

Linear and Integer Programming vs Linear Integration and Counting

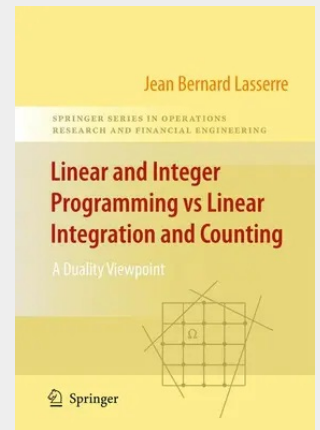
A Duality Viewpoint

Integer programming (IP) is a fascinating topic. Indeed, while linear programming (LP), its continuous analogue, is well understood and extremely efficient LP software packages exist, solving an integer program can remain a formidable challenge, even for some small size problems. For instance, the following small (5-variable) IP problem (called the unbounded knapsack problem) $\min\{213x_1 + 1928x_2 + 11111x_3 + 2345x_4 + 9123x_5 \mid 1 \leq x_i \leq 5, 1 \leq i \leq 5, 12223x_1 + 12224x_2 + 36674x_3 + 61119x_4 + 85569x_5 = 89643482, 1 \leq x_i \leq 5, x_i \in \mathbb{N}, 1 \leq i \leq 5\}$ taken from a list of difficult knapsack problems in Aardal and Lenstra [2], is not solved even by hours of computing, using for instance the last version of the efficient software package CPLEX.

However, this is not a book on integer programming, as very good ones on this topic already exist. For standard references on the theory and practice of integer programming, the interested reader is referred to, e.g., Nemhauser and Wolsey [113], Schrijver [121], Wolsey [136], and the more recent Bertsimas and Weismantel [21]. On the other hand, this book could provide a complement to the above books as it develops a rather unusual viewpoint.

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