Fractional Knapsack Problem

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Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>

The capacity of knapsack W=60. Find the solution to the fractional knapsack problem using greedy method

Fractional Knapsack Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the fractional knapsack problem.

ITEM	w_i	v_i
I1	5	30
I2	10	20
I3	20	100
I4	30	90
I5	40	160

Fractional Knapsack Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the fractional knapsack problem.

ITEM	w_i	v_i	$P_i = v_i / w_i$ Value per weight
I1	5	30	6
I2	10	20	2
I3	20	100	5
I4	30	90	3
I5	40	160	4

Fractional Knapsack Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the fractional knapsack problem.

In the sorted order of p_i

ITEM	w_i	v_i	$P_i = v_i / w_i$ Value per weight
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

Fractional Knapsack Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
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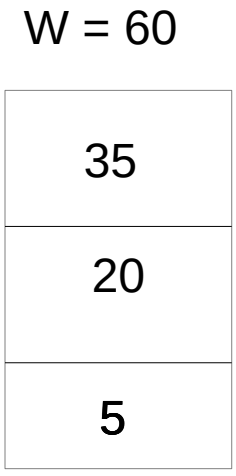
The capacity of knapsack W=60. Find the solution to the fractional knapsack problem.

ITEM	w_i	v_i	$P_i = v_i / w_i$ Value per weight
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

Filling the knapsack,
I1 + I3 + I5
Weight = 5+20+35 =60
Value = 30+100+35*4
= 30+100+140=270



0-1 Knapsack Problem

0-1 Knapsack Problem

Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>

The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem using branch & bound method

0-1 Knapsack Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem.

ITEM	w_i	v_i
I1	5	30
I2	10	20
I3	20	100
I4	30	90
I5	40	160

0-1 Knapsack Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
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The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem.

ITEM	w_i	v_i	$P_i = v_i / w_i$ Value per weight
I1	5	30	6
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I3	20	100	5
I4	30	90	3
I5	40	160	4

0-1 Knapsack Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem.

In the sorted order of p_i

ITEM	w_i	v_i	$P_i = v_i / w_i$ Value per weight
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

0-1 Knapsack Problem

Consider 5 items along their respective weights and values
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I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

What will be the answer?

0-1 Knapsack Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem.

ITEM	w_i	v_i	$P_i = v_i / w_i$ Value per weight
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

What will be the answer?

I = <I1,I2,I3,I4,I5>
Final solution=<0,0,1,0,1>

0-1 Knapsack Problem

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem.

Step 1: Calculate the upper bound (ub) using fractional knapsack

ITEM	w_i	v_i	$P_i = v_i / w_i$ Value per weight
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

Filling the knapsack,
I1 + I3 + I5
Weight = 5+20+35 =60
Value = 30+100+35*4
= 30+100+140=270

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

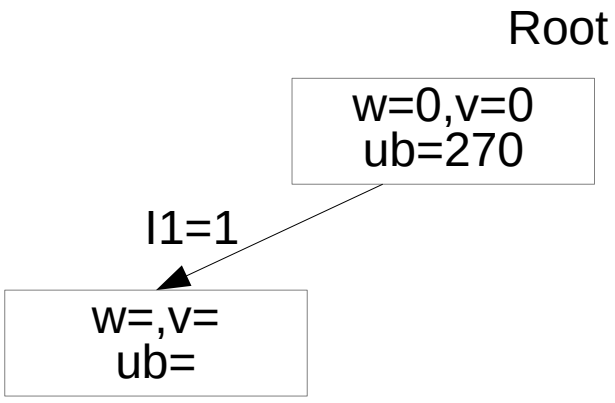
ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

Root

w=0,v=0
ub=270

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



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I = <I1,I2,I3,I4,I5>
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The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

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I1	5	30	6
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I4	30	90	3
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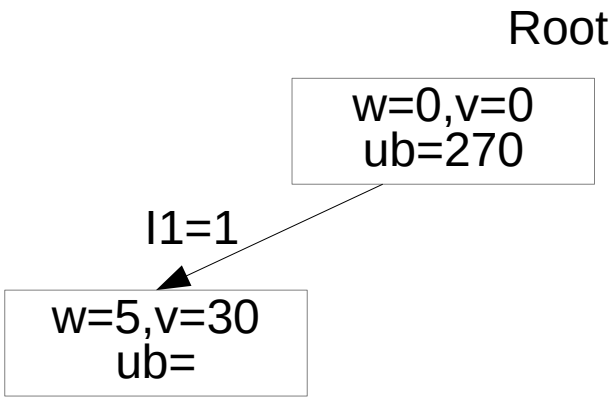

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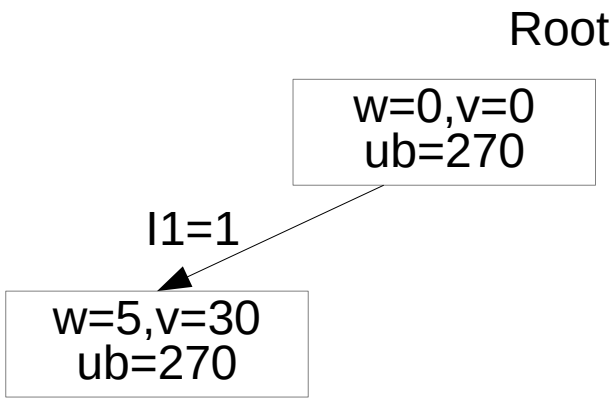
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

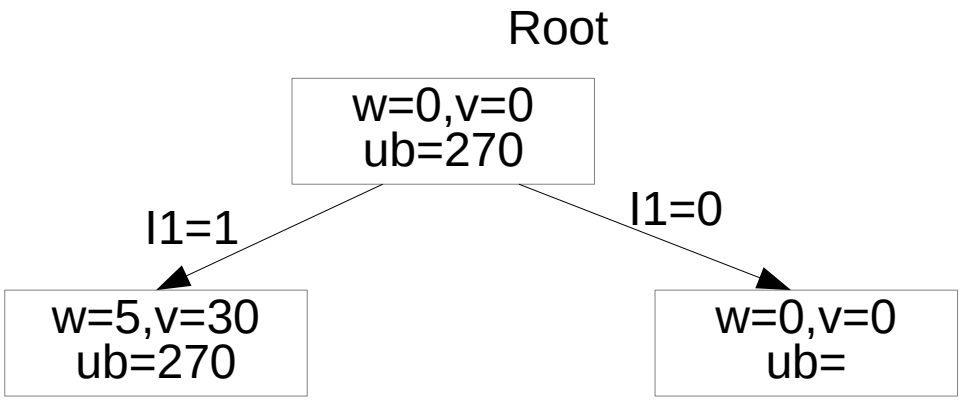
ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



Calculate ub
I1 + I3 + I5
Weight = 5+20+35 =60
Value = 30+100+35*4
= 30+100+140=270

