Travelling Salesman Report

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1 Introduction

In this document I will state my findings and opinions over every genetic operator that I use in this problem. All the examples are done with a population of 100 individuals over 100 generations, cross chance at 60% mutation chance at 5% and no elitism.

2 Selection operators

2.1 Roulette

Roulette is a selection method that keeps a good population variety while also steadily decreasing the average fitness over multiple generations. Good overall selection method though it yields some mediocre results compared to more elitist methods like truncation.

Figure 1: Roulette

2.2 Truncation

Truncation is the most elitist selection method and yields the best results compared to the others when paired with cross operators that keep as many links from the parents as possible like ERX or my personal method which is inspired by ERX. The curve is much steeper compared with roulette but the downside is that it would get stale very quick without the cross combination

to match. It can yield the bast or the worst results depending on how you combine it with the other operators.

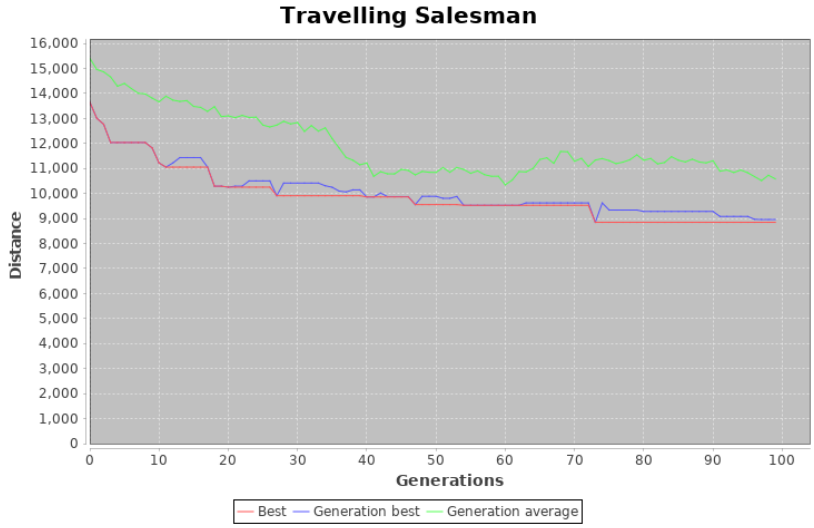

Figure 2: Truncation: Good example(with ERX)

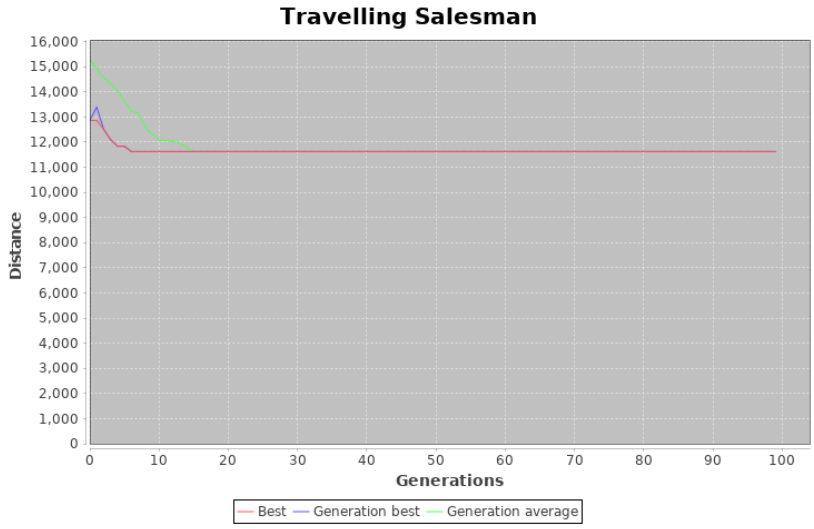

Figure 3: Truncation: Bad example (with PMX)

2.3 Tournaments

I am going to put both Deterministic and Probabilistic Tournament operators in the same category because they yield very similar results. They

both keep a great population variety but with very little increase on the best values over many generations. There is a slight differrence between them and that is that Deterministic tournament is a bit more elitist while the Probabilistic Tornament leans slightly towards variety. Both yield mediocre results with this problem.

