CoContest 2023

Industrial Informatics Research Center

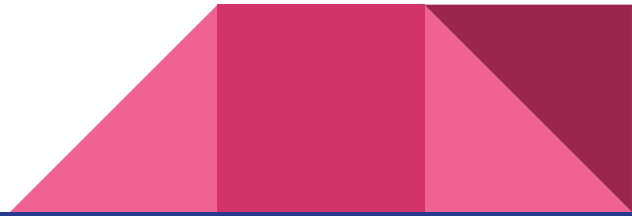
http://industrialinformatics.fel.cvut.cz/

Problem motivation

- A real-life issue as a combinatorial problem

- Hundreds of thousands of patients on the waiting lists worldwide
  - Friends and family would like to help, but they are incompatible
  - => Kidney exchange alleviates the issue

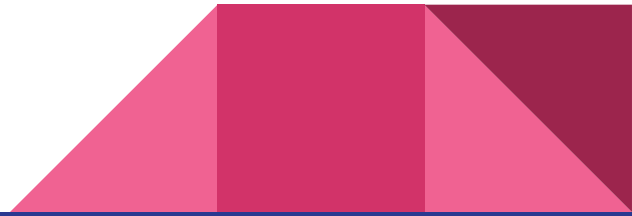
- May include altruistic donors
  - Solution can contain both cycles and paths
  - We simplified the problem



Instances

- Optimal
  - Anonymized real-life instances
  - Acyclic, sanity checks, random

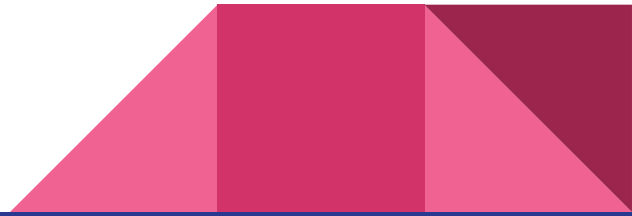
- Threshold + Ranking
  - Randomly generated instances - randomly selected neighbours and number of edges
  - “Special graph" - many low-weight edges and few highly desirable
    - Last two instances in Ranking



Possible solutions (optimal)

- What makes the problem NP?
  - Maximum length L
  - Polynomial for:
    - L = 2 - maximum weighted matching
    - L = inf - maximum weighted perfect matching in the bipartite graph (solvable with min-cost)

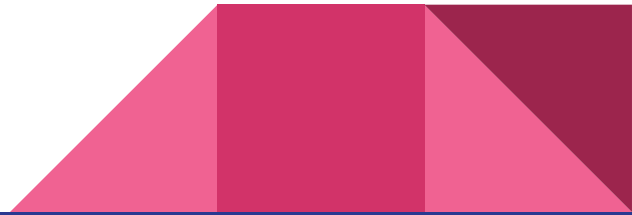
- Optimal:
  - Lazy constraints, cycle enumeration -> Maximum weighted independent set, …
  - Inspiration: https://doi.org/10.1073/pnas.1421853112



Possible solutions (threshold + ranking)

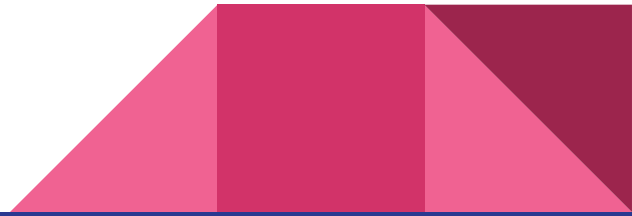
- Sample/find cycles in the graph, then construct solution
  - Solve Maximum Weighted Independent set problem
  - Informed sampling to find good cycles
  - Construct solution using a greedy algorithm (sort cycles by their cost), genetic algorithm (binary variable per cycle + repair operator), matheuristic, …

- Solve the relaxed problem (L = inf), then repair the solution not to contain long cycles



Student best solutions

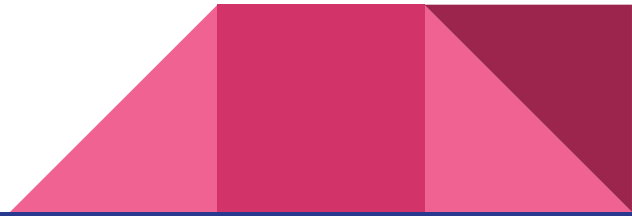
… how did you solve it ?



Statistics

- Top 10 solutions
  - Java 1 (Best, all hail the King)
  - C++ 6 (2nd best, 7th GA)
  - Python 3 (3rd best)
- 77 students entered some valid solution

- Hall of Fame (TOP 5)
  - 1st Šimon Zvára
  - 2nd Martin Hubal
  - 3rd Jiří Pospíšil
  - 4th Matěj Kafka
  - 5th Jakub Dupák



IID group

- Way of cooperation
  - Semestral project
  - Diploma thesis
  - Part-time job
  - Doctorate
- What do we do
  - Optimization
  - Machine learning in industry…
  - Scheduling
  - Simulation
  - Embedded
  - Robots
- Both industrial cooperation and theoretical research