Cairo University
Faculty of Computers and Artificial Intelligence

Term Research Project

Department: Operations Research and Decision Support
Course Name: Computational Intelligence **Due Date: May 20th, 2023**
Course Code: DS313/DS351
Instructor: Assoc. Prof. Ayman Ghoneim

General Instructions to Students

- This term *research project* is a part of the term work.
- This is a *group* project for *up to* four students per group. Each group is assigned *its topic and solution algorithm as stated below, and must attempt its assigned topic only.*
- The *only* programming language allowed to be used in the research project is Python.
- Due date is May 20th 2023 and Submission procedure and discussions will be announced later.
- For the submitted deliverables, see the end of the document.
- For each topic, it will be stated clearly what implementation is required and/or what should be included in the report.
- *Assessment* will be on the report documentation and code implementation submitted based on the following criteria:
  - The correctness of the algorithms employed and implementation.
  - The quality/comprehensiveness of your experiments & documentation.
  - The correctness of your analysis.
- ***Academic Integrity:*** You can only submit your own work. Any student/group suspected of plagiarism will be subject to the procedures set out in by the Faculty/University (including failing the course entirely). Examples of behaviour that is not allowed are:
  - Copying all or part of someone else's work and submitting it as your own;
  - Giving another student in the class a copy of your work; and
  - Copying parts from the internet, text books, etc.

List of Topics:

0. Meal (diet) selection.
1. Resource Management / Assignment (e.g., students to schools, crews to timeslots, tasks to machines).
2. Portfolio / Wealth optimization.
3. Service/facility allocation to locations (e.g., cell phone towers, hospitals, wind turbines).
4. Supply chains and Inventory control.
5. Routing (e.g., buses, trucks).

List of Algorithms:

0. Genetic Algorithm.
1. Differential Evolution
2. Particle swarm optimization.

Topic and Algorithm Assignment:

The group's topic number is the sum of the IDs of its members modulo (6). For example, for the following three IDs 20200111 + 20200112 + 2020113 = 60,600,336 mod (6) is 0 and the topic will be Meal (Diet) Selection. The group's algorithm number is the sum of the IDs of its members modulo (3). For example, 60,600,336 mod (3) is 0 and the algorithm is Genetic algorithm.

Requirements

Given your assigned topic and algorithm, you are required to:

A) Learn about linear and/or nonlinear mathematical formulations for your topic and/or how CI algorithms are used to solve it through internet search (proper journal and conference publications). Write a summary of at least three papers (no less than 2000 words). The references you used in your search must be mentioned.

B) Based on your search, choose a mathematical model for your topic and write down in details the objective function and the type of constraints you will consider.

C) Write a code implementation for your assigned algorithm to solve the formulation you considered for your assigned topic. In your report documentation, discuss the following:

- The encoding, operators, and constraint handling technique you considered. Justify your choices.
- The logical flow of your program (you may use a flow chart).
- The algorithm parameters you considered. Justify your choices.
- Present the results of your implementation using three examples with different sizes of the problem.

Assessment Note:

If you consider a simple model (small number of decision variables and constraints), then you will lose marks. The more detailed your model is in terms of the type of constraints considered, the more you will get marks.

Deliverables

One compressed file which must include a report documentation (Word or PDF file) and Python code implementation files, following the below details.

- Report documentation including:
  - Cover Sheet: Includes the CU and FCAI logos, course code, course name, problem title, group members (name and ID).
  - Table of Contents
  - Each requirement in the problem. Your report must be organized following the same organization of requirements stated here in the document.
  - List of References.

- Code Implementation files. The code file can be included in a folder if you are using input files or submitting a code version for each example.

Good Luck ☺