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



Calculate ub
I1 + I3 + I5
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Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
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The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
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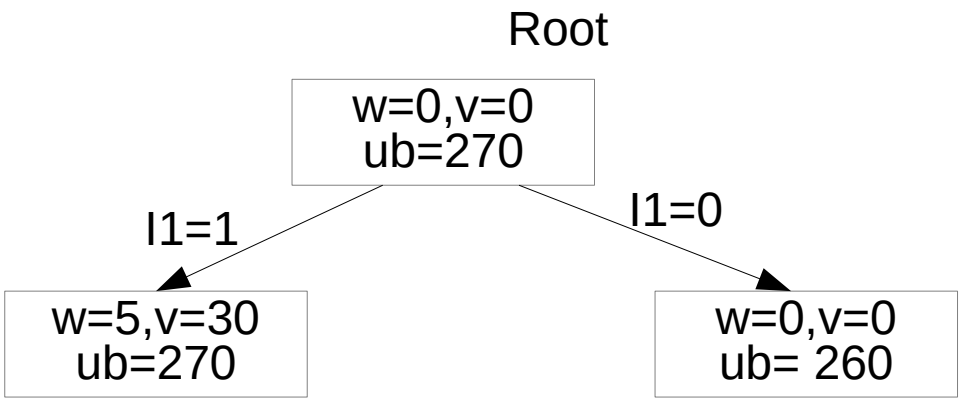
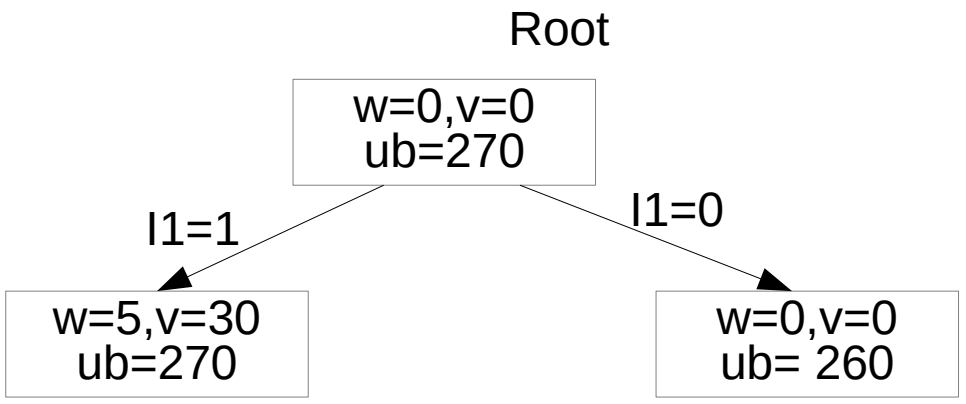


Calculate ub
I1 + I3 + I5
Weight = 5+20+35 =60
Value = 30+100+35*4
= 30+100+140=270

Calculate ub
I3 + I5
Weight = 20+40 =60
Value = 100+160 =260

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



Calculate ub
I1 + I3 + I5
Weight = 5+20+35 =60
Value = 30+100+35*4
= 30+100+140=270

Calculate ub
I3 + I5
Weight = 20+40 =60
Value = 100+160 =260

Next, Explore the highest ub node
(270,260) – highest is 270

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
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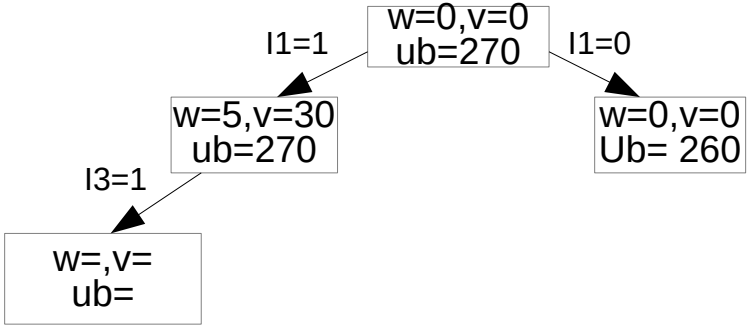
I5	40	160	4
I4	30	90	3
I2	10	20	2



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W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

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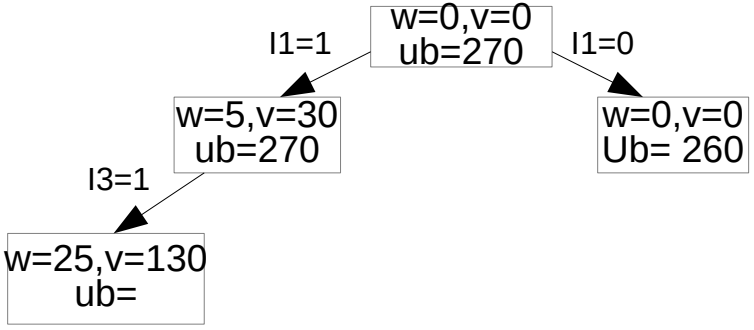
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



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W=<5,10,20,30,40>
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I1	5	30	6
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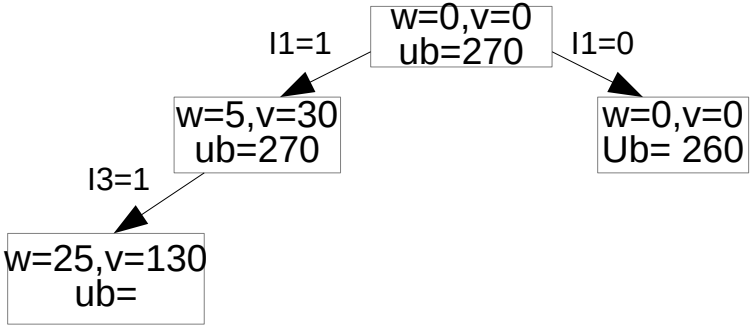
I5	40	160	4
I4	30	90	3
I2	10	20	2



Calculate ub
I1 + I3 + I5
Weight = 5+20+35 =60
Value = 30+100+35*4
= 30+100+140=270

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

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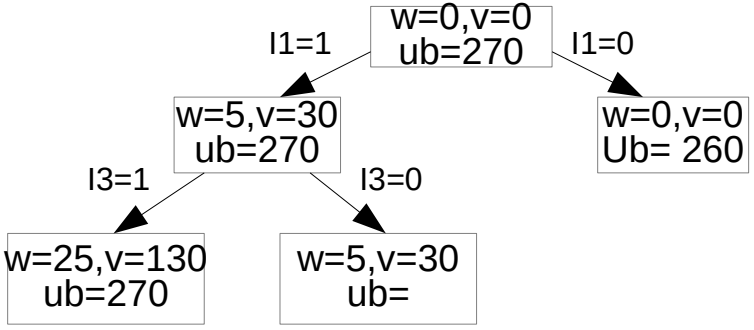

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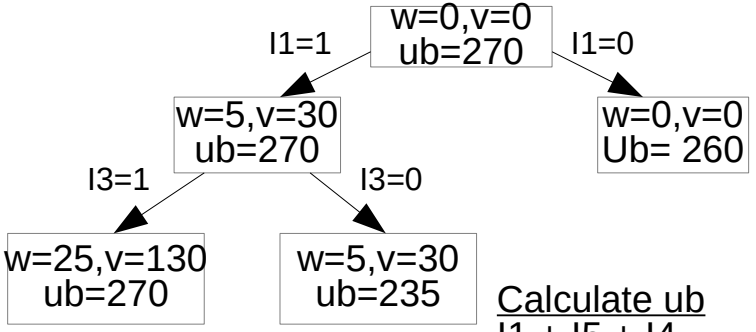

