# CS 451 – Computational Intelligence
Spring' 2023
Assignment # 2 –Swarm Intelligence

Objective:

The assignment focuses on swarm intelligence and provides students hands-on with Ant Colony optimization (ACO) and Particle Swarm Optimization (PSO) techniques to solve complex optimization problems.

Q-1 – Capacitated Vehicle Routing using ACO [25 Points]

Vehicle routing problem (VRP) is a combinatorial optimization problem which asks "What is the optimal set of routes for a fleet of vehicles to traverse in order to deliver to a given set of customers?".
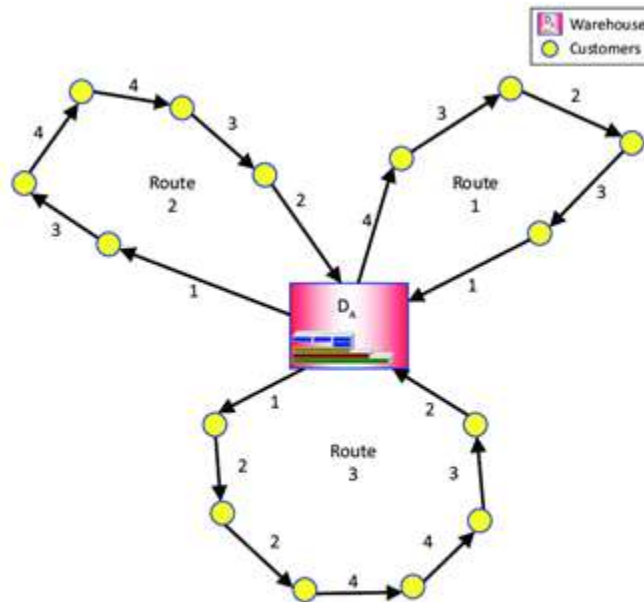
In this question, you will implement Ant Colony Optimization (ACO) technique to solve the capacitated vehicle routing problem. The problem instances to test your implementation are attached with the assignment (instances_CVRP.zip).

You can start with the following values for different parameters (α, β,γ, No. of ants) and are required to fine-tune these values to come up with the best set of parameters for the given problem:

- α: 2
- β: 2
- γ: 0.5

- No. of ants: 10

You also need to plot the following graphs to show the behavior of your implementation during the optimization process:

- Iteration vs best fitness so far
- Iteration vs avg fitness so far

You can take help from the following online resources to understand the problem and its formulation. However, once understood, you have to implement it entirely on your own.

- [Solving Vehicle Routing Problem using Ant Colony Optimization](#)
- [Solving Vehicle Routing Problem with ACO](#)

Submission:

Along with the code, you will also submit a report outlining your problem formulation and best solutions achieved for given problem instances with their graphical visualization.

Q-2 – Visualizing Swarms [25 Points]

Build a simulation of any of the following swarm algorithms (preferably in [Processing language](#)):

- Ant Clustering
- Particle Swarm Optimization
- Particle System

The simulation should allow you to set different parameter values and see their impact on algorithm behavior. Some sample simulations are available at:

- [Simulation of different nature inspired algorithms](#)
- [XnaBoids - Swarm Intelligence Demonstration](#)
- [Ants Colony Simulation AI game experiment](#)
- [Dust Simulation](#)
- [Realtime Particle based 3D Fluid Simulation](#)

Rubric:

Implementation *Correct implementation of the algorithm*	35%
Simulation *Quality of visualization, Innovation, Intuitiveness, Design/Art/Aesthetics*	45%
Interactivity *Interacting with the environment, manipulating environment, adjusting parameters to see their impact in simulation*	20%

Submission: You will submit your code and a pdf report containing your concept behind simulation and your problem formulation. The report will also contain a link to your simulation video uploaded on youtube.