Preliminaries

During Lecture 9, 10, and Tutorial 9, you have been exposed with a new search paradigm: (Stochastic) Local Search (SLS) followed by 4 (FOUR) more established SLS algorithms (also called ‘Meta-heuristics’): SA, TS, ILS, MA, that are reported to be successful in attacking various (NP-)hard COPs A, B, C, ... in various research papers. However, when presented with another new (NP-)hard COP G, or even COP A again but with different constraints (e.g. the classic TSP 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 G 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: For TSP, you have been exposed with 2-exchange (2-opt) local neighborhood whereby we take 2 edges from the current tour, delete them, and reconnect the 2 tour fragments with the only other valid way, thus reintroducing 2 new edges. Some people misunderstand 2-opt local move by ‘swapping 2 vertices/cities’ of the current tour. Discuss what are the pros and cons of doing ‘2 edges swap’ versus ‘2 vertices swap’ in the context of TSP (and your Mini Project 1).

Q2: In slide 8 of [http://www.comp.nus.edu.sg/~stevenha/cs4234/lectures/11.SLS-DTP.pdf](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. Assume that you will use ILS for the TSP. You can refer to [http://www.comp.nus.edu.sg/~stevenha/cs4234/lectures/10.Meta-heuristics.pdf](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.

Q3: In slide 52 of [http://www.comp.nus.edu.sg/~stevenha/cs4234/lectures/11.SLS-DTP.pdf](http://www.comp.nus.edu.sg/~stevenha/cs4234/lectures/11.SLS-DTP.pdf) Steven has shown Fitness Landscape analysis of at least 2 (TWO!) different structures of QUADRATIC ASSIGNMENT PROBLEM (QAP) instances. In fact, Fitness Landscape analysis is an early step (no 3) of what Steven’s recommend in his thesis for dealing with the SLS DTP (slide 44). So for your Mini Project 1, let’s do some Fitness Landscape analysis of typical TSP instances either via your own experiments, by reading external resources (Steven’s thesis or someone else’s paper about TSP), report your findings (on whether TSP has multiple Fitness Landscape too, step no 4), and then formulate hypothesis of effective SLS walks for each class (step no 5)!

Mini Project Presentation Plan

During the last tutorial slot (T11), we will not discuss any new question but you (as pair - default, triple - only one instance, nobody goes solo this time) will present your findings about what should you do to get good performing SLS algorithm to attack ‘TSP up to N = 1000 cities with restricted 2 seconds time limit’ and ‘to extend what is possible with SLS algorithm for LABS problem’. Steven is more interested in
hearing on your experimentation journey rather than just the final version (who knows where you got those implementations).

In that 6 minutes, generally all members (for pairs and one triple) have to speak. You can skip the basic definitions of TSP and LABS as I know them very well. Just concentrate on the various experimentations that your group did, the results (reporting negative results of the experimentation is encouraged, so don’t just jump to the last one that works), and lessons learnt from those experimentations. Limit your group to about 3 minutes per COP and 6 minutes per group as we won’t have enough time otherwise. It is ok to let other project groups (your direct competitors) hear about your success/failures... They can’t do much with that knowledge in just 2-3 hours more...

PS: For the latest known score for https://open.kattis.com/tsp see CS4234 private IVLE, class roster, the TSP column. For the latest known Best Known LABS solution for 66 \leq N \leq 110, please see http://www.comp.nus.edu.sg/~stevenha/cs4234/miniproject.html