Calculate ub
I1 + I5 + I4
Weight = 5+40+15 =60
Value = 30+160+15*3
= 30+160+45=235

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
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I5	40	160	4
I4	30	90	3
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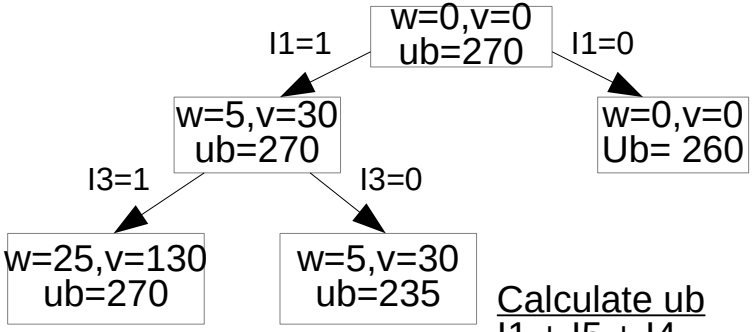

Calculate ub
I1 + I5 + I4
Weight = 5+40+15 =60
Value = 30+160+15*3
= 30+160+45=235

Next, Explore the highest ub node
(270,235,260) – highest is 270

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
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I5	40	160	4
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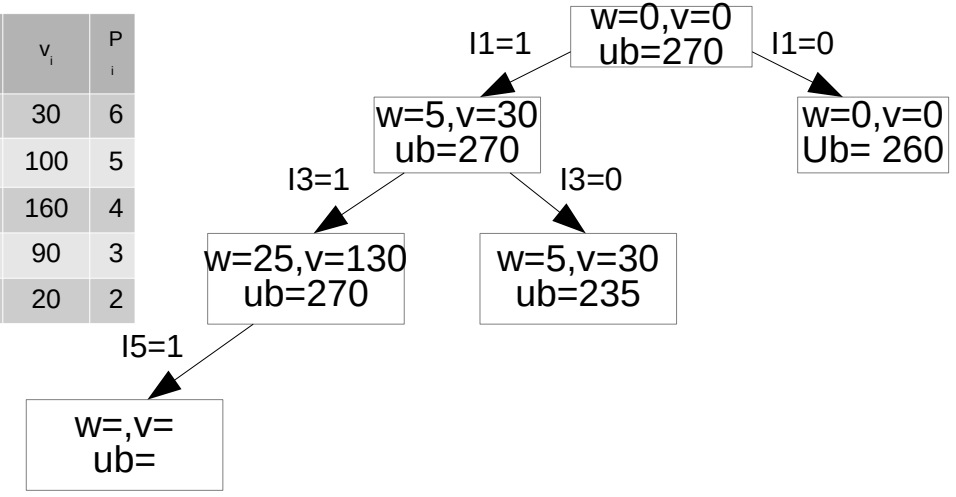

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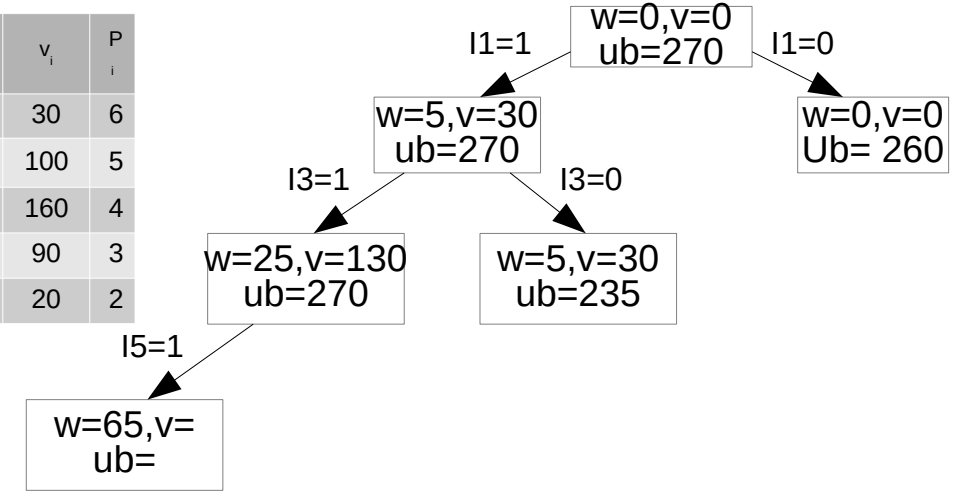

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ITEM	w_i	v_i	P_i
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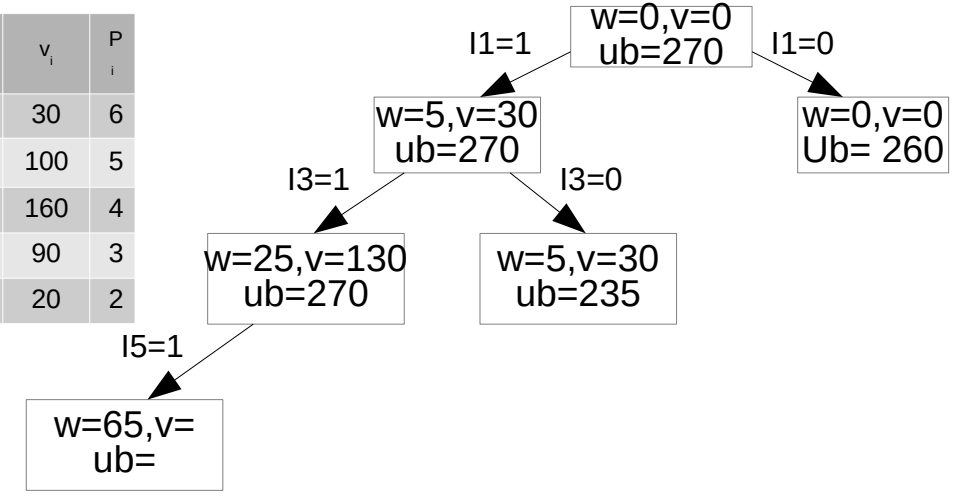

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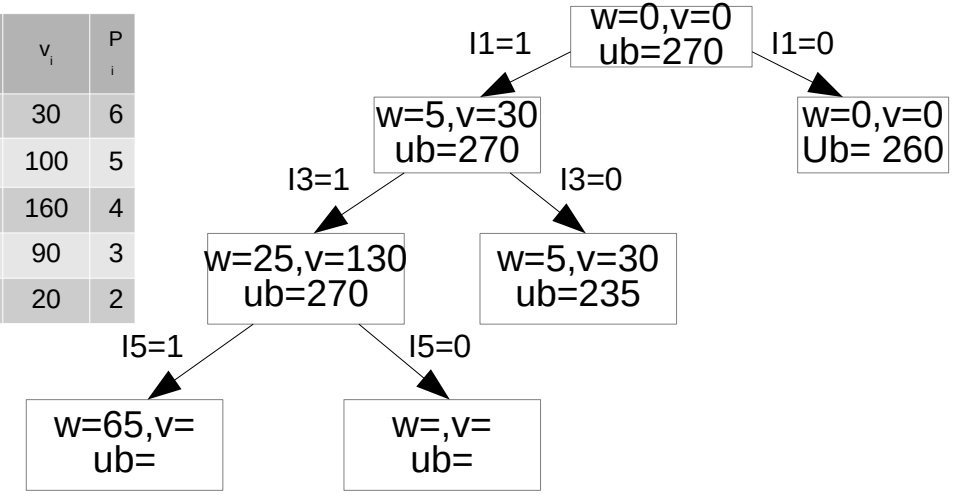

