№8

:

```
from random import randint

import numpy as np
from scipy.optimize import linear_sum_assignment


def hungarian_algorithm(cost_matrix):
    cost_matrix = np.array(cost_matrix)

    # Check if the matrix is rectangular and non-empty
    if len(cost_matrix.shape) != 2 or cost_matrix.shape[0] == 0 or cost_matrix.shape[
        raise ValueError("Cost matrix must be a non-empty 2D array.")

    row_indices, col_indices = linear_sum_assignment(cost_matrix)

    return row_indices.tolist(), col_indices.tolist()


def main():
    try:
        n = int(input())
        should_be_generated = input("Write something to generate table")
        if should_be_generated:
            cost_matrix = [[randint(1, 9) for j in range(n)] for _ in range(n)]
            for i in cost_matrix:
                print(*i)
        else:
            cost_matrix = [list(map(int, input().split())) for _ in range(n)]
        row_ind, col_ind = hungarian_algorithm(cost_matrix)
        print("Optimal assignment:")
        optimal_assignment = [[0 for j in range(n)] for i in range(n)]
        for r, c in zip(row_ind, col_ind):
            optimal_assignment[r][c] = 1
```

```
        for i in optimal_assignment:
            print(*i)

        total_cost = sum(cost_matrix[r][c] for r, c in zip(row_ind, col_ind))
        print(f"Total cost: {total_cost}")
    except Exception as e:
        print(f"Error: {e}")


if __name__ == "__main__":
    main()
```

Ввод-вывод:

```
10
1 6 5 5 8 2 8 4 6 8
9 9 1 6 3 2 4 8 9 9
2 5 2 6 8 8 2 3 9 7
8 8 8 6 7 9 5 2 2 2
5 2 7 5 7 4 7 9 4 2
1 3 7 7 2 8 7 1 4 7
5 6 9 2 3 6 8 5 8 3
8 9 6 7 5 9 2 3 7 3
2 2 2 9 8 8 2 1 5 1
2 6 8 4 8 6 7 9 5 7
Optimal assignment:
0 0 0 0 0 1 0 0 0 0
0 0 1 0 0 0 0 0 0 0
0 0 0 0 0 0 0 1 0 0
0 0 0 0 0 0 0 0 1 0
0 1 0 0 0 0 0 0 0 0
0 0 0 0 1 0 0 0 0 0
0 0 0 1 0 0 0 0 0 0
0 0 0 0 0 0 1 0 0 0
0 0 0 0 0 0 0 0 0 1
1 0 0 0 0 0 0 0 0 0
Total cost: 19
```

:

1	6	5	5	8	2	8	4	6	8
9	9	1	6	3	2	4	8	9	9
2	5	2	6	8	8	2	3	9	7
8	8	8	6	7	9	5	2	2	2
5	2	7	5	7	4	7	9	4	2
1	3	7	7	2	8	7	1	4	7
5	6	9	2	3	6	8	5	8	3
8	9	6	7	5	9	2	3	7	3
2	2	2	9	8	8	2	1	5	1
2	6	8	4	8	6	7	9	5	7

№1

1.

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0	5	4	4	7	1	7	3	5	7	**1**
8	8	0	5	2	1	3	7	8	8	**1**
0	3	0	4	6	6	0	1	7	5	**2**
6	6	6	4	5	7	3	0	0	0	**2**
3	0	5	3	5	2	5	7	2	0	**2**
0	2	6	6	1	7	6	0	3	6	**1**
3	4	7	0	1	4	6	3	6	1	**2**
6	7	4	5	3	7	0	1	5	1	**2**
1	1	1	8	7	7	1	0	4	0	**1**
0	4	6	2	6	4	5	7	3	5	**2**

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0	5	4	4	6	0	7	3	5	7
8	8	0	5	1	0	3	7	8	8
0	3	0	4	5	5	0	1	7	5
6	6	6	4	4	6	3	0	0	0
3	0	5	3	4	1	5	7	2	0
0	2	6	6	0	6	6	0	3	6
3	4	7	0	0	3	6	3	6	1
6	7	4	5	2	6	0	1	5	1
1	1	1	8	6	6	1	0	4	0
0	4	6	2	5	3	5	7	3	5

.

2.

(1, 6). 1 6 .
(2; 6), (1; 1).

