CIVIL-557
Decision-Aid Methodologies in Transportation
Lecture III
Solutions: SPPs

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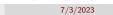
EPFL

Outline

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Exercise 1

1. Is there a cycle in the solution? if so which nodes are cycling?
   Yes, there is a cycle. From 9 to 19.

2. Is the solution a feasible solution? Explain!
   The solution is feasible because it does not violate any constraints.

3. Is the solution the optimal solution? Explain!
   The solution is unbounded. It contains a negative cost cycle, hence, it could cycle forever.

4. If we are using Branch-and-Price to solve the VRP and this SPP was the relaxation of the pricing problem (ESPPRC), can we add this path to the RMP (Restricted Master Problem) as a column? Explain!
   Yes. If there are no capacity or time windows constraints we can add this column as a negative cost column. This solution will be eliminated in the branching process.

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Exercise 2.1

- Why did the cost of the solution increase from the solution of the SPP in exercise 1? The solution increased because we added time window constraints that made the previous solution unfeasible.

- Identify all cycles in the solution. [29, 16], [14, 27, 20, 27, 14], [27,20], [14,7], [40,18], [47,4], [21,45]

- Why is the path leaving negative cost cycles and not continuing to cycle as in exercise 1? It would violate the time windows constraints.

- Is the solution feasible? Explain! Yes, it satisfies all the constraints

- Is the solution the optimal solution? Explain! Yes, the solution is optimal for the SPP with time windows. The algorithm uses the principal of optimality to solve this problem.

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Exercise 2.2

- Identify all cycles in the solution. [29,16], [40,18]
- Why did the cost increase with respect to the previous solution value of the SPPRC (time windows)? We added capacity constraints the eliminated the solution of the previous exercise. By adding constraints the solution can only increase in a minimization problem
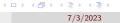
Outline

Exercise 3

- Identify all cycles.
  There are no cycles the path is elementary

- Is this solution also the optimal solution of the ESPPRC? Explain!
  Yes, because the SPPRC is a relaxaion of the ESPPRC and therefore it provides a lower bound for the optimal solution of the ESPPRC. Since it is feasible for the ESPPRC the solution is both an upper bound and a lower bound, thus, it is optimal.

- Increase the value of the size of the Ng_set, i.e., Ng_v, from Ng_v = 2, Ng_v = 5, Ng_v = 10, Ng_v = 15, and Ng_v = 20.
  (Warning: if your computer takes longer then a minute, stop!)
  - At what point are the cycles eliminated? when Ng_v $\geq$ 3.
  - Why does the algorithm take more time as you increase Ng_v? Explain!
    The set of labels grows , since it becomes more difficult to delete labels through dominance rules.

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