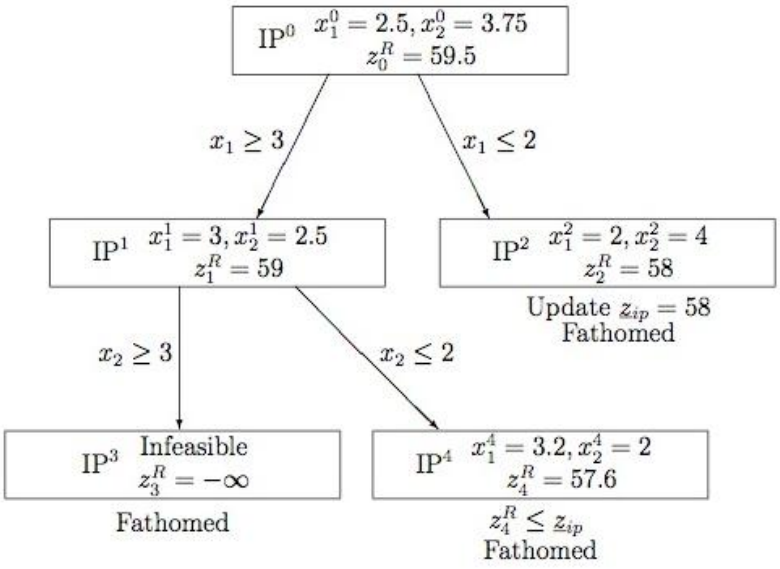
Exercício 1

$$\begin{array}{lrcl} \text{maximize} & 13x_1 + 8x_2 & & \\ \text{subject to} & x_1 + 2x_2 & \leq & 10 \\ & 5x_1 + 2x_2 & \leq & 20 \qquad (\text{IP}^0) \\ & x_1 \geq 0,\ x_2 \geq 0 & & \\ & x_1,\ x_2 \text{ integer} & & \end{array}$$



Exercício 2: Knapsack problem

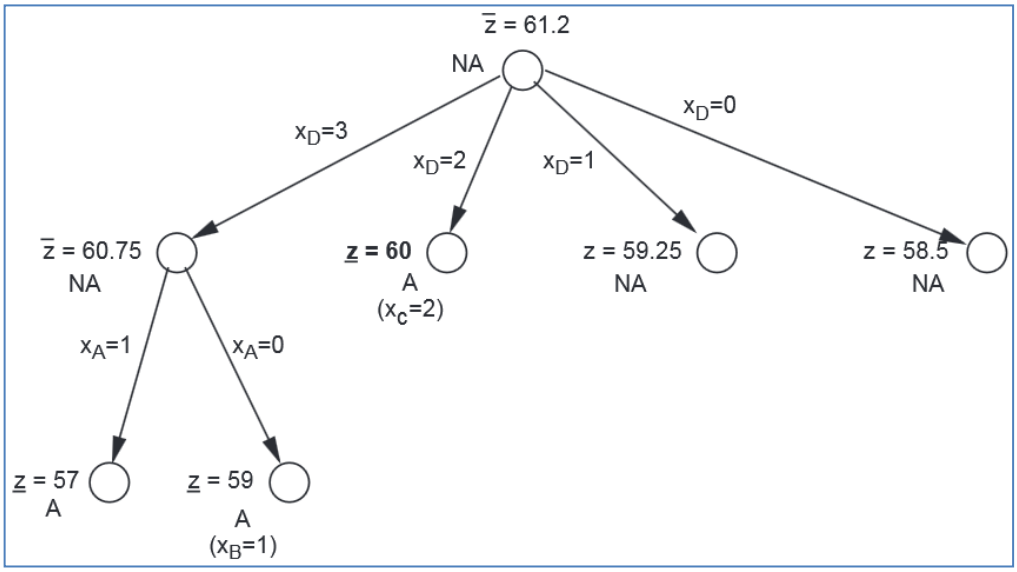
A cargo plane has a cargo capacity of 18 volume units. He must carry freight containers in order to maximize the total value of his cargo. The available containers are in unlimited quantity for each type:

- Container A, value 6, volume 2;
- Container B, value 8, volume 3;
- Container C, value 13, volume 4;
- Container D, value 17, volume 5;
- Container E, value 20, volume 7.

At first, we will solve the problem using a greedy algorithm. Then we will determine the optimal solution by a Branch & Bound procedure.

The mathematical modeling of the problem is the following system: max $z=6*x_A+8*x_B+13*x_C+17*x_D+20*x_E$, s.t $2*x_A+3*x_B+4*x_C+5*x_D+7*x_E \leq 18$ with x_i the number of container of type i.

Iteration	Level	Added constraint	Solution type	Solution Value	XA	XB	XC	XD	XE
			Optimal	60	0	0	2	2	0
1	0		NONinteger	61,2	0	0	0	3,6	0
2	1	X4 ≤ 3	NONinteger	60,75	0	0	0,74999	3	0
3	2	X3 ≤ 0	NONinteger	60	1,5	0	0	3	0
4	3	X1 ≤ 1	NONinteger	59,85714	1	0	0	3	0,1428571
5	4	X5 ≤ 0	NONinteger	59,66667	1	0,33333	0	3	0
6	5	X2 ≤ 0	INTEGER	57	1	0	0	3	0
7	5	X2 ≥ 1	INTEGER	59	0	1	0	3	0
8	4	X5 ≥ 1	Suboptimal	57,4	0	0	0	2,2	0,99999
9	3	X1 ≥ 2	NONinteger	59,6	2	0	0	2,8	0
10	4	X4 ≤ 2	Suboptimal	58	4	0	0	2	0
11	4	X4 ≥ 3	Infeasible						
12	2	X3 ≥ 1	NONinteger	60,6	0	0	1	2,8	0
13	3	X4 ≤ 2	INTEGER	60	0	0	2	2	0
14	3	X4 ≥ 3	Infeasible						
15	1	X4 ≥ 4	Infeasible						



