

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 $v_i = 1$
- $V_0 + V_1 + V_2 + \dots + V_i + \dots + V_n$
- $0/1 \ 0/1 \ 0/1 \ \dots \ 0/1 \ \dots \ 0/1$
- 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

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.”

Consider adding item one by one and solve the problem for all constraints less than maximum constraints.

For each item, constraints use the results that were computed for previous item and memorized.

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
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- 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

Sienna bought:

Share-GRUT

Share-KMTG	Value:23.21	Profit:9.277037
Share-GHIZ	Value:28.00	Profit:11.169200
Share-NHWA	Value:29.18	Profit:11.604886
Share-UEZB	Value:24.87	Profit:9.806241
Share-LPDM	Value:39.35	Profit:15.629820
Share-MTLR	Value:16.48	Profit:6.587056
Share-USSR	Value:25.62	Profit:10.135272
Share-GTQK	Value:15.40	Profit:6.152300
Share-FKJW	Value:21.08	Profit:8.385624
Share-MLGM	Value:0.01	Profit:0.001886
Share-QLMK	Value:17.38	Profit:6.863362
Share-WPLI	Value:34.64	Profit:13.821360
Share-LGWG	Value:31.41	Profit:12.406950
Share-ZSDE	Value:15.11	Profit:6.025868
Share-SKKC	Value:24.87	Profit:9.821163
Share-QQTU	Value:33.19	Profit:13.143240
Share-GIAJ	Value:10.75	Profit:4.289250
Share-XJMO	Value:9.39	Profit:3.753183
Share-LRBZ	Value:32.90	Profit:13.143550
Share-KZBL	Value:28.99	Profit:11.346686
Share-EMOV	Value:8.89	Profit:3.513328
Share-IFCP	Value:29.23	Profit:11.656924

Sienna bought:

Share-ECAQ	3166
Share-IXCI	2632
Share-FWBE	1830
Share-ZOFA	2532
Share-PLLK	1994
Share-YFVZ	2255
Share-ANFX	3854
Share-PATS	2770
Share-NDKR	3306
Share-ALIY	2908
Share-JWGF	4869
Share-JGTW	3529
Share-FAPS	3257
Share-VCAX	2742
Share-LFXB	1483
Share-DWSK	2949
Share-XQII	1342
Share-ROOM	1506

Share-ECAQ	Value:31.66	Profit:12.502534
Share-IXCI	Value:26.32	Profit:10.370080
Share-FWBE	Value:18.30	Profit:7.287060
Share-ZOFA	Value:25.32	Profit:10.072296
Share-PLLK	Value:19.94	Profit:7.956060
Share-LXZU	Value:4.24	Profit:1.676496
Share-YFVZ	Value:22.55	Profit:8.817050
Share-ANFX	Value:38.54	Profit:15.308088
Share-PATS	Value:27.70	Profit:11.071690
Share-SCWM	Value:6.42	Profit:2.446020
Share-NDKR	Value:33.06	Profit:13.190940
Share-ALIY	Value:29.08	Profit:11.611644
Share-JWGF	Value:48.69	Profit:19.441917
Share-JGTW	Value:35.29	Profit:13.914847
Share-FAPS	Value:32.57	Profit:12.878178
Share-VCAX	Value:27.42	Profit:10.691058
Share-LFXB	Value:14.83	Profit:5.900857
Share-DWSK	Value:29.49	Profit:11.604315
Share-XQII	Value:13.42	Profit:5.302242
Share-ROOM	Value:15.06	Profit:5.906532