

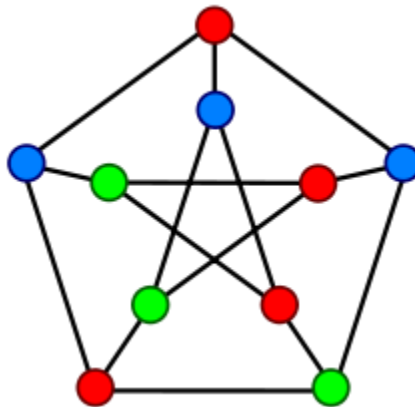
CS 451 – Computational Intelligence
Spring' 2024
Assignment # 2 –Swarm Intelligence

Objective:

This assignment provides students with hands-on experience using various swarm-based techniques to solve complex optimization problems. The students will also build a simulation/visualization of a selected swarm-based technique to gain a good understanding of how they work and how different parameters affect the performance of the swarm.

Q-1 – Coloring Graphs using ACO [25 Points]

Graph coloring is a classic problem in Computer Science in which you are required to color the vertices of a graph (vertex coloring) with minimum colors such that no two adjacent vertices are of same color (as shown in the image below).



In this question, you will implement Ant-Colony Optimization (ACO) technique to solve the vertex-coloring problem. Several problem instances are available [here](#) from where you can download the data file (*queen11_11.col* and *le450-15b.col*) for your testing.

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

- α : 0.8
- β : 0.8
- γ : 0.8
- No. of ants: 20

You also need to plot a graph to show the behavior of your implementation during the optimization process in terms of:

- Iteration vs Best fitness so far
- Iteration vs avg fitness so so far

The grading will be based on the following components:

Problem Formulation <i>Properly formulating ACO to address Graph coloring problem</i>	25%
Implementation <i>Correct implementation of the algorithm and the proposed formulation</i>	40%
Results <i>Fine-tuning of parameters, Convergence behavior, Final outcome, Graph plotting</i>	15%
Report <i>Quality of Writing, Clarity</i>	20%

Submission:

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

Q-2 – Visualizing Swarms [25 Points]

Swarm exhibits interesting and, in many cases, aesthetically pleasing behavior. You are required to build a simulation of any of the following swarm algorithms (preferably in [Processing language](#)):

- Particle Swarm Optimization
- Particle Systems
- Ant Clustering

The simulation should allow you to set different parameter values and see their impact on algorithm execution and its 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 <i>Correct implementation of the algorithm</i>	25%
Simulation <i>Quality of visualization, Innovation, Intuitiveness, Design/Art/Aesthetics</i>	50%
Interactivity <i>Interacting with the environment, manipulating environment, adjusting parameters to see their impact in simulation</i>	25%

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