**Q2**

**What is metaheuristic optimization?**

Metaheuristic optimization makes use of metaheuristic algorithms to solve an optimization problem. Optimization problems are minimization or maximization problems that use first or second derivative; however, for nonlinear, multimodal, multivariate, discontinuous functions obtaining a derivative is not possible. This is when metaheuristic optimization is used. Metaheuristic optimization concerns more generalized, nonlinear optimization problems.

Famous examples of metaheuristic optimization problems include:

* Hill climbing
* Simulated Annealing
* Population-based algorithms such as Particle Swarm Optimization

In modern literature, metaheuristic refers to algorithms that contain stochastic components. Metaheuristic algorithms use the idea of heuristic, i.e., find or discover by trial and error, to land on a solution that is in most cases but not guaranteed to be a global optimum. Metaheuristic algorithms use the two components, exploitation, and exploration, i.e., they create a balance between exploring the search space on a global scale and focusing the search in a local region, knowing that a current good solution is found in this region.

1. **What are the situations in which gradient-based optimization techniques do not work?**

Some of the examples of the problem on which optimization techniques do not work are:-

* Combinatorial Problem
* Traveling Salesman Problem
* Graph Coloring Problem
* Knapsack Problem

1. **Briefly explain anyone swarm based algorithm that we have NOT discussed in the class.**

The Firefly Algorithm (FA):

Firefly Algorithm was developed in 2008 and is based on the flashing patterns and behavior of fireflies. Few principles that the FA algorithms follow are:

* One firefly will mate with another irrespective of its gender as they are unisex.
* The attractiveness is directly proportional to the brightness of the fireflies. As the distance between two fireflies increases there brightness diminishes, and so does their attractiveness. Hence, for any two flashing fireflies, the brighter firefly will attract the other one. If neither one is brighter, then a random move is performed.
* The brightness of a firefly is determined by the landscape of the objective function.