Knapsack Problem Formulation

Objective

Maximize the total value of the items packed in the knapsack.

$$\text{Maximize} \quad Z = \sum_{k=1}^{K} \text{Value}_k \cdot x_k$$

Constraints

$$\sum_{k=1}^{K} \text{Size}_k \cdot x_k \leq C \qquad \text{(Total size constraint)} \quad (1)$$

$$x_k \in \{0, 1\} \quad \forall k \in \{1, 2, \ldots, K\} \qquad \text{(Binary decision for each item)} \quad (2)$$

$$C \geq 0 \qquad \text{(Non-negative knapsack capacity)} \quad (3)$$

$$\text{Size}_k \geq 0 \quad \forall k \in \{1, 2, \ldots, K\} \qquad \text{(Non-negative size for each item)} \quad (4)$$

$$\text{Value}_k \geq 0 \quad \forall k \in \{1, 2, \ldots, K\} \qquad \text{(Non-negative value for each item)} \quad (5)$$

Parameters

- C: Total Capacity of the Knapsack (constant)
- Value_k: Value of item k (array of size K)
- Size_k: Size of item k (array of size K)