4 - Complexity and the need for metaheuristics, exploration versus Exploitation

Complexity classes:

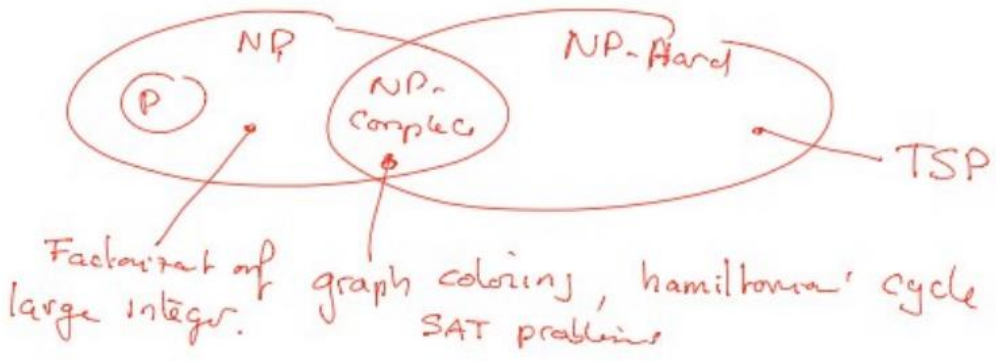
Class P : There is an algorithme that solves the problem in a polynomial time $T(n) = O(n^m)$

Class NP : Problems for which a solution can be checked in a polynomial time.

Thus $P \subseteq NP$

Class NP-hard : Those are problems whose solution can be used to solve any NP problem up to a polynomial additional time.

Class NP-Complete Are problems that are both in NP and in NP-hard.



Typically, NP-hard and NP-complete problems can be solved by exponential algorithms

Example:

Hamilton cycle: find a graph that goes through all nodes once and only once can use TSP to be solved.

Exploration vs exploitation:

In all cases, a metaheuristic traverses the search space trying to combine two actions: intensification and diversification, also called exploitation and exploration respectively

- ➔ (exploitation) intensification phase the search explores the neighbourhood of an already promising solution in the search space
- ➔ (exploration) diversification a metaheuristic tries to visit regions of the search space not already seen