Figure 4: Tournaments

2.4 Universal Stochastic

This selection operator is a pretty good middle ground between elitism and variety. A solid choice that gives a little bit more variety than roulette or truncation and also a bit more elitism than the tournaments.

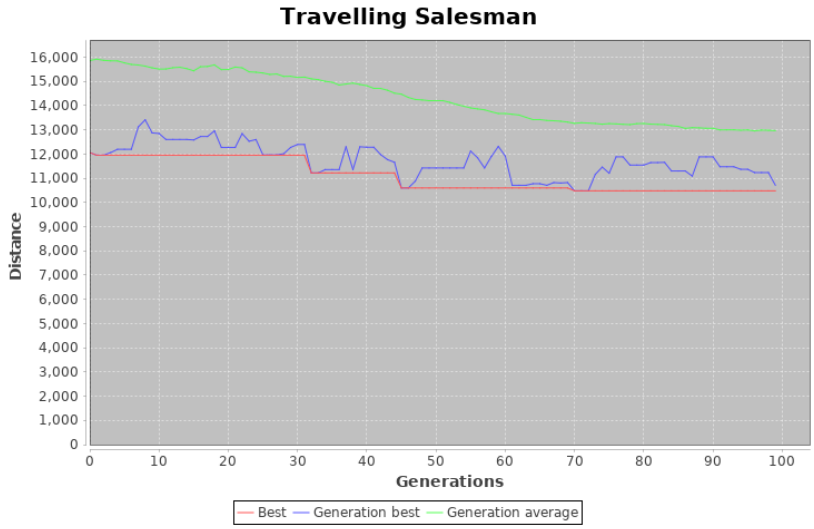

Figure 5: Universal Stochastic

3 Crossover operators

3.1 Partial Matching

PMX is a very basic crossover method for this problem and the results are as mediocre as some of the following methods. Here is an example of it combined with the Roulette selection.

Figure 6: PMX with Roulette

3.2 Order, Cycle, Ordinal Coding

Again I put these operators under the same section because I think they produce very similar results, with very little difference. They perform best when paired with a higher variety selection method like universal stochastic. Out of these, the Cycle operator in particular seems to be producing slightly better results than the others.

