Combinatorial Optimization Project: The Steiner Tree Problem #3

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The Steiner tree problem is a well known combinatorial optimization problem that requires a set of nodes in a weighted graph, to be connected at minimum cost. For this purpose, it is possible to use a set of extra nodes (Steiner nodes). The problem can be formally defined as follows: Let $G = (N, A)$ be a given directed network with node set N and arc set A, with arc weights c_{ij}. Moreover, let $R \subseteq N$ be the set of required (or terminal) nodes. Find a minimum weight tree in G that spans R.

Several integer programming (IP) formulations for solving this problem are available in the literature. In this project, you will study three IP formulations:

- The flow formulation proposed by Wong (1984). You can find this formulation (P_F) in page 244 of Polzin and Daneshmand (2001);
- The two-terminal formulation proposed by Liu (1990). You can find this formulation (P_{2T}) in page 245 of Polzin and Daneshmand (2001);
- The common-flow formulation proposed by Polzin and Daneshmand (2001). You can find this formulation (P_{F^2}) in page 257 of Polzin and Daneshmand (2001).

For this project:

- You must implement these formulations in Julia language combined with JuMP package.
- You must prepare a project report written in LaTeX. In this report you should describe the mathematical formulations referenced above (explaining the meaning of each variable and constraint set), describe the computational experiments, and discuss the results;
- You must send the report and code to guillerme.duvillie@ulb.ac.be and leave a physical copy at the *Secrétariat des Étudiants du Département d'Informatique* at the 8th floor of the NO building, by 8^{th} of May.

Practical informations:

- the ease of use (read/write on the standard input, options, CLI, etc) is taken into consideration in the grading,
- the performance of the implementation is also taken into consideration in the grading.

References

Polzin, T., Daneshmand, S.V. (2001) A comparison of Steiner tree relaxations. Discrete Applied Mathematics, 112(1), pp.241-261.

Wong, R.T. (1984) A dual ascent approach for Steiner tree problems on a directed graph, Math. Program, 28 pp.271287.

Liu, W. (1984) A lower bound for the Steiner tree problem in directed graphs, Networks 20, pp.426434