1. Metaheuristics (NIVEAU I)

Given the complete undirected graph $G = (V, E)$ for a set of $V$ of vertices, and a function $w : E \mapsto \mathbb{R}^+$ that assigns a positive weight to each edge. The Traveling Salesman Problem (TSP) is to find a cyclic path in $G$ that contains each vertex in $V$ exactly once and has minimal total weight.

(a) Describe a brute force algorithm for solving the TSP.

(b) Describe several heuristics to approximate the TSP. Use at least the following techniques:

- Iterated local search.
- Simulated annealing.
- Ant colony optimization.
- Evolutionary computing.

You may also evolve your own ideas.

(c) How can the TSP be formulated as ILP?

2. SAT Problem (NIVEAU I)

The pigeon-hole SAT problem expresses the problem of finding a way to place $n$ pigeons in $n - 1$ pigeon-holes such that no hole contains more than one pigeon. Obviously, this problem is unsatisfiable.

- Model the Pigeon-hole SAT problem. (See script: Literals, clauses, clause-sets)

3. IP (NIVEAU II)

Given variables $x_1, ..., x_n \in \{0, 1, \ldots m\}$

model in IP: $|x_i - x_j| \geq 2, \forall i \neq j.$