[0]	5	4	4	6	**[0]**	7	3	5	7
8	8	**[0]**	5	1	[0]	3	7	8	8
[0]	3	[0]	4	5	5	**[0]**	1	7	5
6	6	6	4	4	6	3	[0]	[0]	**[0]**
3	**[0]**	5	3	4	1	5	7	2	[0]
[0]	2	6	6	[0]	6	6	**[0]**	3	6
3	4	7	[0]	**[0]**	3	6	3	6	1
6	7	4	5	2	6	[0]	1	5	1
1	1	1	8	6	6	1	[0]	4	[0]
0	4	6	2	5	3	5	7	3	5

10 (
7), .

3.

: 1, 4, 2,
5, 3, 8, 5, 4, 1, 7, 9.
( ):

$$
\begin{array}{cccccccccc}
0 & 5 & 4 & 4 & 6 & 0 & 7 & 3 & 5 & 7 \\
8 & 8 & 0 & 5 & 1 & 0 & 3 & 7 & 8 & 8 \\
0 & 3 & 0 & 4 & 5 & 5 & 0 & 1 & 7 & 5 \\
6 & 6 & 6 & 4 & 4 & 6 & 3 & 0 & 0 & 0 \\
3 & 0 & 5 & 3 & 4 & 1 & 5 & 7 & 2 & 0 \\
0 & \mathbf{2} & \mathbf{6} & 6 & 0 & \mathbf{6} & 6 & 0 & \mathbf{3} & \mathbf{6} \\
3 & \mathbf{4} & \mathbf{7} & 0 & 0 & \mathbf{3} & 6 & 3 & \mathbf{6} & \mathbf{1} \\
6 & \mathbf{7} & \mathbf{4} & 5 & 2 & \mathbf{6} & 0 & 1 & \mathbf{5} & \mathbf{1} \\
1 & 1 & 1 & 8 & 6 & 6 & 1 & 0 & 4 & 0 \\
0 & \mathbf{4} & \mathbf{6} & 2 & 5 & \mathbf{3} & 5 & 7 & \mathbf{3} & \mathbf{5}
\end{array}
$$

$(\min(2, 6, 6, 3, 6, 4, 7, 3, 6, 1, 7, 4, 6, 5, 1, 4, 6, 3, 3, 5) = 1)$:

$$
\begin{array}{cccccccccc}
0 & 5 & 4 & 4 & 6 & 0 & 7 & 3 & 5 & 7 \\
8 & 8 & 0 & 5 & 1 & 0 & 3 & 7 & 8 & 8 \\
0 & 3 & 0 & 4 & 5 & 5 & 0 & 1 & 7 & 5 \\
6 & 6 & 6 & 4 & 4 & 6 & 3 & 0 & 0 & 0 \\
3 & 0 & 5 & 3 & 4 & 1 & 5 & 7 & 2 & 0 \\
0 & \mathbf{1} & \mathbf{5} & 6 & 0 & \mathbf{5} & 6 & 0 & \mathbf{2} & \mathbf{5} \\
3 & \mathbf{3} & \mathbf{6} & 0 & 0 & \mathbf{2} & 6 & 3 & \mathbf{5} & \mathbf{0} \\
6 & \mathbf{6} & \mathbf{3} & 5 & 2 & \mathbf{5} & 0 & 1 & \mathbf{4} & \mathbf{0} \\
1 & 1 & 1 & 8 & 6 & 6 & 1 & 0 & 4 & 0 \\
0 & \mathbf{3} & \mathbf{5} & 2 & 5 & \mathbf{2} & 5 & 7 & \mathbf{2} & \mathbf{4}
\end{array}
$$

, :

