**CS4234: Optimisation Algorithms** Tutorial 10

# SLS Design and Tuning Problem; Finale

*V1.2: Steven Halim* *November 12, 2018*

## Preliminaries

During Lecture 9, 10, and the previous 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 $Z$, 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:** In slide 52 of `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)!

**Q3:** Statements About SLS (up to Lecture 11)

For each statement below about Stochastic Local Search (SLS) algorithm, determine if it is More Towards True/More Towards False/It depends and give a short explanation.

1. We can easily take a state-of-the-art SLS algorithm $S$ for another (NP-)hard COP $C$ and use it directly for our new COP $D$.

2. If we have a COP whereby the typical fitness landscapes of its instances are of 'Big Valley' type with high Fitness-Distance Correlation (FDC) coefficient, it is much better to focus our SLS algorithm on intensification strategies than diversification strategies.

3. In ILS, it is better to use Acceptance Criteria that *always accept* newly found Local Optima to encourages exploration of Local Optima space.

**Q4:** Finale. 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://open.kattis.com/problems/taxicab`
- `https://open.kattis.com/problems/bilateral`
- `https://open.kattis.com/problems/piano`
- `https://open.kattis.com/problems/hidingchickens`