ECE 492: Artificial Intelligence Methods ----- Summer 2023

Project 4: Applying Evolutionary Computing in Salesman Traveling Problem

Background Story

The first time I knew evolutionary computing is back to 2003. I took a neural network class, and at the last week of that semester, the professor introduced the genetic algorithm (GA) to us. He said, this may be "the least math but the most powerful" approach. For me, GA was just a name by then.

The second time I met GA was back to 2009, when I worked on my Ph.D. dissertation. I had an optimization problem need to address. This problem is using weather radar to study hydrometeor's microphysics properties: including their species, temperature, back radar cross section (RCS), melting ratio, size, shape, dielectric constant, …. All these factors are related to each other. Changing any factors, other variables will change. It is a chain affect, and different combinations could show an identical outcome. I stuck there for a while, and I thought I will never graduate, until one day someone suggested me to use Maltab GA toolbox. The problem was solved (till today, I still don't quite understand the microphysics properties, but anyway, I am an engineer not a meteorologist, so I can forgive myself), and I got my degree. For me, GA is a toolbox by then.

The third time I studied GA is in 2018 summer. That summer, I did not teach, but focus on a research topic, again, another optimization problem: using dual-frequency dual-polarization radar to retrieve rain drop size distribution (DSD). I have a very unique data set, I also have a very good retrieval model (at least I think it looks very "science" and "technology"). I tried a lot of traditional optimization approach, including: Gauss-Newton algorithm, QR decomposition, gradient methods, etc. However, the results are not always as I expected. It easily converges at some "local minimum", no matter how hard I tune the settings. But, what I wanted is the "global minimum". Finally, I remembered my old friend, GA. So, I decide to use GA toolbox again. Unfortunately, the Matlab license SIUE purchased does not include the optimization toolbox. I need to pay extra money to get the toolbox. For a low-income family guy with two kids like me, this is impossible. I am not going to pay that extra money. This made me decide giving up "lazy", but study Evolutionary Computing. After few weeks struggle, I wrote my GA toolbox. I really enjoy studying this fun approach. Sometimes, it even makes me think about some philosophy issues: is human really becoming better and better? what is the "best" population? ….

Project:

1.) Please watch the lecture video from "self-organizing maps" to know what is "the salesman traveling problem".

2.) Please load the Uruguay map (yu734.dat). The data is uploaded on BB. There are 734 cities in the map. You can only choose first 50 cities in this project to save the computation cost.
3.) Find the best route, which gives you the shortest total travel distance.
4.) In your evolutionary computing code,
    a.) please use permutation representation.
    b.) Please use Partially Mapped Crossover (PMX) in the recombination
    c.) Please use three mutation approaches: swap, insert, scramble. For one child, you should have three output, after mutation.
5.) Please play around all of your settings, and get the best route.
6.) In the presentation, please generate a short movie to demonstrate your optimization procedure. How your algorithm finalizes the best routine. (Please refer to the code I used in my video)

Delivery:
A concise report includes: source code, plots, and simple discussion.

Report Due: 06/30/2023
Presentation Due: 07/01/2023

Basic requirements for this project:
1.) Do your work, don't seek helps from your siblings, friends….. (They don't pay the tuition, I don't want them having this expensive fun).
2.) If you have questions, ASK ME. It is FREE. Again, ask me.
3.) Have fun. It is a very interesting project. It gave me the same happiness as playing video game when I did this project. I want you guys have the same fun.