

| Feature name | CPU load (%) | storage load (%) | business value score |
|--------------|--------------|------------------|----------------------|
| A            | 20           | 30               | 10                   |
| B            | 10           | 5                | 5                    |
| C            | 30           | 10               | 10                   |
| D            | 5            | 10               | 3                    |
| F            | 15           | 30               | 10                   |
| G            | 60           | 70               | 30                   |
| H            | 80           | 80               | 80                   |
| I            | 10           | 50               | 20                   |
| J            | 3            | 50               | 5                    |

Feature A, and J is mandatory while the rest is optional. The objective is to maximize the business value score of the website while not overloading CPU and storage servers. His engineering friend, Taisho-kun, also suggests him that he could improve the website efficiency by performing the following operations:

method I

• Feature compression. This method will reduce both CPU and storage load by half, but it also reduces the business value to 55% of the original value. Every feature could be compressed, but the number of compressed features in the website is limited to two.

method II

• The usage of storage efficient algorithm. By using this method, the feature storage load is reduced by half but it also doubles the CPU load. However, only feature H, I, J can use this method. This method could not be used concurrently with feature compression.

## Decision Variable

$a$  = normal method in Feature A

$a_1$  = method I in Feature A

$b$  = normal method in Feature B

$b_1$  = method I in Feature B

$c$  = normal method in Feature C

$c_1$  = method I in Feature C

$d$  = normal method in Feature D

$d_1$  = method I in Feature D

$f$  = normal method in Feature F

$f_1$  = method I in Feature F

$g$  = normal method in Feature G

$g_1$  = method I in Feature G

$h$  = normal method in Feature H

$h_1$  = method I in Feature H

$h_2$  = method II in Feature H

$i$  = normal method in Feature I

$i_1$  = method I in Feature I

$i_2$  = method II in Feature I

$j$  = normal method in Feature J

$j_1$  = method I in Feature J

$j_2$  = method II in Feature J

Obj:  $\text{Max } (10a + 5b + 10c + 3d + 10f + 30g + 80h + 20i + 5j + 0.55(10a_1 + 5b_1 + 10c_1 + 3d_1 + 10f_1 + 30g_1 + 80h_1 + 20i_1 + 5j_1) + 80h_2 + 20i_2 + 5j_2)$

s.t. CPU Load:  $20a + 10b + 30c + 5d + 15f + 60g + 80h + 10i + 3j + 0.5(20a_1 + 10b_1 + 30c_1 + 5d_1 + 15f_1 + 60g_1 + 80h_1 + 10i_1 + 3j_1) + 2(80h_2 + 10i_2 + 5j_2) \leq 100$

Storage Load:  $30a + 5b + 10c + 10d + 30f + 70g + 80h + 50i + 50j + 0.5(30a_1 + 5b_1 + 10c_1 + 10d_1 + 30f_1 + 70g_1 + 80h_1 + 50i_1 + 50j_1) + 0.5(80h_2 + 50i_2 + 50j_2) \leq 100$

$a + b + c + d + f + g + h + i + j \leq 2$

$a + a_1 = 1$        $g + g_1 \leq 1$

$a, b, c, d, f, g, h, i, j, a_1, b_1, c_1, d_1, f_1, g_1, h_1, i_1, j_1, h_2, i_2, j_2 \in \{0, 1\}$

$b + b_1 \leq 1$        $h + h_1 + h_2 \leq 1$

$c + c_1 \leq 1$        $i + i_1 + i_2 \leq 1$

$d + d_1 \leq 1$        $j + j_1 + j_2 = 1$

$f + f_1 \leq 1$

Ans

result.x = [0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1]  
 Select b, c, a1, h1, j2  
 CPU usage: 96.0  
 Storage usage: 95.0  
 The optimal solution is 69.5