X

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

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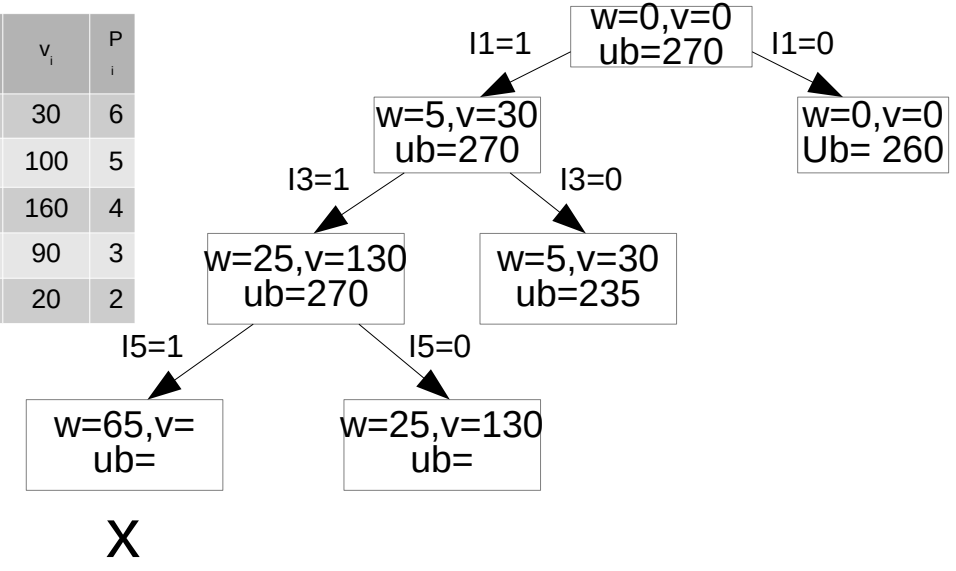

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I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
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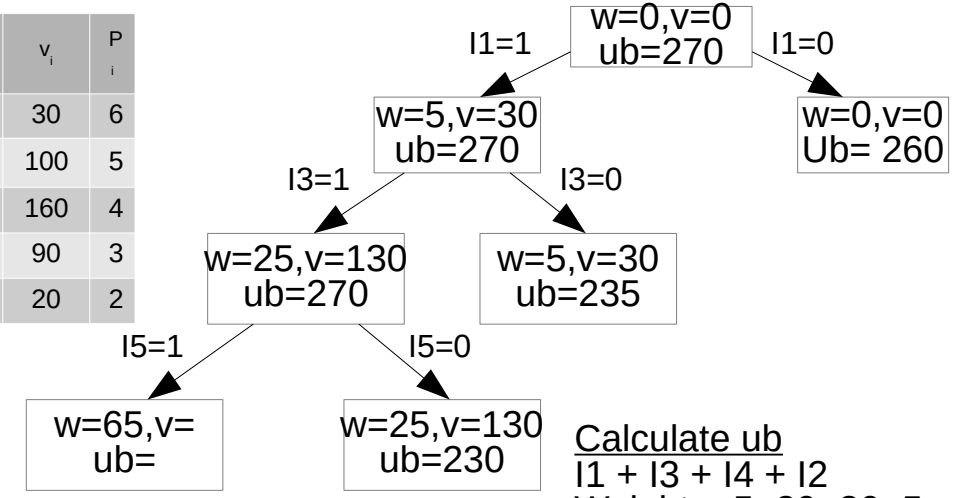

X

Calculate ub
I1 + I3 + I4 + I2
Weight = 5+20+30+5 =60
Value = 30+100+90+5*2
= 30+100+90+10=230

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

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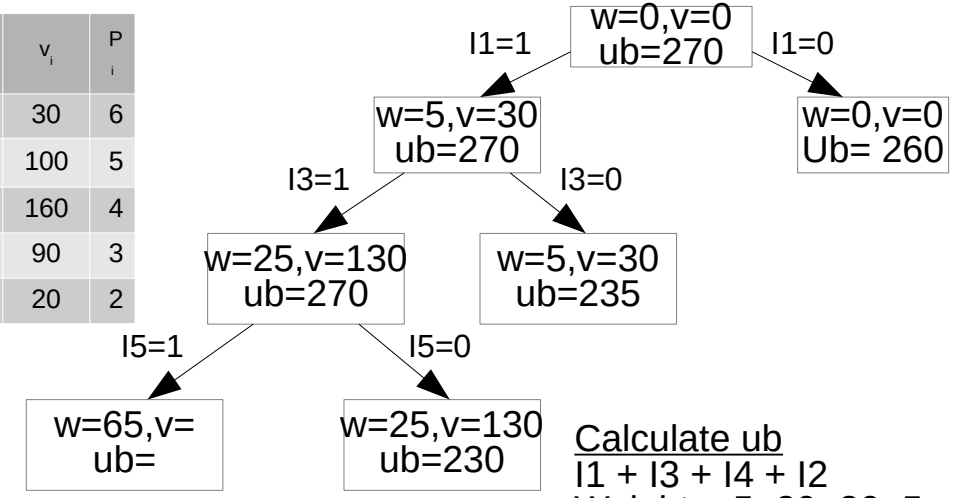


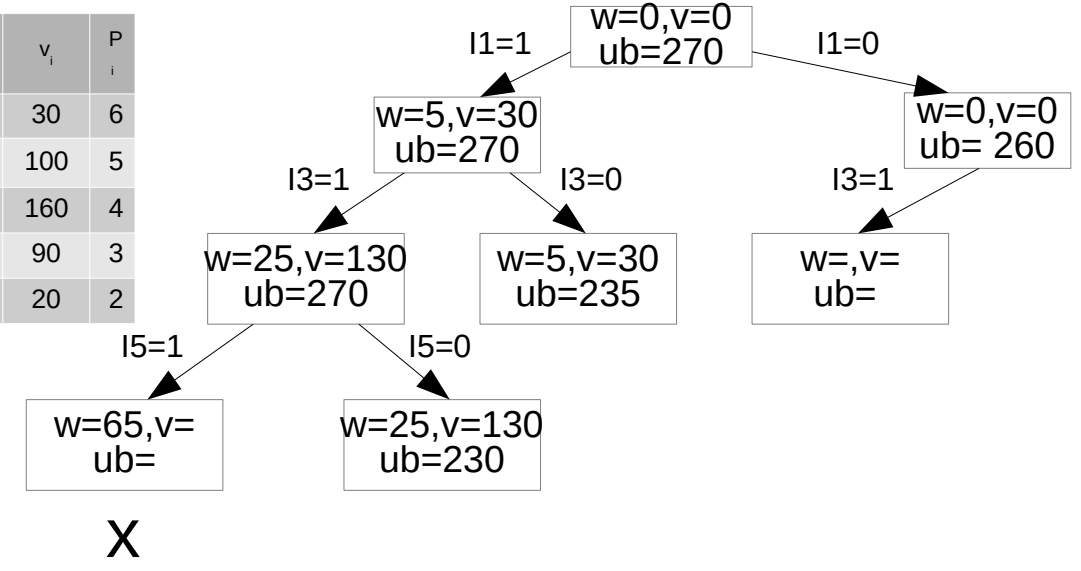
X

Calculate ub
I1 + I3 + I4 + I2
Weight = 5+20+30+5 =60
Value = 30+100+90+5*2
= 30+100+90+10=230

