

Practical Work 1

Problem Modeling

The Knapsack problem is a classic optimization challenge in computer science. It involves selecting items to maximize value while staying within a weight limit.

Instance: Let X be a set of n items $X=\{I_1, I_2, \dots, I_n\}$, each Item I_i has a value v_i and a weight w_i . W is the total knapsack capacity to not exceed.

Question: What are the items to take (put in the knapsack) to maximize its total value with respect to the total weight constraint ?

Example:

$W = 50$ Kg

Items	Item ₁	Item ₂	Item ₃	Item ₄	Item ₅	Item ₆	Item ₇	Item ₈
Value	5	10	6	18	12	20	10	13
Weight	20	5	16	32	8	4	21	19
Solution 1	0	1	0	1	1	1	0	0
Solution 2	1	0	1	1	0	0	1	0

Solution 1: valid solution

Total value = $10+18+12+20 = 60$

Total weight = $5+32+8+4 = 49 \leq W$

Solution 2: invalid solution

Total value = $5+6+18+10 = 39$

Total weight = $20+16+32+21 = 89 > W$

Modeling a problem means describing it in a scientific manner, translating a statement from everyday language into a formal representation. To achieve this, it is essential to thoroughly understand the problem and identify its variables or unknowns.

In metaheuristics, modeling an optimization problem mainly involves defining:

- **Solution:** The structure of a solution for a given problem.
- **Evaluation:** A method to assess the quality of a given solution.

To Do :

Thus, you are required to propose an appropriate modeling of the knapsack Problem. This modeling includes:

- Generating a random instance of the problem.
- Modeling a solution to the problem.
- Verifying the validity of a solution.
- Evaluating a solution.

Have fun!