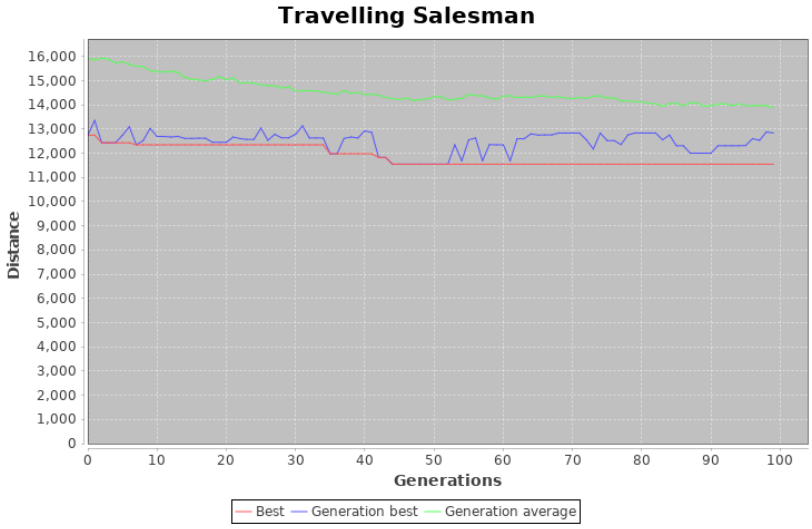

Figure 7: OX with Universal Stochastic

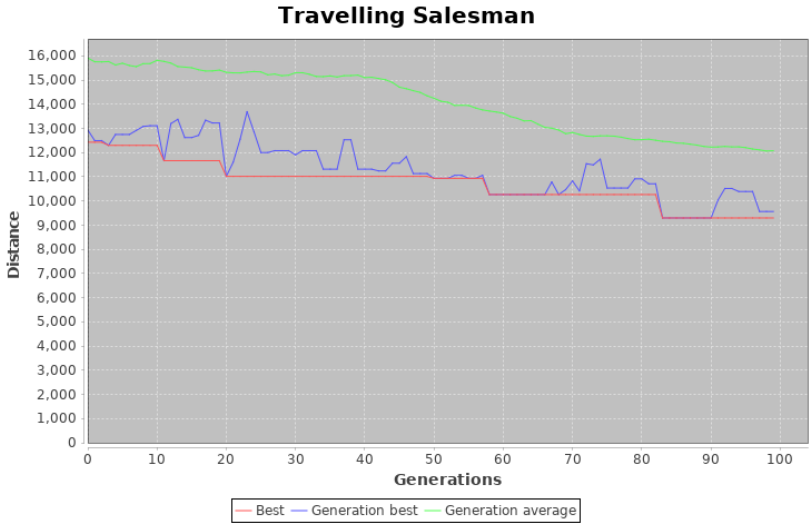

Figure 8: Cycle Cross with Universal Stochastic

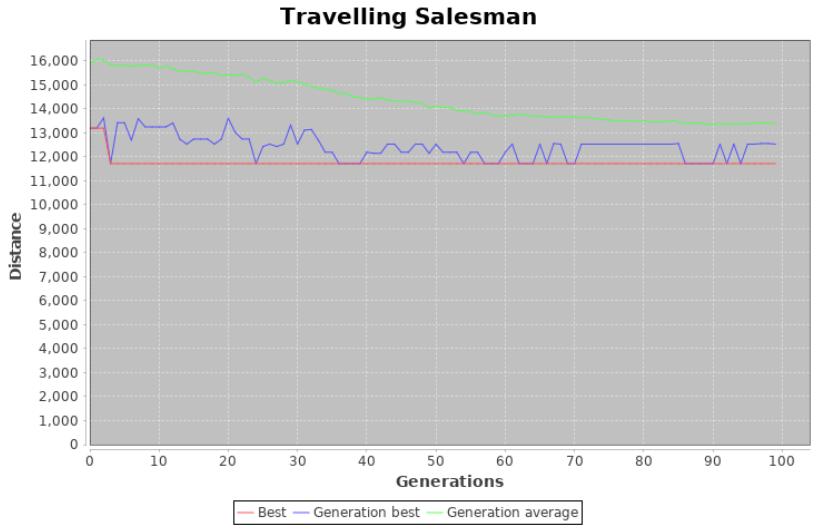

Figure 9: Ordinal Coding with Universal Stochastic

3.3 Edge Recombination

Compared with the previous methods, this one aims to keep as many of the links from the parents as possible. Therefore the chance that progenitures will be at least as good as the parents is greatly increased. Yields very good results especially combined with more elitist selection methods such as truncation.

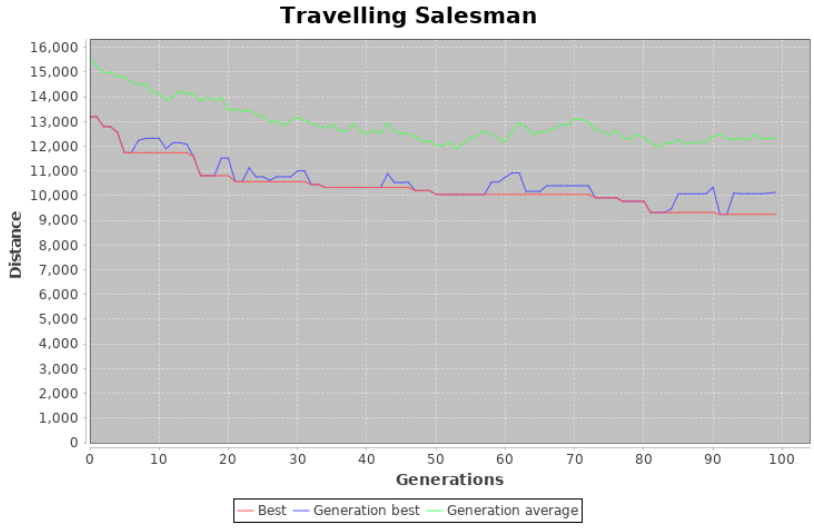

Figure 10: ERX with Truncation

3.4 Personal crossover operator

My crossover idea inspires from the ERX method with a few changes that, in my case yielded slightly better results. First we build a graph where edges are neighbour relationships between cities in the route. Then, the children are build by doing Depth First Search on said graph starting from two randomly chosen nodes. Best results, again, paired with truncation selection.