$$
\begin{array}{cccccccccc}
\mathbf{1} & 5 & 4 & \mathbf{5} & \mathbf{7} & 0 & \mathbf{8} & \mathbf{4} & 5 & 7 \\
\mathbf{9} & 8 & 0 & \mathbf{6} & \mathbf{2} & 0 & \mathbf{4} & \mathbf{8} & 8 & 8 \\
\mathbf{1} & 3 & 0 & \mathbf{5} & \mathbf{6} & 5 & \mathbf{1} & \mathbf{2} & 7 & 5 \\
\mathbf{7} & 6 & 6 & \mathbf{5} & \mathbf{5} & 6 & \mathbf{4} & \mathbf{1} & 0 & 0 \\
\mathbf{4} & 0 & 5 & \mathbf{4} & \mathbf{5} & 1 & \mathbf{6} & \mathbf{8} & 2 & 0 \\
0 & 1 & 5 & 6 & 0 & 5 & 6 & 0 & 2 & 5 \\
3 & 3 & 6 & 0 & 0 & 2 & 6 & 3 & 5 & 0 \\
6 & 6 & 3 & 5 & 2 & 5 & 0 & 1 & 4 & 0 \\
\mathbf{2} & 1 & 1 & \mathbf{9} & \mathbf{7} & 6 & \mathbf{2} & \mathbf{1} & 4 & 0 \\
0 & 3 & 5 & 2 & 5 & 2 & 5 & 7 & 3 & 5
\end{array}
$$

№2

1.

.

1	5	4	5	7	**[0]**	8	4	5	7
9	8	**[0]**	6	2	[0]	4	8	8	8
1	3	[0]	5	6	5	1	2	7	5
7	6	6	5	5	6	4	1	0	0
4	0	5	4	5	1	6	8	2	0
0	1	5	6	0	5	6	0	2	5
3	3	6	0	0	2	6	3	5	0
6	6	3	5	2	5	0	1	4	0
2	1	1	9	7	6	2	1	4	0
0	3	5	2	5	2	5	7	3	4

10 (
2), .

3.

: 10, 6, 2,
7, 1, 2, 1, 3, 4, 7.
( ):

1	5	4	5	7	0	8	4	5	7
9	8	0	6	2	0	4	8	8	8
1	3	0	**5**	**6**	**5**	1	**2**	**7**	5
7	6	6	5	5	6	4	1	0	0
4	0	5	**4**	**5**	**1**	6	**8**	**2**	0
0	1	5	6	0	5	6	0	2	5
3	3	6	0	0	2	6	3	5	0
6	6	3	**5**	**2**	**5**	0	**1**	**4**	0
2	1	1	**9**	**7**	**6**	2	**1**	**4**	0
0	3	5	**2**	**5**	**2**	5	**7**	**2**	4

(min(5, 6, 5, 2, 7, 4, 5, 1, 8, 2, 5, 2, 5, 1, 4, 9, 7, 6,
1, 4, 2, 5, 2, 7, 2) = 1) :

1	5	4	5	7	0	8	4	5	7
9	8	0	6	2	0	4	8	8	8
1	3	0	**4**	**5**	**4**	1	**1**	**6**	5
7	6	6	5	5	6	4	1	0	0
4	0	5	**3**	**4**	**0**	6	**7**	**1**	0
0	1	5	6	0	5	6	0	2	5
3	3	6	0	0	2	6	3	5	0
6	6	3	**4**	**1**	**4**	0	**0**	**3**	0
2	1	1	**8**	**6**	**5**	2	**0**	**3**	0
0	3	5	**1**	**4**	**1**	5	**6**	**1**	4

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:

2	**6**	**5**	5	7	0	**9**	4	5	**8**
10	**9**	**1**	6	2	0	**5**	8	8	**9**
1	3	0	4	**6**	**5**	1	**2**	6	**6**
8	**7**	**7**	5	5	6	**5**	1	0	**1**
4	0	5	3	**5**	**1**	6	**8**	1	**1**
1	**2**	**6**	6	0	**5**	**7**	0	2	**6**
4	**4**	**7**	0	**1**	**3**	**7**	3	5	**2**
7	**7**	**4**	5	**2**	**5**	0	**1**	4	**1**
2	**1**	**1**	**9**	**7**	**6**	2	**1**	4	**0**
0	**3**	**5**	2	5	**2**	5	**7**	3	**4**

№3

1.

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2	6	5	5	7	**[0]**	9	4	5	8
10	9	1	6	2	[0]	5	8	8	9
1	3	0	4	5	4	1	1	6	5
8	7	7	5	5	6	5	1	0	1
4	0	5	3	4	1	6	8	1	0
1	2	6	6	0	5	7	0	2	6
4	4	7	0	0	2	7	3	5	1
7	7	4	5	2	5	0	1	4	1
2	1	1	9	6	6	2	1	4	0
0	3	5	2	5	2	5	7	3	4

10 (
1), .

3.