Next, Explore the highest ub node (230,235,260) – highest is 260

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

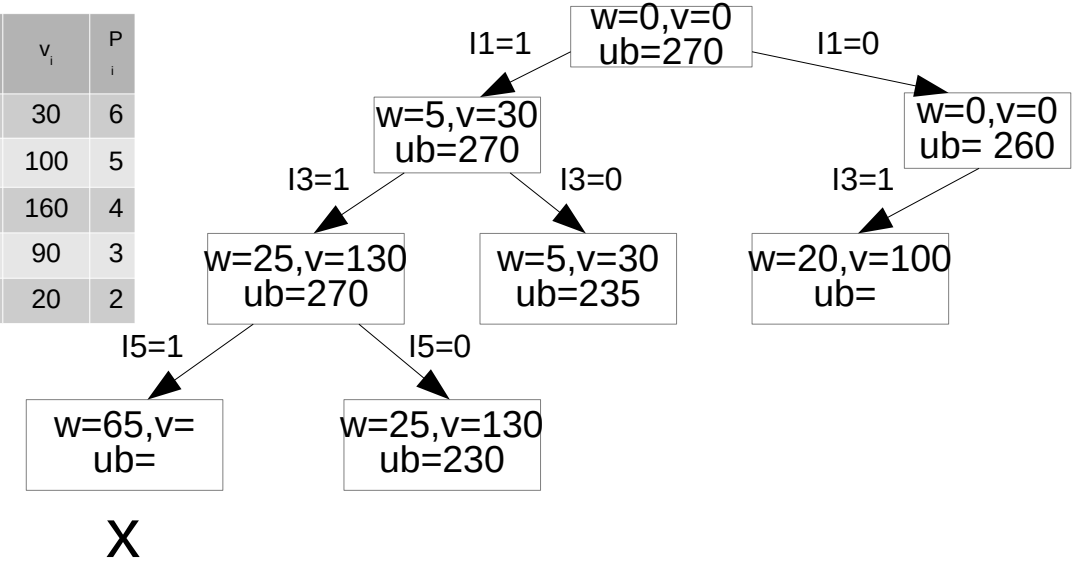
ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



X

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

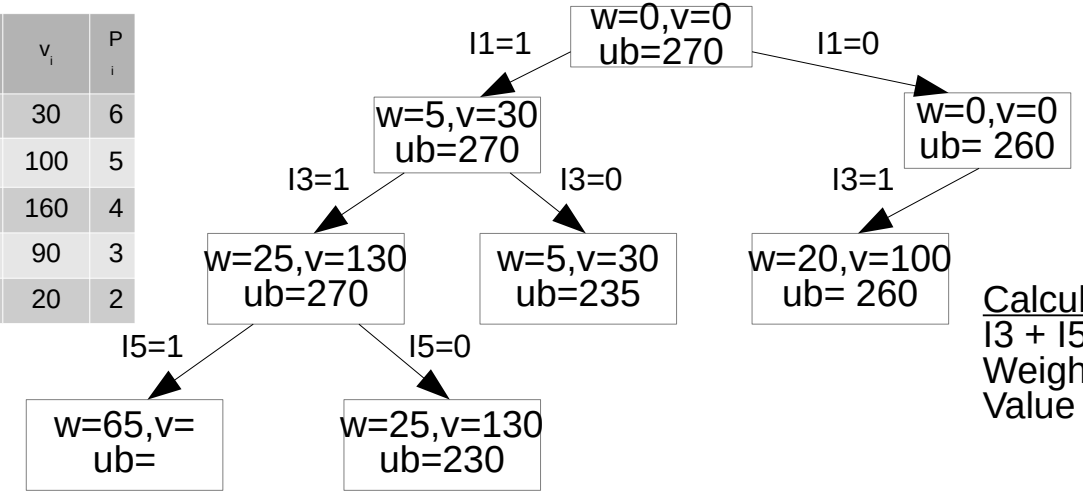
ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



