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Discrete Mathematics for Bioinformatics (P1)

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Exercises 12 (Optional)

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 $x_1, ..., x_n \in \{0, 1, ...m\}$
   model in IP: $|x_i - x_j| \geq 2, \forall i \neq j$.