

Simple Knapsack algorithm

subject to and .

Brute force algorithm

- Maximize the value of N elements (w_i, v_i) while keeping the total weight less than a maximum value W .
- Maximize $\sum(x_i * v_i)$ $i = 0, \dots, n$ and $v_i = 0$ or $v_i = 1$
- Subject to $\sum(x_i * w_i) \leq W$ $i = 0, \dots, n$ and $v_i = 0$ or $v_i = 1$
- $V_0 + V_1 + V_2 + \dots + V_i + \dots + V_n$
- 0/1 0/1 0/1 0/1 0/1
- This results in 2^{**n} different sums (2^{**n} binary numbers with n bits)

Brute force algorithm

- Requires the computation of $2^{**}n$ sums
- 20 items $\rightarrow 2^{**}20$ computations $\sim 10^{**}6$
- 40 items $\rightarrow 2^{**}40$ computations $\sim 10^{**}12$
- Complexity $O(2^{**}n)$
- Only possible for small sets of items

Knapsack algorithm : Dynamic Programming

Quoting wikipedia

“given a set of items, each with a weight and a value, determine which item to include in a collection so that the total weight is less than or equal to a given limit and the total value is as large as possible.”

The problem is recursively split in smaller sub-problems which are then solved, and the result is memorized and used to build the solution for the initial problem.

Knapsack algorithm (Wikipedia)

```
1 // Input:
2 // Values (stored in array v)
3 // Weights (stored in array w)
4 // Number of distinct items (n)
5 // Knapsack capacity (W)
6 // NOTE: The array "v" and array "w" are assumed to store all relevant values starting at index 1.
7
8 array m[0..n, 0..W];
9 for j from 0 to W do:
10     m[0, j] := 0
11 for i from 1 to n do:
12     m[i, 0] := 0
13
14 for i from 1 to n do:
15     for j from 0 to W do:
16         if w[i] > j then:
17             m[i, j] := m[i-1, j]
18         else:
19             m[i, j] := max(m[i-1, j], m[i-1, j-w[i]] + v[i])
```

Knapsack algorithm

- Complexity time $O(nw)$
- Complexity space $O(nw)$

Knapsack algorithm : Dataset 1

- Total investment: 499.95
 - Total profit: 198.53
-
- Previous Results
 - Total investment: 498.76
 - Total profit: 196.61

Knapsack algorithm: Dataset 2

- Total investment: 499.9
 - Total profit: 197.95
-
- Previous Results
 - Total investment: 489.24
 - Total profit: 193.78

DATASET 1

1	Share-KMTG	Value:23.21	Profit:9.277037
2	Share-GHIZ	Value:28.00	Profit:11.169200
3	Share-NHWA	Value:29.18	Profit:11.604886
4	Share-UEZB	Value:24.87	Profit:9.806241
5	Share-LPDM	Value:39.35	Profit:15.629820
6	Share-MTLR	Value:16.48	Profit:6.587056
7	Share-USSR	Value:25.62	Profit:10.135272
8	Share-GTQK	Value:15.40	Profit:6.152300
9	Share-FKJW	Value:21.08	Profit:8.385624
10	Share-MLGM	Value:0.01	Profit:0.001886
11	Share-QLMK	Value:17.38	Profit:6.863362
12	Share-WPLI	Value:34.64	Profit:13.821360
13	Share-LGWG	Value:31.41	Profit:12.406950
14	Share-ZSDE	Value:15.11	Profit:6.025868
15	Share-SKKC	Value:24.87	Profit:9.821163
16	Share-QQTU	Value:33.19	Profit:13.143240
17	Share-GIAJ	Value:10.75	Profit:4.289250
18	Share-XJMO	Value:9.39	Profit:3.753183
19	Share-LRBZ	Value:32.90	Profit:13.143550
20	Share-KZBL	Value:28.99	Profit:11.346686
21	Share-EMOV	Value:8.89	Profit:3.513328
22	Share-IFCP	Value:29.23	Profit:11.656924
23	Share-GRUT	49876	

SIENNA

OPTIMIZED

DATASET 2

1	Share-ECAQ	3166	Share-ECAQ	Value:31.66	Profit:12.502534
2	Share-IXCI	2632	Share-IXCI	Value:26.32	Profit:10.370080
3	Share-FWBE	1830	Share-FWBE	Value:18.30	Profit:7.287060
4	Share-ZOFA	2532	Share-ZOFA	Value:25.32	Profit:10.072296
5	Share-PLLK	1994	Share-PLLK	Value:19.94	Profit:7.956060
6			Share-LXZU	Value:4.24	Profit:1.676496
7	Share-YFVZ	2255	Share-YFVZ	Value:22.55	Profit:8.817050
8	Share-ANFX	3854	Share-ANFX	Value:38.54	Profit:15.308088
9	Share-PATS	2770	Share-PATS	Value:27.70	Profit:11.071690
10			Share-SCWM	Value:6.42	Profit:2.446020
11	Share-NDKR	3306	Share-NDKR	Value:33.06	Profit:13.190940
12	Share-ALIY	2908	Share-ALIY	Value:29.08	Profit:11.611644
13	Share-JWGF	4869	Share-JWGF	Value:48.69	Profit:19.441917
14	Share-JGTW	3529	Share-JGTW	Value:35.29	Profit:13.914847
15	Share-FAPS	3257	Share-FAPS	Value:32.57	Profit:12.878178
16	Share-VCAX	2742	Share-VCAX	Value:27.42	Profit:10.691058
17	Share-LFXB	1483	Share-LFXB	Value:14.83	Profit:5.900857
18	Share-DWSK	2949	Share-DWSK	Value:29.49	Profit:11.604315
19	Share-XQII	1342	Share-XQII	Value:13.42	Profit:5.302242
20	Share-ROOM	1506	Share-ROOM	Value:15.06	Profit:5.906532

SIENNA

OPTIMIZED