: 5, 8, 7,
6, 8, 1, 3, 5, 4, 10.
( ):

2	**6**	**5**	**5**	7	0	**9**	4	**5**	8
10	**9**	**1**	**6**	2	0	**5**	8	**8**	9
1	3	0	4	5	4	1	1	6	5
8	7	7	5	5	6	5	1	0	1
4	0	5	3	4	1	6	8	1	0
1	**2**	**6**	**6**	0	**5**	**7**	0	**2**	6
4	4	7	0	0	2	7	3	5	1
7	7	4	**5**	**2**	**5**	0	**1**	4	1
2	**1**	**1**	**9**	6	**6**	2	**1**	4	0
0	**3**	**5**	**2**	5	**2**	5	**7**	3	4

(min(6, 5, 5, 9, 5, 9, 1, 6, 5, 8, 2, 6, 6, 7, 2, 1, 1, 8,
2, 3, 3, 5, 1, 5, 1) = 1) :

2	**5**	**4**	**4**	7	0	**8**	4	**4**	8
10	**8**	**0**	**5**	2	0	**4**	8	**7**	9
1	3	0	4	5	4	1	1	6	5
8	7	7	5	5	6	5	1	0	1
4	0	5	3	4	1	6	8	1	0
1	**1**	**5**	**5**	0	**5**	**6**	0	**1**	6
4	4	7	0	0	2	7	3	5	1
7	7	4	**4**	**1**	**4**	0	**0**	**3**	1
2	**0**	**0**	**8**	6	**5**	2	**0**	4	0
0	**2**	**4**	**1**	4	**1**	5	**6**	**0**	4

, :

2	5	4	4	7	0	8	4	4	8
10	8	0	5	2	0	4	8	7	9
2	3	0	4	**6**	**5**	1	**2**	6	**6**
9	7	7	5	**6**	**7**	5	**2**	0	**2**
5	0	5	3	**5**	**1**	6	**8**	1	**1**
1	1	5	5	0	5	6	0	1	6
5	4	7	0	**1**	**3**	7	**4**	5	**2**
8	7	4	5	**2**	**5**	0	**1**	4	**1**
2	0	0	8	6	5	1	0	4	0
0	2	4	1	4	1	5	6	1	4

№4

1. **.**

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2. , .

(1, 6). 1 6 .

(2; 6). (2, 3). 2

3 . (3; 3), (9; 3).

:

2	5	4	4	7	**[0]**	8	4	4	8
10	8	**[0]**	5	2	[−0−]	4	8	7	9
2	3	[−0−]	4	6	5	1	2	6	6
9	7	7	5	6	7	5	2	0	2
5	0	5	3	5	1	6	8	1	1
1	1	5	5	0	5	6	0	1	6
5	4	7	0	1	3	7	4	5	2
7	6	3	4	2	5	0	1	3	1
2	0	[−0−]	7	6	5	1	0	2	0
0	2	4	0	4	1	4	6	0	4

10 (

2), .

3. **.** :

9, 10, 3, 6, 6, 2, 4, 4, 8.

( ):

2	5	4	4	**7**	0	**8**	**4**	**4**	**8**
10	8	0	5	**2**	0	**4**	**8**	**7**	**9**
2	3	0	4	**6**	5	**1**	**2**	**6**	**6**
9	7	7	5	6	7	5	2	0	2
5	0	5	3	**5**	1	**6**	**8**	**1**	**1**
1	1	5	5	0	5	6	0	1	6
5	4	7	0	**1**	3	**7**	**4**	**5**	**2**
7	6	3	4	2	5	0	1	3	1
2	0	0	7	6	5	1	0	2	0
0	2	4	0	4	1	4	6	0	4

$(\min(2, 7, 8, 4, 4, 8, 10, 2, 4, 8, 7, 9, 2, 6, 1, 2, 6, 6, 5, 5, 6,$ 1) :

1	5	4	4	**6**	0	**7**	**3**	**3**	**7**
9	8	0	5	**1**	0	**3**	**7**	**6**	**8**
1	3	0	4	**5**	5	**0**	**1**	**5**	**5**
9	7	7	5	6	7	5	2	0	2
4	0	5	3	**4**	1	**5**	**7**	**0**	**0**
1	1	5	5	0	5	6	0	1	6
4	4	7	0	**0**	3	**6**	**3**	**4**	**1**
7	6	3	4	2	5	0	1	3	1
2	0	0	7	6	5	1	0	2	0
0	2	4	0	4	1	4	6	0	4

