An example KNAPSACK PROBLEM.
(Horowitz and Sahni, 1978)

Vectors are sorted by Profit/Weight Ratio.

P = Profit
W = Weight
P/W = Profit/Weight Ratio
Cap = Capacity

```
  P = 11,   21,   31,   33,  43,   53,   55,   65
  W =  1,   11,   21,   23,  33,   43,   45,   55
P/W = 11, 1.91, 1.47, 1.43, 1.3, 1.23, 1.22, 1.18
Cap = 110
```

In the ZERO-ONE KNAPSACK PROBLEM.
Each object is selected or not selected.
The selection (solution) vector, Y, is binary (zero-one).

```
Y =  1,   1,    1,    0,   1,    1,    0,    0
Total Weight of Y:  109
Total Profit of Y:  159
```

A Greedy Solution: (Take the next object with the best profit/weight ratio)

```
Y =  1,   1,    1,    1,   1,    0,    0,    0
Total Weight of Y:  89
Total Profit of Y:  139
```

The FRACTIONAL KNAPSACK PROBLEM:

You may pick fractional pieces of objects to place in the knapsack. The selection (solution) vector, K, can have fractional values ranging from zero to one.

This has an easy (Polynomial) greedy solution:

```
  K =   1,  1,   1,   1,   1,   0.48837209,   0,  0
K*W =   1,  11,  21,  23, 33,  21,             0,  0

  Weight of K:   89 + 21 = 110

  Profit of K:  139 + 25.88 = 164.88
```

The INTEGER KNAPSACK PROBLEM:

You may pick integer numbers of objects to place in the knapsack.

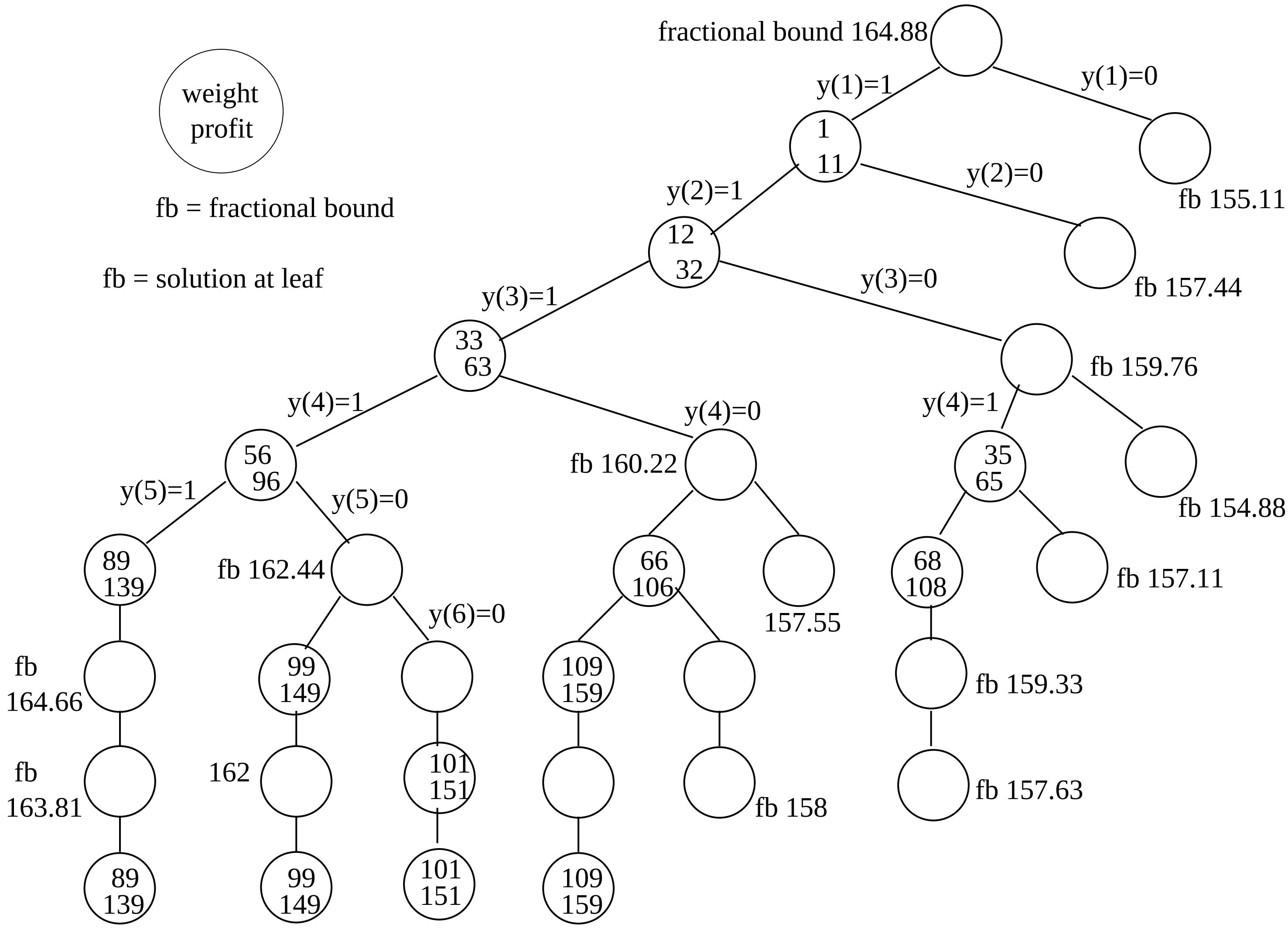
```
Z =  110,  0,  0,  0,  0,  0,  0,  0
```

This is optimal in this case. (This problem is more interesting when the weight vector is not integers.)

UPPER AND LOWER BOUNDS

The solution to the Fractional Knapsack Problems provides an Upper Bound for the Zero-One Knapsack Problem: you can do no better than this.

The Greedy Solution to the Zero-One Knapsack Problem provides an initial Lower Bound: you must do better than this to be competitive. The best-so-far solution is also a lower bound.



A Zero-One Knapsack Example