

IT3708 Homework 2: Evolutionary Algorithms and the Traveling Salesman Problem

Purpose: Gain experience with a variety of EA representations and genetic operators for solving the same general problem in many different ways.

1 Assignment

Enhance the evolutionary algorithm that you wrote for assignment 1 so that it can solve the Traveling Salesman Problem (TSP) using three different genotypic representations:

1. A direct encoding of the tour as a permutation of integers. Goldberg's Partially-Mapped Crossover (PMX) should be used for recombination, while simple integer swaps suffice for mutation.
2. An indirect encoding wherein a bit-vector genotype is converted into a list of integers (i_1, i_2, \dots) , where $i_k = m$ implies that the k th city in the tour should be the m th city in the list of remaining cities. Here, standard bit mutation and bit-vector crossover work fine.
3. Another direct encoding as integers, but in this case, use Whitley et. al's Edge Recombination Operator (ERO) during crossover.

Each of these representations is detailed in section 3 of the compendium chapter ea-apps.pdf.

For each representation, run it on at least two of the TSP datasets at site www.tsp.gatech.edu/world/countries.html. It is perfectly acceptable to use the smaller data sets, such as *Western Sahara* and *Djibouti*.

For each run, plot the best and average fitness as a function of generation number. Include these plots in your report. Each case should be run for at least 200 generations with a population of at least 500 individuals. For larger data sets, a few thousand generations are advisable.

Your system must be set up so that all 6 (or more) cases can be run without any recompilation of code. The system should take the index or name of a TSP problem set and the representation type as inputs and produce the fitness graph and any other informative outputs.

2 Deliverables

1. A high-level description of the code for each of the three representations. This description should stress the modularity and generality of your code, indicating how your basic EA handles all three representations with only small modular code additions required for each approach.
2. Fitness plots for each run.
3. For each TSP data set, compare the behavior of the three different representations. In cases where one approach seems to work better, try to explain why. Does your data indicate that ERO beats PMX and indirect coding? Explain.
4. General conclusions about the use of EAs on TSPs.

Your report should be around 5-10 pages long.