X

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

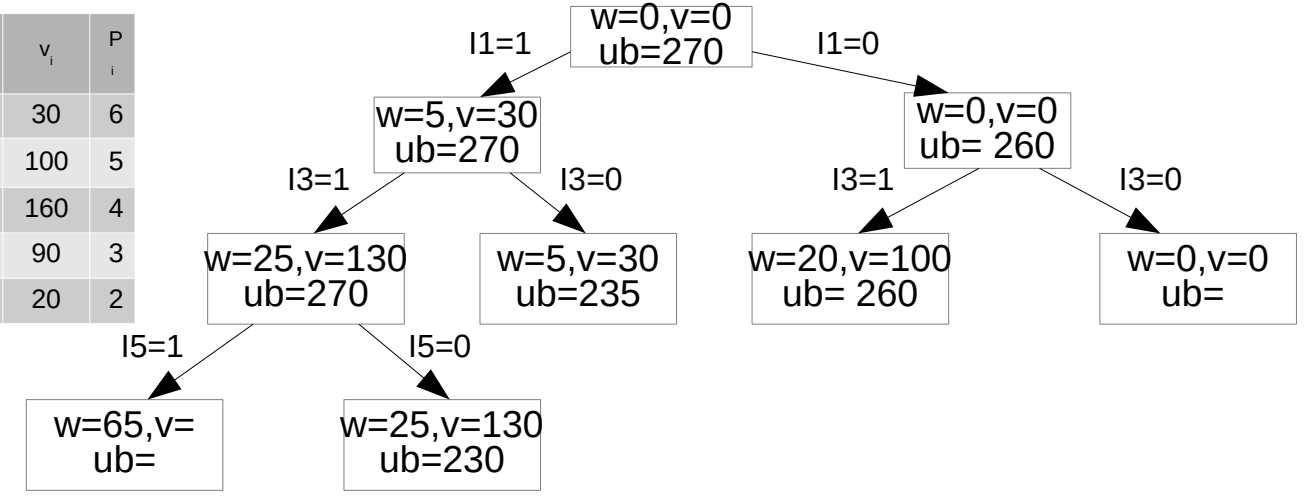


X

Calculate ub
I3 + I5
Weight = 20+40 =60
Value = 100+160 = 260

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

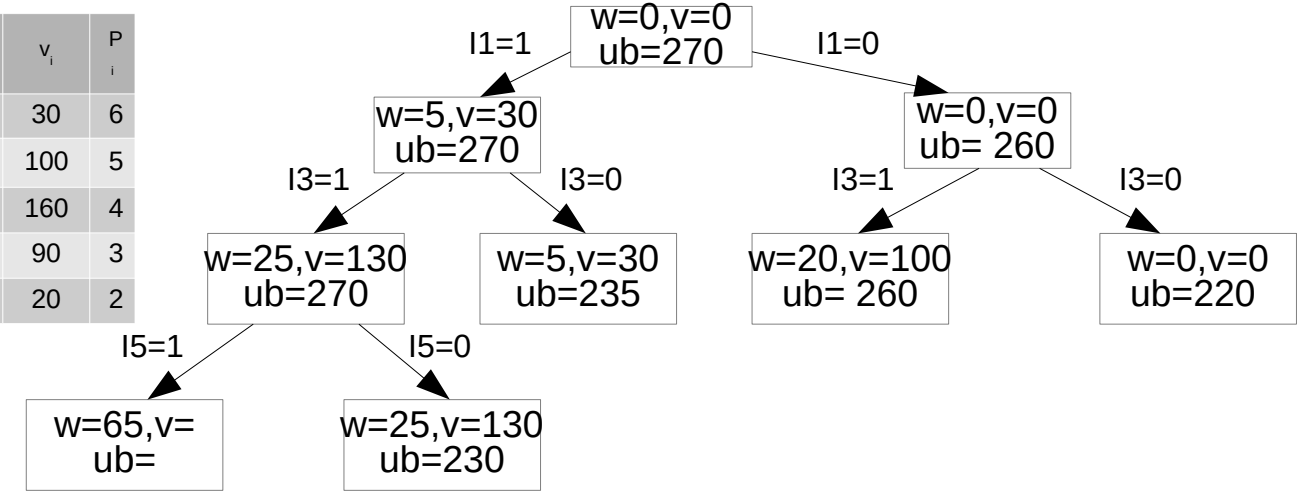
ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