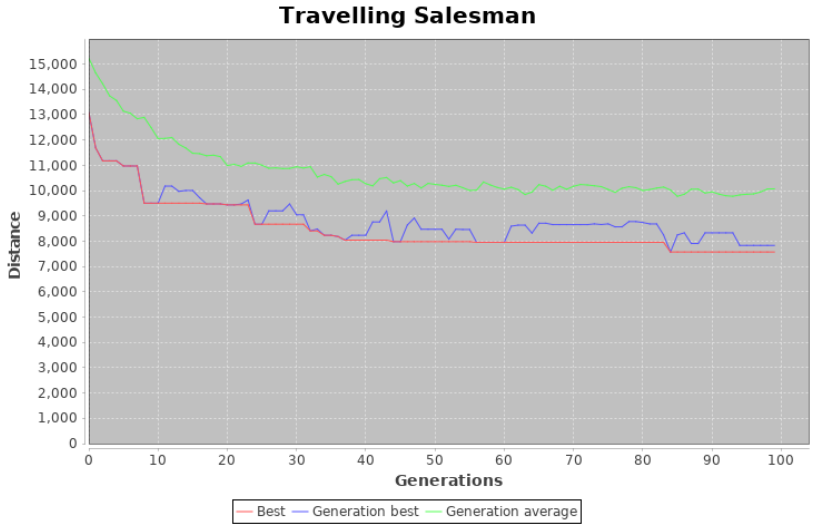

Figure 11: Personal cross with Truncation

4 Mutation operators

4.1 Exchange,Insertion,Inversion,Heuristic

I do not have very much to say about these various operators as their results are hard for me to observe from the graphical representations. Heuristic mutation seems to produce the best results.

4.2 Personal mutation operator

The mutation operator I proposed generates a binary tree based on the original representation. Then, the result given is computed by doing a Depth First Search from the root node.

5 Conclusion

Finally, this was a very interesting problem to tackle that produced results that were unexpected for me based on the operators used. Basically some combinations of operators seem to produce extremely stale graphs while others quite the contrary. I will end stating the best result that I got on this problem, a distance of 6503 with the following order: (27, 0, 18, 9, 4, 16, 20, 11, 12, 26, 2, 1, 10, 5, 15, 22, 19, 23, 6, 7, 13, 24, 21, 25, 17, 8, 3, 14). This was achieved using Truncation selection, My personal crossover method and Heuristic mutation.

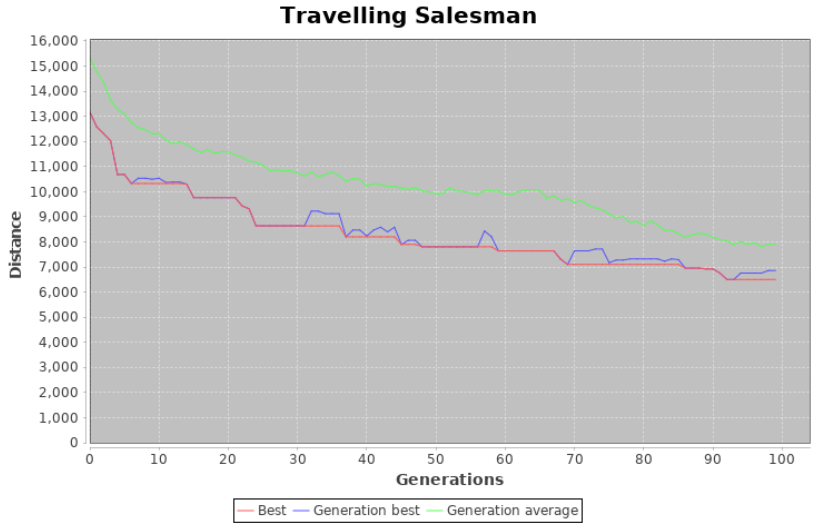

Figure 12: Truncation selection +Personal cross+ Heuristic mutation