Exercício 3

Max $10x_1 + 9x_2 + 7x_3 + 5x_4 + 2x_5 + 1x_6$

s.a: $1x_1 - 2x_2 + 2x_3 + 1x_4 - 2x_5 + 1x_6 \leq 1$

$2x_1 + 1x_2 - 2x_3 - 1x_4 + 1x_5 + 2x_6 \leq 2$

$3x_1 + 2x_2 - 1x_3 + 3x_4 - 4x_5 + 1x_6 \leq 2$

$x_1, x_2, x_3, x_4, x_5, x_6 \in \{0,1\}$

Iteration	Level	Added constraint	Solution type	Solution Value	X1	X2	X3	X4	X5	X6
			Optimal	28	1	1	1	0	1	0
1	0		NONinteger	31,33333	1	1	1	0,66667	1	0
2	1	X4 ≤ 0	INTEGER	28	1	1	1	0	1	0
3	1	X4 ≥ 1	NONinteger	29,66667	0,66666	1	1	1	1	0
4	2	X1 ≤ 0	Suboptimal	24	0	1	1	1	1	1
5	2	X1 ≥ 1	NONinteger	28,5	1	0,500001	1	0,99996	0,99996	0
6	3	X2 ≤ 0	Suboptimal	20,5	1	0	0,499999	0,99996	0,99996	0
7	3	X2 ≥ 1	Infeasible							

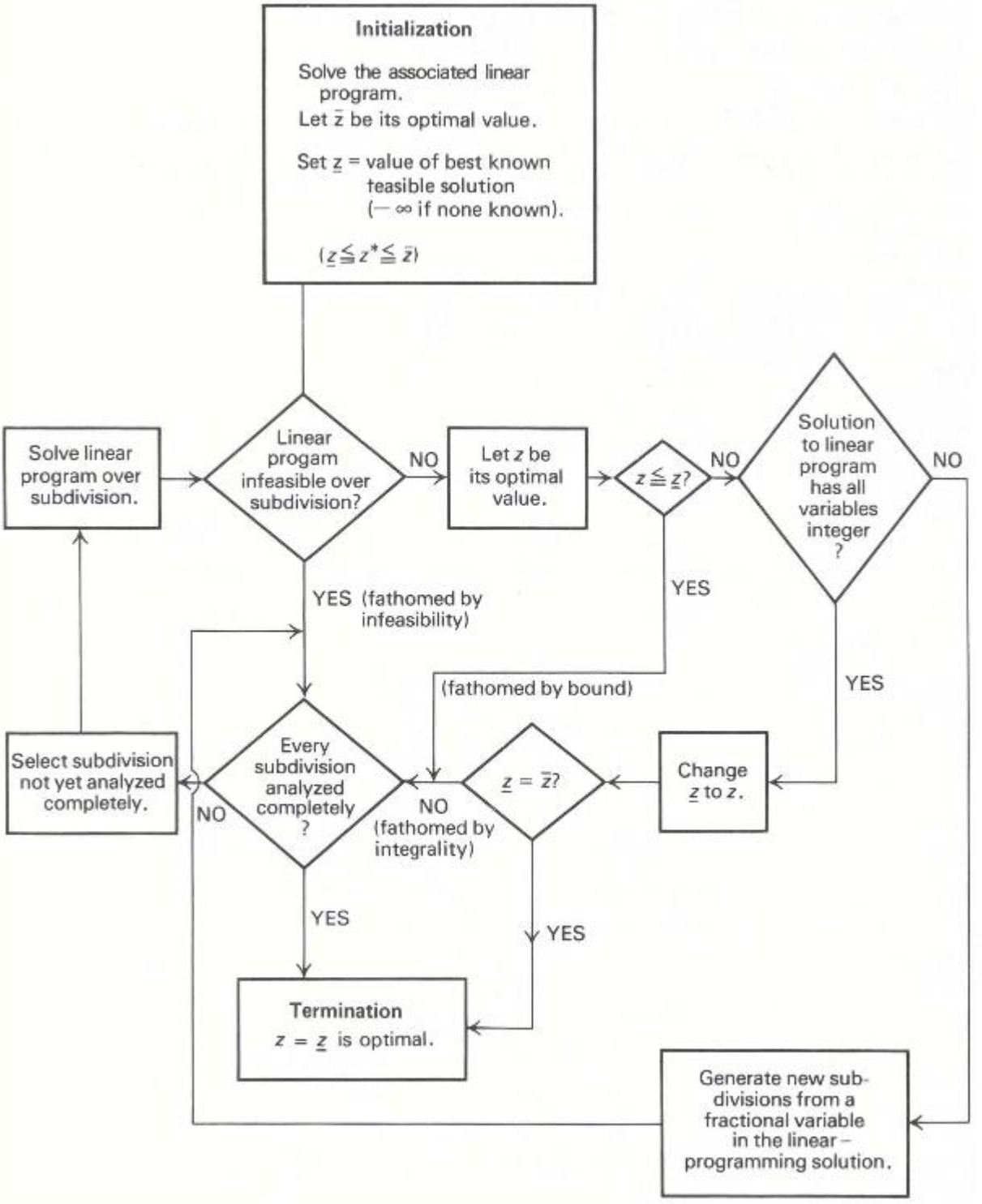


Figure 9.17 Branch-and-bound for integer-programming maximization.

http://web.mit.edu/15.053/www/AMP-Chapter-09.pdf