Project **Winter 2021/22**
Algorithm Engineering for hard problems **TU Berlin**
Nichterlein/Boehmer/Niedermeier **December 15, 2021**

4th Exercise Sheet

Weighted Cluster Editing I

Solver: January 10 **Handout:** January 11 **Presentation:** January 12

Task 1. Modelling WCE

Implement (team size -1) models for Weighted Cluster Editing using solvers based on the following underlying techniques:

- Integer Linear Programming,
- Satisfiability,
- Pseudo Boolean Satisfiability,
- Answer Set Programming, or
- Constraint Satisfaction Programming.

Your program(s) should read the weights in the usual way, then call the solver, and finally report the solution in the usual format.

Analyze whether applying data reduction rules improves the performance of your solver formulation(s). Compare your best solver (i.e., from the previous exercise) with the new program(s) above. Mention these results shortly in the handout and in the presentation.

Hint: We highly recommend that one of your implementations is based on Integer Linear Programming (ILP) as it will be reused in the 5^{th} exercise sheet. Moreover, we suggest using CPLEX as ILP solver as it is fast, installed on our machines, and can be used without acquiring personalized (i. e., tied to the user) licenses.

Task 2. Heuristic

Implement a heuristic to solve Weighted Cluster Editing (we recommend to use some sort of local search). Your algorithm **must** be able to compute and output a valid solution on each provided instance within *one minute*. Note that, after one minute, the benchmark script sends an interrupt signal (`SIGINT`) to your program. After another five seconds, your program is killed.

Hint:
For testing your heuristic you can use the benchmark script and change line 14 to
`maxSecPerInstance=60`

The benchmark script will indicate suboptimal solutions (as long as we do know the optimum solution) by >>BAD COST<< in the "verified" column in the csv file. The cell to the right will then contain a number indicating how much larger your solution is compared to the optimum one.

Task 3. Presentation & Handout

Please submit a handout of your evaluation and present your findings with a short talk lasting at most 10 minutes.

The main focus of the handout should be

- a comparison of your fastest exact solver and the exact solver(s) from Task 1,
- a brief explanation of the main ideas and tricks of your heuristic, and
- a comparison of the solutions of your heuristic with the optimum solution.

You have a space limit of one page of text in the handout and two pages overall.

In the presentation, briefly show your results for the solvers for Task 1. Then explain the main ideas and tricks of your heuristic and compare how far you are away from an optimal solution. Come up with possible explanations for observed differences.

Note that the main focus of this sheet should be on the heuristic exercise. The (unofficial) competition is also going to evaluate the heuristic only. Herein, we compare how close your heuristic is to the optimum.