IE801B Homework Assignment 4

1 Implementations and Strategies

Implement the branch-and-price algorithm for solving the constrained shortest path problems (CSPP).

1. Use Gurobi, CPLEX, or HiGHS to solve the Integer Programming Formulation of CSPP.
2. Create code for the complete branch-and-price algorithm, i.e., restricted master problem + pricing subproblem + branch-and-bound, to find an optimal solution.
3. Using the IP formulation and your own branch-and-price code, solve the problems given in Figures 1 and 2.

Refer to Desrosiers and Lübbecke (2005). Reviewing an undergraduate OR textbook for basic branch-and-bound schemes would be helpful.

2 Submission

Submit the following files for this assignment:

1. A PDF report that summarizes your code, experiments, and findings. LaTeX is recommended but not required. Using a Jupyter notebook is fine. Describe your experimental settings: CPU, RAM, OS, language version, package version, computational time, etc. In most cases, this is the only file that I will read. I will read your source code if necessary. In your report, describe how you used AI tools; this is not for grading but for my own education on how students are using AI tools.
2. Your code files.
    - Do NOT submit your algorithm code as a Jupyter Notebook. You can use Jupyter while developing your code but not in the submission.
    - You can write your main code as `main.py` and import it to your Jupyter notebook to create the final report.
    - In your report, specify which source file is the file that I need to run to reproduce the results. If you choose to use C/C++/Java, describe how I can compile and run the code. For C/C++, `cmake` is recommended.
    - I read your submissions in VSCode. So files readable within VSCode are allowed (except `.ipynb`). Examples are `.pdf, .m, .cpp, .jl, .py, .csv, .png, .gif`, etc.

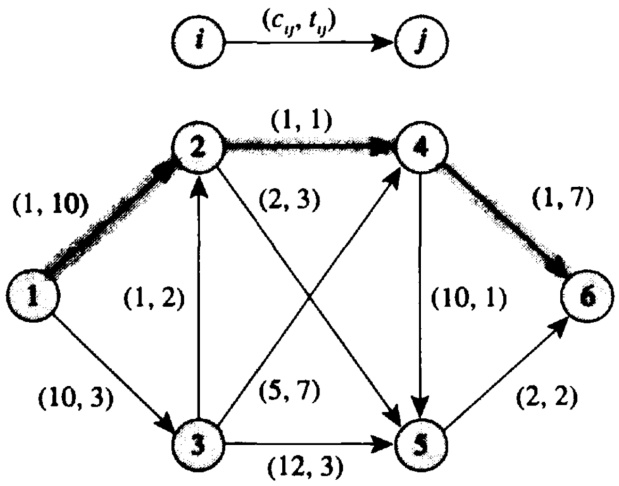

Figure 1: An instance from Ahuja et al. (1993, p. 599). Time budget (T) = 14.

Please upload each file (PDF and source codes) separately without zipping unless you have too many separate files or use special directory structures. If you prefer to submit your code via a GitHub repo, that is okay, too. You need to mention the repo URL and the specific commit SHA. Please make sure that I have access to the repo. My GitHub account name is `chkwon`.

References

Ahuja, R. K., Magnanti, T. L., and Orlin, J. B. (1993). *Network Flows: Theory, Algorithms, and Applications*. Pearson.

Desrosiers, J. and Lübbecke, M. E. (2005). A primer in column generation. In *Column generation*, pages 1–32. Springer.

Handler, G. Y. and Zang, I. (1980). A dual algorithm for the constrained shortest path problem. *Networks*, 10(4):293–309.

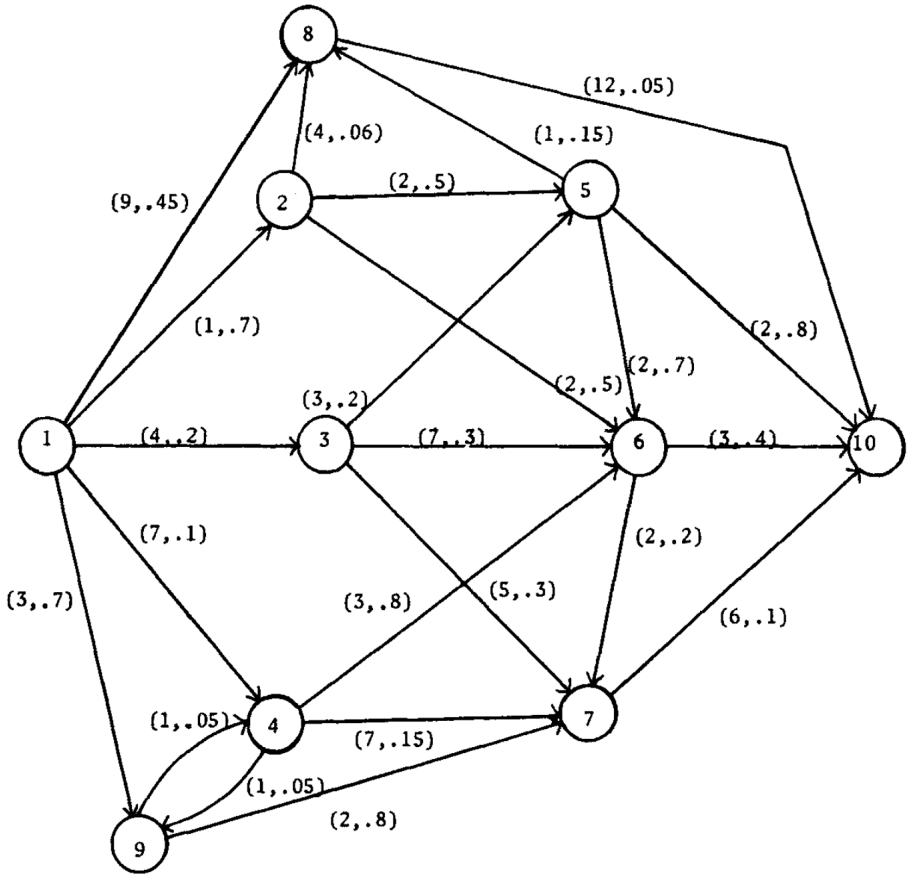

Figure 2: An instance from Handler and Zang (1980). Time budget (T) = 1.