X

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

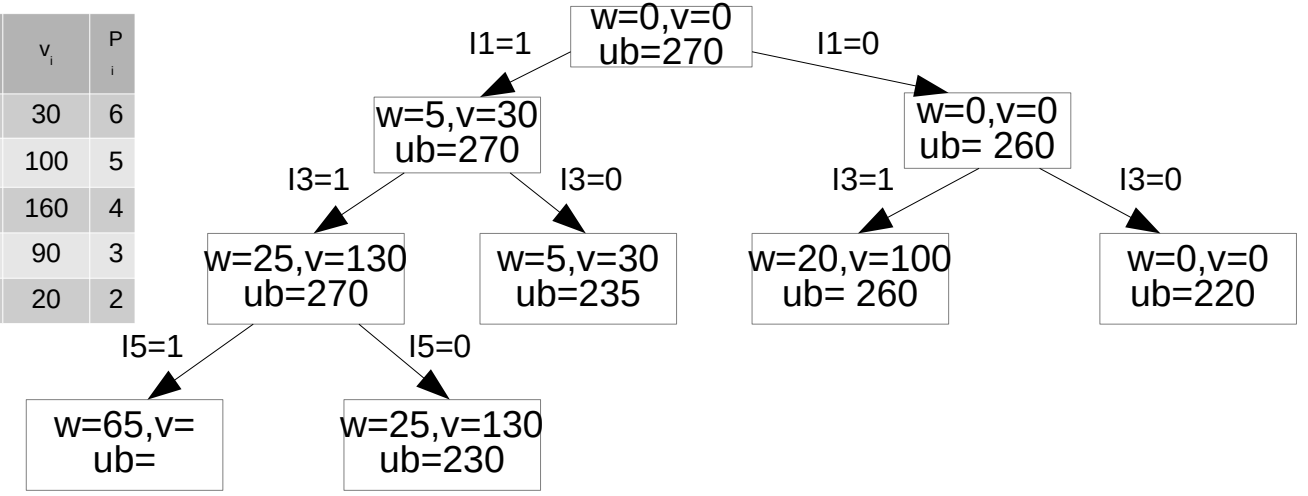


X

Calculate ub
I5 + I4
Weight = 40+20 =60
Value = 160+20*3
= 160+60=220

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



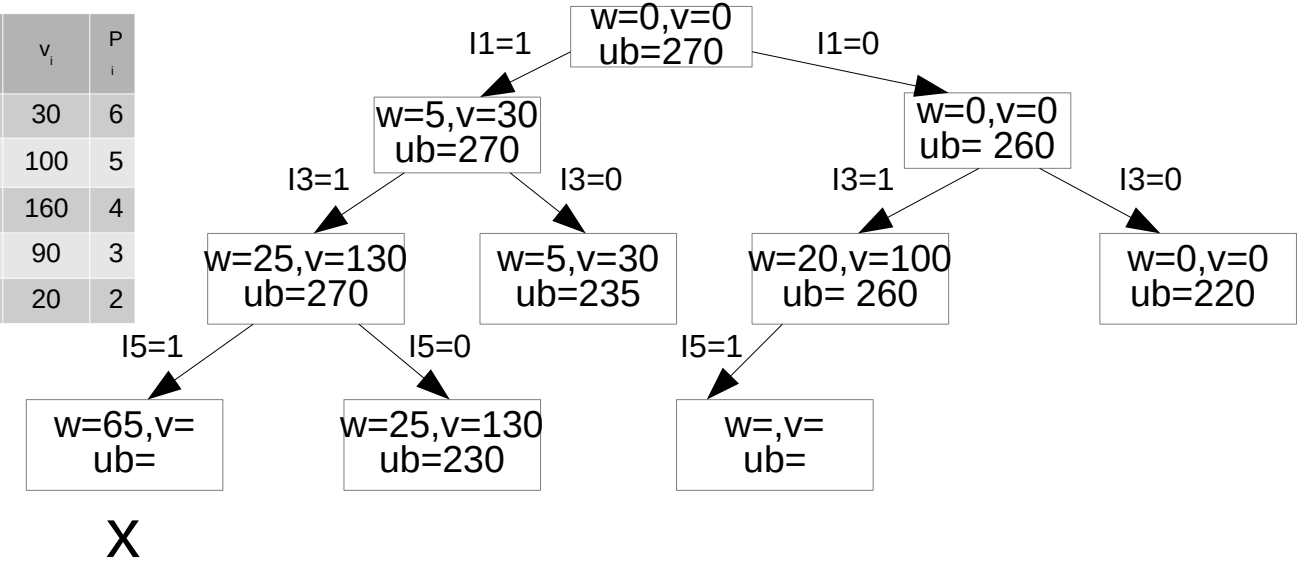
X

Calculate ub
I5 + I4
Weight = 40+20 =60
Value = 160+20*3
= 160+60=220

Next, Explore the highest ub node
(230,235,260,220) – highest is 260

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

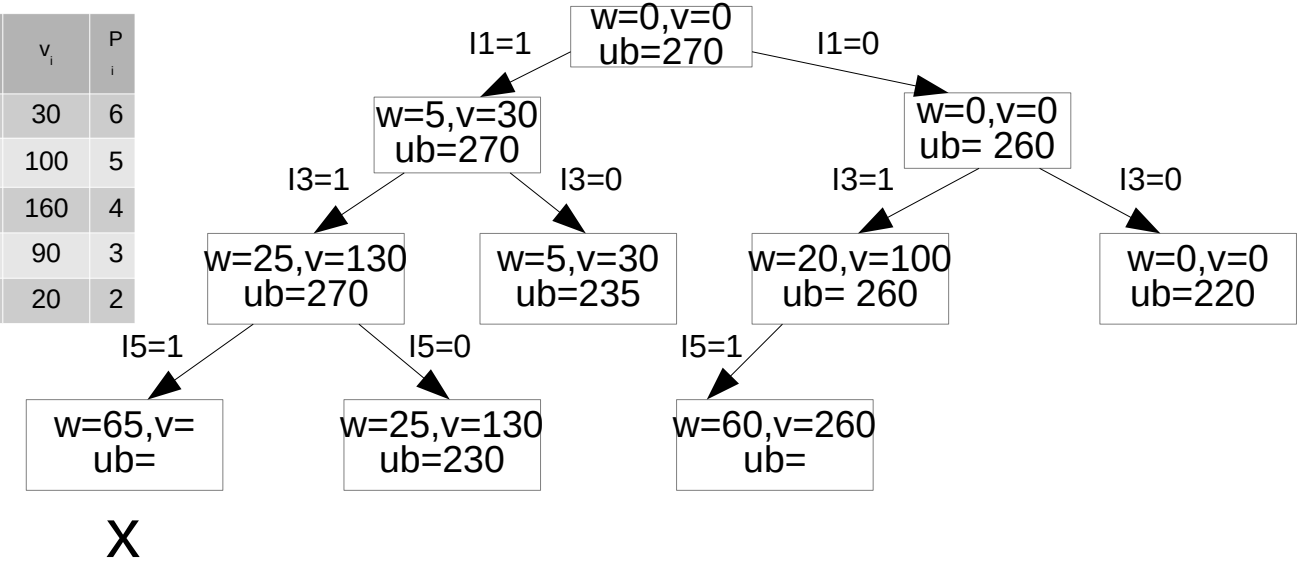
ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



X

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

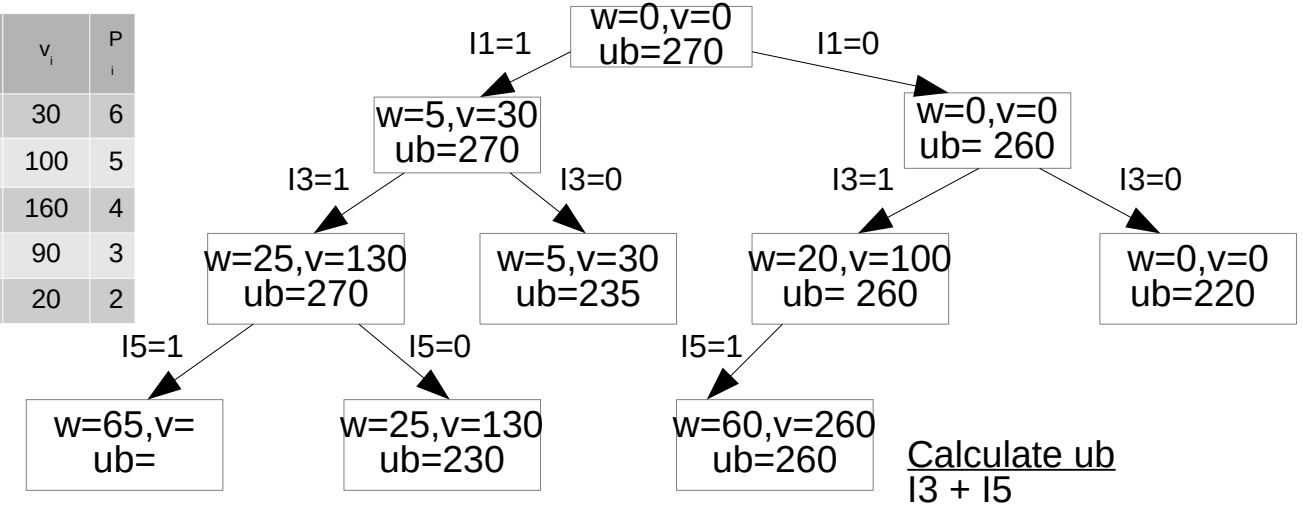
ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



