Knapsack Problem

- Integer kp.
- fractional kp

NP Hard / NP Complete

Eksponensial.

Himpunan solusi :

I { item ; $item_1$, $item_2$, ...., $item_n$.

0 1 , . , 1

$\{x_1, x_2, \ldots, x_n\}$ ← Himp solusi

$x_i \in \{0, 1\}$

F { $0 \leq x_i \leq 1$

Nilai optimal : $\sum_{i=1}^{n} x_i p'$

Int. KP. < 6. By profit
— weight
— density
(Pi/wi).

→ Sorting

① 6 by profit

- Sort items by profit descending
  Ambil barang yg profit paling tinggi
  selama kapasitas masih terpenuhi
- Kapasitas. Stop tergantung pd jumlah item nya.

Total weight < Kapasitas
Tapi stop ada lagi barang yg bisa diambil

② 6 by weight.

- Sort items by weight ascending
  ambil yg paling ringan
  kapasitas ok.

③ Ro. by density $\left(\frac{\text{profit}}{\text{weight}}\right)$

- Sort items by density descending

Pseudocode:

```
Greedy by technique.
    S = {}
    sum = 0
    value = 0
    for i = 1 to n.
        if sum + wi ≤ K.
            S ← S ∪ {xi}
                also
            xi ← 1.
            value ← value + pi
```

# Fractional knapsack.

↳ Tujuannya $\sum$ weight = K.

Greedy by density.

$$\frac{P_1}{w_1} \geq \frac{P_2}{w_2} \geq \frac{P_3}{w_3} \geq \dots \geq \frac{P_n}{w_n}$$

| | $w_i$ | $p_i$ | $p_i/w_i$ |
|---|---|---|---|
| 1 | 18 | 25 | 1,4 |
| 2 | 15 | 24 | 1.6 |
| 3 | 10 | 15 | 1.5 |

K = 20.

solusi $\{0, 1, \frac{1}{2}\}$

Nilai opt = 31,5

{2

* 1 item$_2$ → $w_2 = 15$ $P_2 = 24$.
residu = 5

$\frac{1}{2}$ item$_3$ → $\frac{1}{2}w_3 = 5$ $\frac{1}{2}P_3 = 7.5$.
residu = 0

31.5

Knapsack optimization

$$\begin{cases} \text{Max} \quad F = \sum_{i=1}^{n} p_i x_i \\ \text{s.t.} \quad \sum_{i=1}^{n} x_i v_i \leq K \\ 0 \leq x_i \leq 1 \quad \forall i = 1, \dots n \end{cases}$$

FKP $\longrightarrow$ 6. by density.
membership opt.

Coding <

Encoding ≠ teks → kode

Decoding : kode → teks

code . 101 0011...

Fixed - length encoding.

Variable - length encoding.

SAMA

S : 00

A : 01

M : 11

00011101 → odoiiio1

S A M A

S : 0

A : 1

M : 10

01101

0101 1101

AAMA

# Huffman coding.

| Karakter | a | b. | c | d | e | f |
|---|---|---|---|---|---|---|
| Frequency | 45% | 13% | 12% | 16% | 9% | 5% |

Fixed - leng:

| Encoding | 000 | 001 | 010 | 011 | 100 | 111 |
|---|---|---|---|---|---|---|

Prinsip HC.

└ Encoding based on frequency

Greedy : karakter diurut berdasar kan frekuensi

AMABBCMADDE

| | | |
|---|---|---|
| A : | C : | E : |
| B : | D : | |

# Coding tree.

* Karakter yg muncul paling sering/ freq. terbesar ⟹ encode dg menggunakan kode yg pendek

* Karakter yg jarang muncul ⟹ kode yg panjang

| Char | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| Freq | 45 | 13 | 12 | 16 | 9 | 5 |

→ 100

a d ~~b~~ ~~c~~ ~~e f~~

45 16 ~~13~~ ~~12~~ ~~9 5~~

bc : 25 ef : 14

i

efd : 30

bcefd : 55

abcefd : 100

child node ( left / right