MB University of M'sila
Faculty of MI
Department of Computer Science
Master 2 IDO

Optimization Methods
Normal session exam January 2026
Duration : 2 hours

Exercise 1 (Course questions / 04 points)

1) **List the genetic operators of a genetic algorithm.**
2) **What does a solution represent in each of the metaheuristic GP, ACO, BCO, PSO.**
3) **In the ACO algorithm, what happens if we take $\alpha = 0$?**
4) **What is the purpose of velocity in the PSO algorithm?**
5) **What do pbest and gbest represent in PSO algorithm?**
6) **How does BCO balance exploration and exploitation?**

Exercise 2 (06 points)

We consider the ACO algorithm for solving symmetric TSP with the input n = 4 cities A, B, C, D such as: AB=6, AC=3, AD=2, BC= 8. BD=4, CD=5 and the following parameter configuration: Q = 10, α=1, β=1, τ_0=1, ρ = 0.8, m= 4 ants.

1) **Assume that the ant 1 starts from city A. Compute the probability to move to each of the remaining cities.**
2) **To select the next city using roulette method, this ant draws the random number r = 0.76. Determine the next city chosen by this ant.**
3) **Assume that this ant builds the tour ADBC. Compute the length of this tour. Compute the new amounts of pheromone on each edge. (i.e. the matrix τ) write the algorithm that update the matrix τ.**

Exercise 3 (10 points)

Consider a combinatorial optimization problem whose solution is a string of n letters from the set { A , T , C , G }. Example with n = 7: s = (TCTATCC) is a candidate solution.

1) **Give another candidate solution x with n = 7 of your choice. Determine the search space then calculate its size in terms of n. Write the algorithm for creating a random population P of m individuals.**
2) **Give two children obtained by a crossover of the two parents s and x on a one-point of your choice. Write the one-point crossover algorithm for the entire population P with probability pc.**
3) **Consider the mutation operator that consists of exchanging two random adjacent letters of a solution.**
   - **Give the individual obtained by a mutation of s.**
   - **Write the mutation algorithm for the entire population P with probability pm.**
4) **The Hamming distance between two solutions is defined as the number of positions at which the corresponding letters are different. Example the hamming distance between s and TCTCTGC is: Hamming (s, TCTCTGC) = 2. Write the evaluation algorithm that consists to minimize Hamming (s,y).**