, :

1	5	4	4	6	0	7	3	3	7
9	8	0	5	1	0	3	7	6	8
1	3	0	4	5	5	0	1	5	5
9	**8**	**8**	**6**	6	**8**	5	2	0	2
4	0	5	3	4	1	5	7	0	0
1	**2**	**6**	**6**	0	**6**	6	0	1	6
4	4	7	0	0	3	6	3	4	1
7	**7**	**4**	**5**	2	**6**	0	1	3	1
2	**1**	**1**	**8**	6	**6**	1	0	2	0
0	**3**	**5**	**1**	4	**2**	4	6	0	4

№5

1. **.**

. ,

. .

2. , .

(1, 6). 1 6 .

(2; 6). (2, 3). 2

3 . (3; 3).

:

1	5	4	4	6	**[0]**	7	3	3	7
9	8	**[0]**	5	1	[−0−]	3	7	6	8
1	3	[−0−]	4	5	5	**[0]**	1	5	5
9	8	8	6	6	8	5	2	**[0]**	2
4	[−0−]	5	3	4	1	5	7	[−0−]	**[0]**
1	2	6	6	[−0−]	6	6	**[0]**	1	6
4	4	7	[−0−]	**[0]**	3	6	3	4	1
7	7	4	5	2	6	[−0−]	1	3	1
2	1	1	8	6	6	1	[−0−]	2	[−0−]
0	3	5	1	4	2	4	6	[−0−]	4

10 (

7), .

3. **.** :

5, 3, 6, 6, 7, 7, 9, 9, 10.

( ):

1	**5**	4	**4**	**6**	0	7	**3**	3	**7**
9	**8**	0	**5**	**1**	0	3	**7**	6	**8**
1	**3**	0	**4**	**5**	5	0	**1**	5	**5**
9	**8**	8	**6**	**6**	8	5	**2**	0	**2**
4	0	5	3	4	1	5	7	0	0
1	2	6	6	0	6	6	0	1	6
4	4	7	0	0	3	6	3	4	1
7	**7**	4	**5**	**2**	6	0	**1**	3	**1**
2	1	1	8	6	6	1	0	2	0
0	3	5	1	4	2	4	6	0	4

(min(1, 5, 4, 6, 3, 7, 9, 8, 5, 1, 7, 8, 1, 3, 4, 5, 1, 5, 9, 8, 6, 6

1) :

0	**4**	4	**3**	**5**	0	7	**2**	3	**6**
8	**7**	0	**4**	**0**	0	3	**6**	6	**7**
0	**2**	0	**3**	**4**	5	0	**0**	5	**4**
8	**7**	8	**5**	**5**	8	5	**1**	0	**1**
4	0	5	3	4	1	5	7	0	0
1	2	6	6	0	6	6	0	1	6
4	4	7	0	0	3	6	3	4	1
6	**6**	4	**4**	**1**	6	0	**0**	3	**0**
2	1	1	8	6	6	1	0	2	0
0	3	5	1	4	2	4	6	0	4

, :

0	4	4	3	5	0	7	2	3	6
8	7	0	4	0	0	3	6	6	7
0	2	0	3	4	5	0	0	5	4
8	7	8	5	5	8	5	1	0	1
4	0	**6**	3	4	**2**	**6**	7	**1**	0
1	2	**7**	6	0	**7**	**7**	0	**2**	6
4	4	**8**	0	0	**4**	**7**	3	**5**	1
6	6	4	4	1	6	0	0	3	0
2	1	**2**	8	6	**7**	**2**	0	**3**	0
0	3	**6**	1	4	**3**	**5**	6	**1**	4

№6

1. **.**

. ,

. .

2. , .

(1, 6). 1 6 .

(2; 6), (1; 1).

