overline{c}}_{r,s} = \overline{c}_{r,s} - \pi^M_s + \pi^M_r$$

π^M_i = minimum cost from origin to i

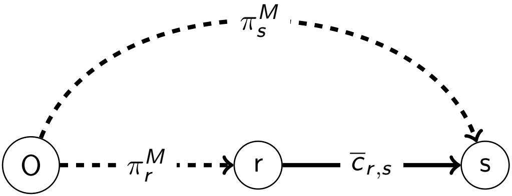


Figure: Illustration of full Arc-Reduced Cost

Focus on Sub-problems

- compute a Path-Reduced cost that uses (r, s):

$$\overline{\overline{c}}^{P}_{r,s} = \overline{c}_{r,s} - \pi^m_s + \pi^M_r$$

π^m_j = minimum cost from destination to j

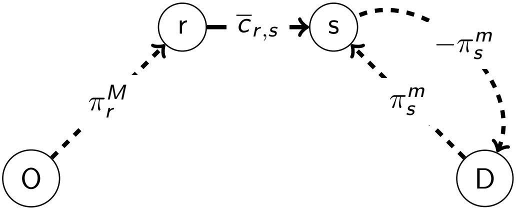


Figure: Illustration of full Path-Reduced cost - Backward labeling coming up

Why bi-directional?

We compute:

- all forward labels as before - π_r^M - blue arcs;
- and now all backward labels - π_s^m - red arcs;
- green arcs are in the bank.

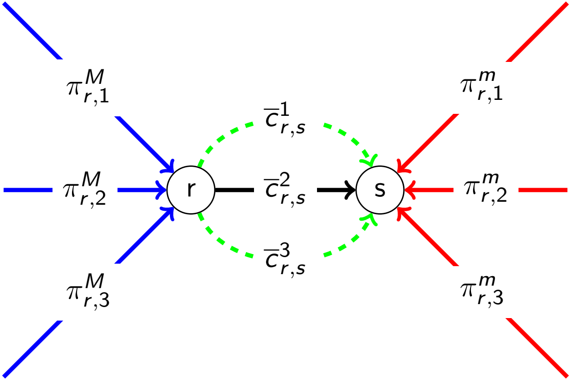
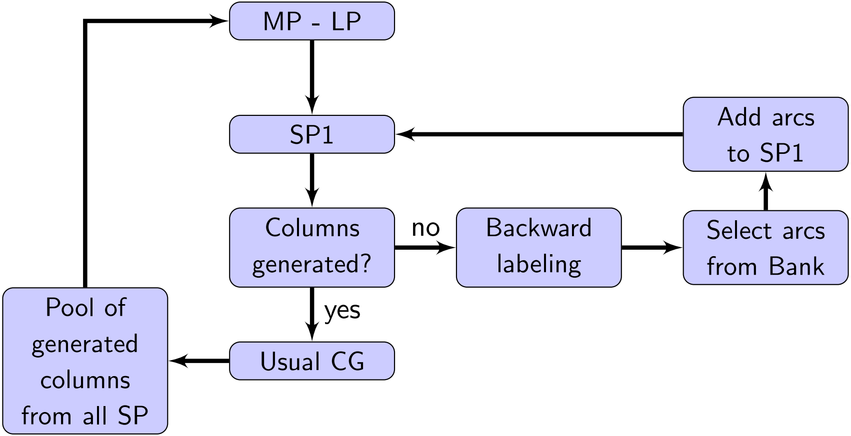


Figure: Selection of best green arcs to add

Simplified Algorithm



Conclusion

- Coding on the way (!) on AdOpt' pairing generator
- Challenges:
    - deal with resources
    - set-up the bank structure
    - manage dominance in the SPP
- Have just enough to survive then choose and pick the cherries