CS4234: Optimisation Algorithms Tutorial 11

SLS Design and Tuning Problem; Final Preparation 2

V1.4: Steven Halim *November 9, 2020*

Preliminaries

By now, we have seen three weeks worth of SLS ideas. Hopefully you have realized that when one is presented with a new (NP-)hard COP Z, or even COP A again but with different constraints (e.g., the classic TSP/MWVC but with very limited run time limit), one cannot simply take 'any favorite' SLS algorithm from a book/lecture note/research paper/one's own experience and apply that SLS algorithm verbatim with 'default parameters' on problem Z and hopes to get a good result out of the box. In this tutorial, we will apply what we have learned in Lecture 11 and/or in our Mini Project experimentations so far.

Discussion Points

Q1: In slide 8 of `http://www.comp.nus.edu.sg/~stevenha/cs4234/lectures/11.SLS-DTP.pdf`, Steven has outlined the list of potential parameters (type-1 of SLS DTP), components (type-2 of SLS DTP), and search strategies (type-3 of SLS DTP) of Tabu Search (TS) Meta-heuristic. Now please do the same for Iterated Local Search (ILS) Meta-heuristic (assuming that you use ILS for the TSP). You can refer to `http://www.comp.nus.edu.sg/~stevenha/cs4234/lectures/10.Meta-heuristics.pdf` for the **bold red text** parts of ILS or other resources to give a more complete view.

Q2: Past paper (AY2019/20) hidden MCQs:

1. Which part of SLS algorithm engineering process is usually the most time consuming?
   (a) Picking the correct SLS algorithm
   (b) Picking the correct components of the chosen SLS algorithm
   (c) Implementing the SLS algorithm into a working program
   (d) Debugging the SLS algorithm
   (e) Fine tuning the SLS algorithm
2. Context: Mini-Project 1: Traveling-Salesman-Problem (TSP) of up to 1000 vertices with limited 2s runtime. Which of the following SLS/heuristic ideas has the highest chance to work well as discussed in the final project presentations? You can assume that 2-edges-exchange (2-opt) Neighborhood relation is used for all 5 options below.
   (a) Steepest Descent with random restart upon hitting any Local Optima
   (b) Simulated Annealing with aggressive cooling function

(c) Iterated Local Search that only accepts the better of the two Local Optima after each perturbation+subsidiary local search steps

(d) Evolutionary/Memetic Algorithm with a medium-size population

(e) Tabu Search algorithm with high Tabu Tenure to encourage exploration of search space

3. Context: Mini-Project 2: MIN-WEIGHTED-VERTEX-COVER (MWVC) of up to 4000 vertices and 600 000 edges with limited 2s runtime. Which statement is likely incorrect?

   (a) We can use add vertex to vertex cover and remove vertex from vertex cover local moves

   (b) We need to favor intensification to get a good performing SLS for MWVC

   (c) We can use gain/loss scoring heuristic to help the SLS picks the next local move

   (d) We need to take care of potential *infeasible* solutions that are not a vertex cover

   (e) We can complement the input graph and optimizing for MAX-CLIQUE instead

Q3: Final Assessment Preparation. As you might have suspected, Steven usually put some (NP-)hard problems from past programming competitions in his paper. So, try to solve the following problems at Kattis that have been used in CS4234/CS3233 before. Your TA will discuss a few (possibly not all) problems:

- `https://nus.kattis.com/problems/dutyscheduler` (used in S1 AY2018/19)

Optional Discussion of any other question(s) in past papers.

Remarks Before we end CS4234 tutorial sessions, let's take a class photo (with social distancing :O) or we-fie with webcam as momento.