:

[−0−]	4	4	3	5	**[0]**	7	2	3	6
8	7	**[0]**	4	[−0−]	[−0−]	3	6	6	7
[−0−]	2	[−0−]	3	4	5	**[0]**	[−0−]	5	4
8	7	8	5	5	8	5	1	**[0]**	1
4	**[0]**	6	3	4	2	6	7	1	[−0−]
1	2	7	6	**[0]**	7	7	[−0−]	2	6
4	4	8	**[0]**	[−0−]	4	7	3	5	1
6	6	4	4	1	6	**[0]**	[−0−]	3	[−0−]
2	1	2	8	6	7	2	[−0−]	3	**[0]**
[0]	3	6	1	4	3	5	6	1	4

$k = 10$. C_e:

0	4	4	3	5	0	7	2	3	6
8	7	0	4	0	0	3	6	6	7
0	2	0	3	4	5	0	0	5	4
8	7	8	5	5	8	5	1	0	1
4	0	6	3	4	2	6	7	1	0
1	2	7	6	0	7	7	0	2	6
4	4	8	0	0	4	7	3	5	1
6	6	4	4	1	6	0	0	3	0
2	1	2	8	6	7	2	0	3	0
0	3	6	1	4	3	5	6	1	4

4. X,

( ) .

[−0−]	4	4	3	5	**[0]**	7	2	3	6
8	7	**[0]**	4	[−0−]	[−0−]	3	6	6	7
[−0−]	2	[−0−]	3	4	5	[−0−]	**[0]**	5	4
8	7	8	5	5	8	5	1	**[0]**	1
4	**[0]**	6	3	4	2	6	7	1	[−0−]
1	2	7	6	**[0]**	7	7	[−0−]	2	6
4	4	8	**[0]**	[−0−]	4	7	3	5	1
6	6	4	4	1	6	**[0]**	[−0−]	3	[−0−]
2	1	2	8	6	7	2	[−0−]	3	**[0]**
[0]	3	6	1	4	3	5	6	1	4

:

$$C_{\min} = 2 + 2 + 2 + 2 + 2 + 1 + 2 + 2 + 1 + 3 = 19$$

: (4;9), (5;2), (7;4), (1;6), (10;1), (2;3), (6;5), (8;7), (9;10), (3;8) : (4;9), (9;10), (10;1), (1;6), (6;5), (5;2), (2;3), (3;8), (8;7), (7;4)

. :

$$X_0 = (1,2);(2,3);(3,4);(4,5);(5,6);(6,7);(7,8);(8,9);(9,10);(10,1)$$

$$F(X_0) = 34 + 56 + 91 + 83 + 51 + 77 + 26 + 44 + 87 + 58 = 607.$$

,

D .

$$d_i = \min_j d_{ij}$$

i j	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	$\mathbf{d}_i$
1	M	34	68	18	63	80	12	44	58	87	12
2	56	M	56	94	62	65	18	38	67	22	18
3	34	53	M	91	13	73	70	51	13	37	13
4	28	19	14	M	83	89	25	9	89	22	9
5	67	13	1	19	M	51	7	13	31	4	1
6	3	78	24	90	14	M	77	6	35	69	3
7	96	32	100	4	8	19	M	26	37	36	4
8	79	2	48	25	63	99	17	M	44	45	2
9	97	49	33	74	23	72	23	73	M	87	23
10	58	83	24	39	17	76	64	78	100	M	17

d_i .

.

i j	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	M	22	56	6	51	68	0	32	46	75
2	38	M	38	76	44	47	0	20	49	4
3	21	40	M	78	0	60	57	38	0	24
4	19	10	5	M	74	80	16	0	80	13
5	66	12	0	18	M	50	6	12	30	3
6	0	75	21	87	11	M	74	3	32	66
7	92	28	96	0	4	15	M	22	33	32
8	77	0	46	23	61	97	15	M	42	43
9	74	26	10	51	0	49	0	50	M	64
10	41	66	7	22	0	59	47	61	83	M

, :

$$d_j = \min_i d_{ij}$$

i j	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	M	22	56	6	51	68	0	32	46	75
2	38	M	38	76	44	47	0	20	49	4
3	21	40	M	78	0	60	57	38	0	24
4	19	10	5	M	74	80	16	0	80	13
5	66	12	0	18	M	50	6	12	30	3
6	0	75	21	87	11	M	74	3	32	66
7	92	28	96	0	4	15	M	22	33	32
8	77	0	46	23	61	97	15	M	42	43
9	74	26	10	51	0	49	0	50	M	64
10	41	66	7	22	0	59	47	61	83	M
$\mathbf{d}_j$	0	0	0	0	0	15	0	0	0	3

, d_i d_j

.

i j	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	M	22	56	6	51	53	0	32	46	72
2	38	M	38	76	44	32	0	20	49	1
3	21	40	M	78	0	45	57	38	0	21
4	19	10	5	M	74	65	16	0	80	10
5	66	12	0	18	M	35	6	12	30	0
6	0	75	21	87	11	M	74	3	32	63
7	92	28	96	0	4	0	M	22	33	29
8	77	0	46	23	61	82	15	M	42	40
9	74	26	10	51	0	34	0	50	M	61
10	41	66	7	22	0	44	47	61	83	M

H:

$$H = \sum d_i + \sum d_j$$

$$H = 12+18+13+9+1+3+4+2+23+17+0+0+0+0+0+15+0+0+0+3 = 120$$

№1.

