Exercise 2: MCF and SPPRC

June 2, 2020

Due: June 23, 2020, 23:59
Upload to MyStudy in the **Exercise 2 submission** folder
Submitted in the form of a PDF with the title
Exercise2-name1-name2-name3 (with your comments and results) and your codes in .ipynb

1 Task 1

The following is the same problem as the first task in Exercise 1; you need to design it as the **multicommodity flow model**.

The company **LGLog** is active in forest and wood management, transporting logs from the forest to sawmills. The company operates in multiple forests and owns several sawmills. The forest can only be reached by very expensive and specialized forest transporters with high fuel consumption. Therefore, the company wants to build transshipment hubs near the harvested forest areas to move the logs to cheaper and more fuel-efficient trucks that will transport the logs to the sawmills. The company has identified several potential transshipment hubs. Your job is to decide which preselected locations should be chosen.

Each transshipment hub has a fixed cost for being open. Vehicles have travel costs depending on the amount of logs they are carrying, which are arc dependent. For each type of vehicle, there is a maximum number of logs that can be carried. Assume that a truck can handle more logs than a forest transporter. Additionally there is a uniform handling cost per log at the hubs. You can assume there are enough vehicles of both types available to carry all of the demand, but multiple vehicles of the same type may not travel on the same arc at the same time.

Assume you are aware of the demand at each sawmill, and the supply in terms of logs at each forest. Note that these two quantities need not be balanced. LGLog is paid a fixed price per log delivered to any sawmill. Every hub can be reached from any forest, and every sawmill can be reached from any hub, with different distances in between them. It is also possible to travel directly from the forest to a sawmill. Transporting logs between

hubs is prohibited. Furthermore, no logs are transported between sawmills nor between forest areas.

1.1 Model

Design a multicommodity flow model to maximize LGLog's profit. Formally define the model and explain all of its components.

1.2 Extension

Modify your model to support the following problem extension: Due to limited storage capacity, transshipment hubs may only transship logs from a limited number of forest areas. That is, each transshipment hub i may only take logs from at most p_i forest areas.

2 Task 2

Please implement the **dynamic programming** approach in Python to solve a shortest path problem with time constraints on movement and parking. The problem description and an example are given in the Sancho 1992 paper. You can use the example given in the paper to test your implementation. Furthermore, you can test your program with the following situation: the feasible parking period at the source node 1 is restricted to period 0–12, instead of free parking being available. And output your solutions in Python at the end. Please document your code to make it easy to understand.

2.1 Grading

The homework will be evaluated based on the following criterion:

- Correctness and quality of the algorithm implementation