Secret Santa

Difficulty level: advanced

Keywords

- Graph theory
- Undirected graphs
- Integer Linear Programming
- Python+PuLP

Problem description

For Christmas, the reading group of the local library organizes a *Secret Santa* to exchange gifts. In particular, each participant who joins the initiative is assigned to another to whom he will have to give a book and, in turn, receive a book as a gift from a third person.

The list of members is as follows: Alessandra, Bruna, Carlo, Daniela, Elisa, Fabio, Germana, Katia, Luca, Mariangela, Nicola, Roberta, Simone, Vilma, and William. Having proposed the initiative also the previous year, the coordinator of the reading group:

- would prefer not to reassign the same recipients to the same people;
- wants to prevent two people from being assigned to each other;
- wants Fabio to give Alessandra a book.

Past assignments are the following: Alessandra has already given a book to Elisa, Bruna to Nicola, Carlo to Simone, Daniela to Katia, Elisa to Fabio, Fabio to Germana, Katia to Alessandra, and Luca to William.

Tasks

1. To what classical Operations Research problem that we have already encountered can this problem be reduced?
2. Formulate the mathematical model of the problem and implement it in Python to solve it with PuLP, in the two following ways:
   (a) first, write all the instance data directly into the script;
   (b) then, try to read the instance data from a text file and adapt the script accordingly.