X

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

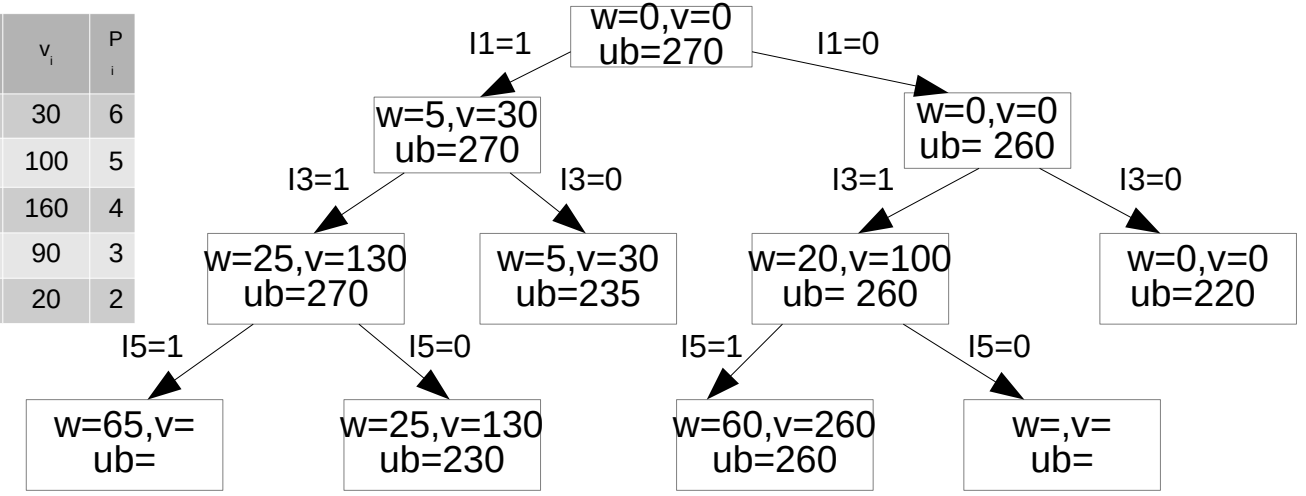


X

Calculate ub
I3 + I5
Weight = 20+40 =60
Value = 100+160 = 260

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

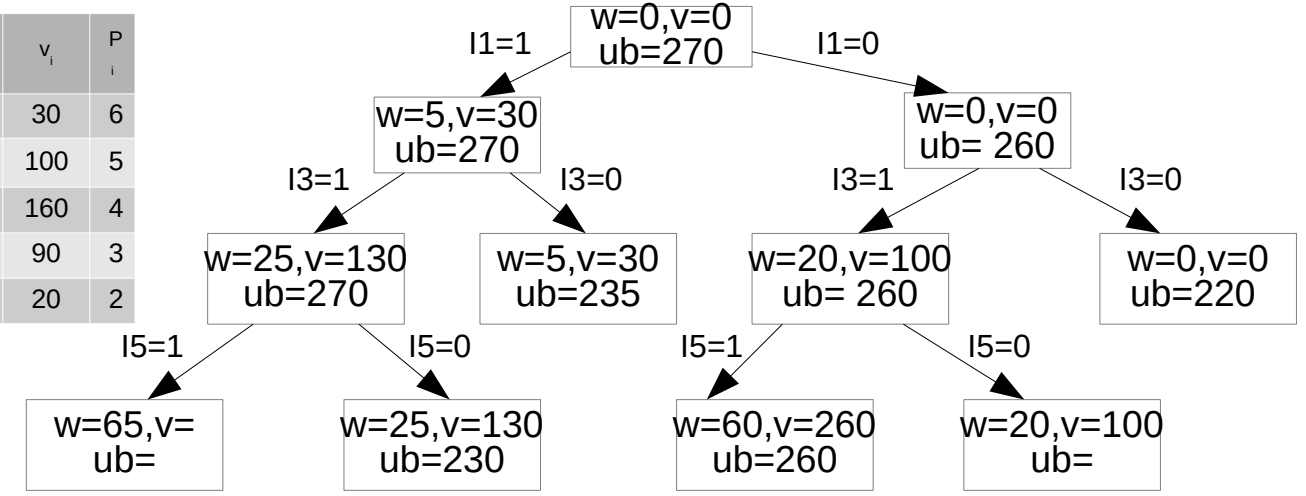
ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



X

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

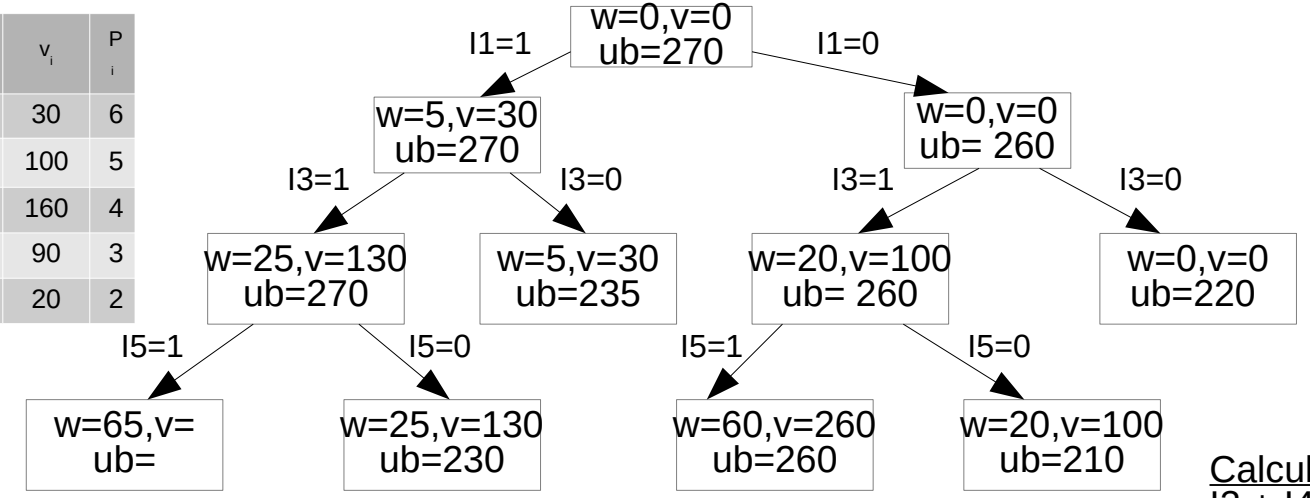
ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



X

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2

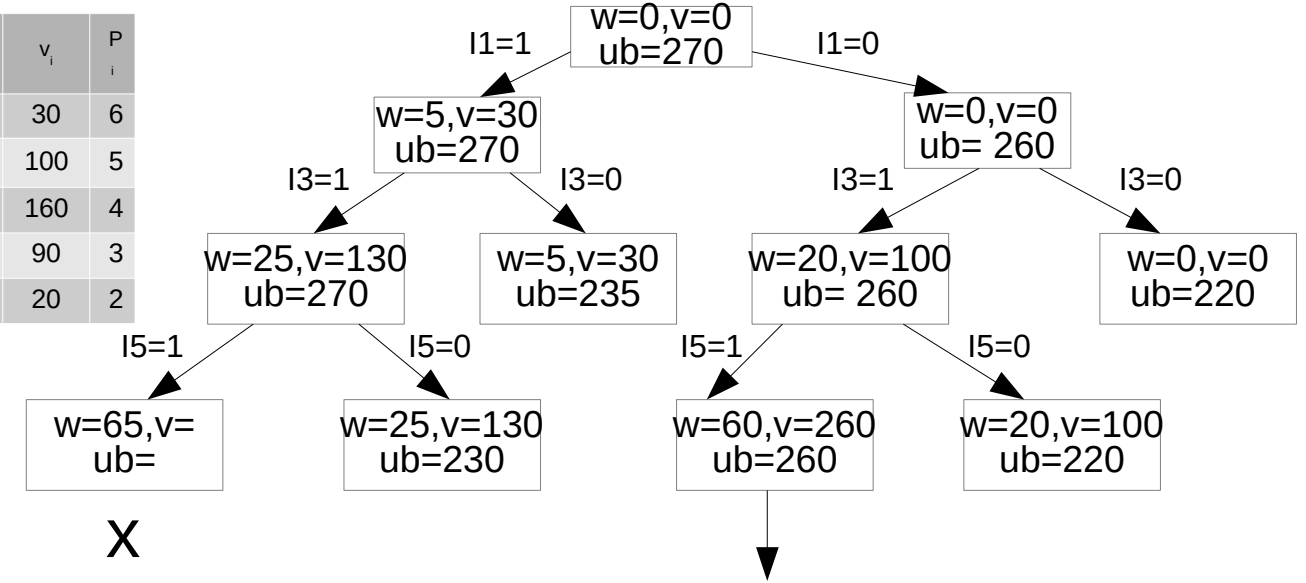


X

Calculate ub
I3 + I4 + I2
Weight = 20+30+10 =60
Value = 100+90+20 = 210

Consider 5 items along their respective weights and values
I = <I1,I2,I3,I4,I5>
W=<5,10,20,30,40>
V=<30,20,100,90,160>
The capacity of knapsack W=60. Find the solution to the 0-1 knapsack problem

ITEM	w_i	v_i	P_i
I1	5	30	6
I3	20	100	5
I5	40	160	4
I4	30	90	3
I2	10	20	2



Final solution
I3 + I5
Weight = 20+40 =60
Value = 100+160 = 260
I=<I1,I2,I3,I4,I5>
Solution=<0,0,1,0,1>

Thank You