# Simple Knapsack algorithm

subject to and .

# Brute force algorithm

- Maximize the value of N elements (wi,vi) while keeping the total weight
- less than a maximum value W.

- Maximize sum(xi*vi) i = 0,..,n and vi = 0 or vi = 1
- Subject to sum(xi*wi) <= W) i = 0,..,n and vi = 0 or vi = 1

- V0 + V1 +V2+ ….. + Vi + …. + Vn
- 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 → 2**20 computations ~= 10**6
- 40 items → 2**40 computations ~= 10**12
- Complexity O(2**n)
- Only possible for small sets of items

# Knapsack algorithm

- Evaluate for all constraints less than maximum constraint W
- The current element is included in the subset when adding it does not exceed the constraint and improves the best value computed in prior iteration

# Knapsack algorithm (Wikipedia)

```
// Input:
// Values (stored in array v)
// Weights (stored in array w)
// Number of distinct items (n)
// Knapsack capacity (W)
// NOTE: The array "v" and array "w" are assumed to store all relevant values starting at index 1.

array m[0..n, 0..W];
for j from 0 to W do:
    m[0, j] := 0
for i from 1 to n do:
    m[i, 0] := 0

for i from 1 to n do:
    for j from 0 to W do:
        if w[i] > j then:
            m[i, j] := m[i-1, j]
        else:
            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

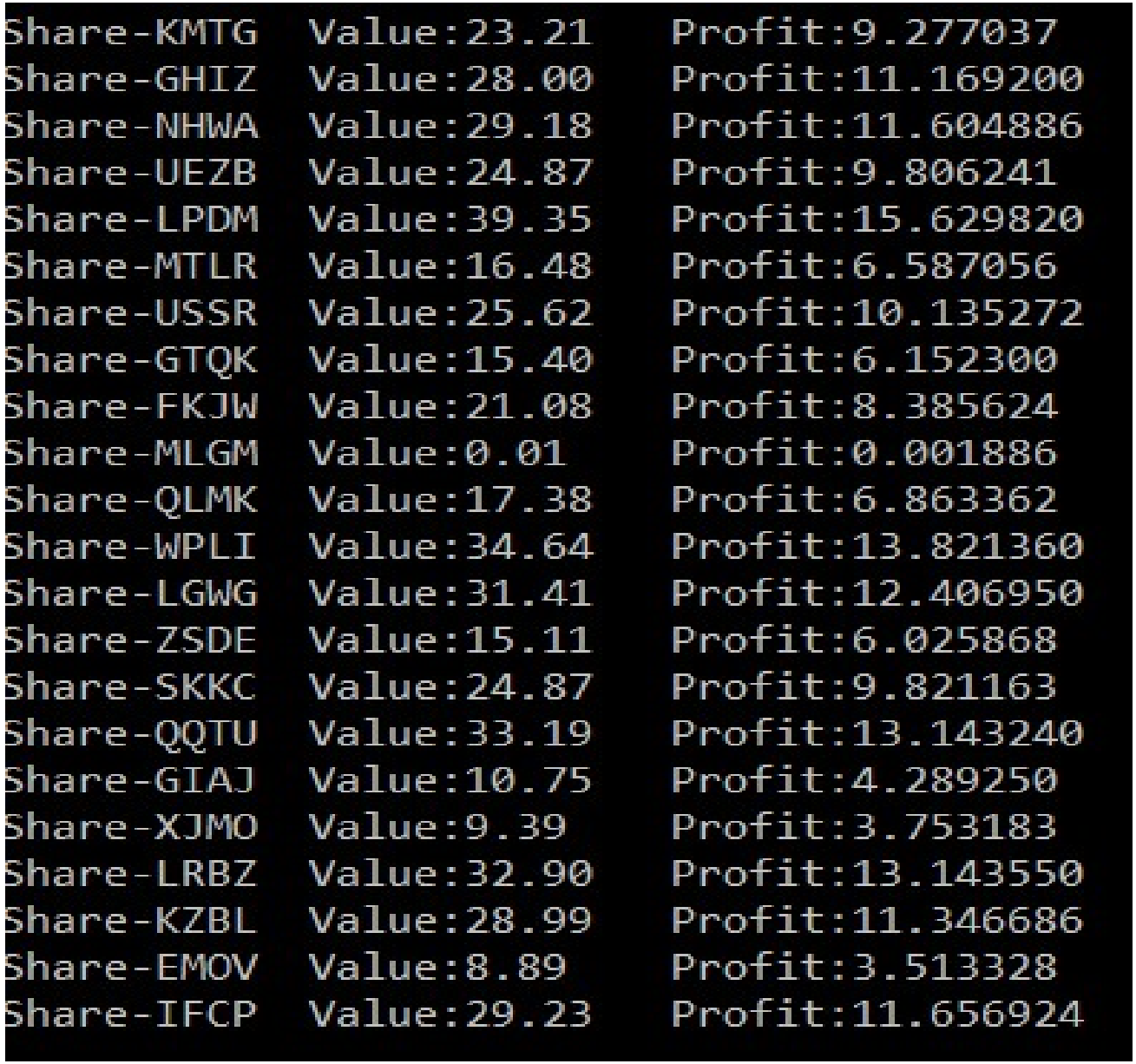
# Knapsack algorithm: Dataset 2

- Total investment: 499.9
- Total profit: 197.95

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

Sienna bought:

Share-GRUT



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
```