(i, j) (i^*, j^*).

M ( ) , .

i j	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	$\mathbf{d}_i$
1	M	22	56	6	51	53	0(6)	32	46	72	6
2	38	M	38	76	44	32	0(1)	20	49	1	1
3	21	40	M	78	0(0)	45	57	38	0(30)	21	0
4	19	10	5	M	74	65	16	0(8)	80	10	5
5	66	12	0(5)	18	M	35	6	12	30	0(1)	0
6	0(22)	75	21	87	11	M	74	3	32	63	3
7	92	28	96	0(6)	4	**0(32)**	M	22	33	29	0
8	77	0(25)	46	23	61	82	15	M	42	40	15
9	74	26	10	51	0(0)	34	0(0)	50	M	61	0
10	41	66	7	22	0(7)	44	47	61	83	M	7
$\mathbf{d}_j$	19	10	5	6	0	32	0	3	30	1	0

$d(1,7) = 6{+}0 = 6;$ $d(2,7) = 1{+}0 = 1;$ $d(3,5) = 0{+}0 = 0;$ $d(3,9) = 0{+}30 = 30$

$d(4,8) = 5{+}3 = 8;$ $d(5,3) = 0{+}5 = 5;$ $d(5,10) = 0{+}1 = 1;$ $d(6,1) = 3{+}19 = 2$

$d(7,4) = 0{+}6 = 6;$ $d(7,6) = 0{+}32 = 32;$ $d(8,2) = 15{+}10 = 25;$ $d(9,5) = 0{+}0$

$$d(9,7) = 0 + 0 = 0; \quad d(10,5) = 7 + 0 = 7;$$

$(0 + 32) = 32$ $(7,6)$, ,

$(7,6)$ $(7^*, 6^*)$.

$(7,6)$ $d_{76} = 0$ M,

$(7^*, 6^*)$, .

i j	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	$\mathbf{d}_i$
1	M	22	56	6	51	53	0	32	46	72	0
2	38	M	38	76	44	32	0	20	49	1	0
3	21	40	M	78	0	45	57	38	0	21	0
4	19	10	5	M	74	65	16	0	80	10	0
5	66	12	0	18	M	35	6	12	30	0	0
6	0	75	21	87	11	M	74	3	32	63	0
7	92	28	96	0	4	M	M	22	33	29	0
8	77	0	46	23	61	82	15	M	42	40	0
9	74	26	10	51	0	34	0	50	M	61	0
10	41	66	7	22	0	44	47	61	83	M	0
$\mathbf{d}_j$	0	0	0	0	0	32	0	0	0	0	32

:

$$H(7^*, 6^*) = 120 + 32 = 152$$

$(7, 6)$ 7- 6- ,
d_{67} M, .
$(9 \text{ x } 9)$, . :

i j	**1**	**2**	**3**	**4**	**5**	**7**	**8**	**9**	**10**	$\mathbf{d}_i$
1	M	22	56	6	51	0	32	46	72	0
2	38	M	38	76	44	0	20	49	1	0
3	21	40	M	78	0	57	38	0	21	0
4	19	10	5	M	74	16	0	80	10	0
5	66	12	0	18	M	6	12	30	0	0
6	0	75	21	87	11	M	3	32	63	0
8	77	0	46	23	61	15	M	42	40	0
9	74	26	10	51	0	0	50	M	61	0
10	41	66	7	22	0	47	61	83	M	0
$\mathbf{d}_j$	0	0	0	6	0	0	0	0	0	6

:

$$\sum d_i + \sum d_j = 6$$

$(7, 6)$:

$$H(7, 6) = 120 + 6 = 126 \leq 152$$

$(7,6)$, $(7^*,6^*)$, $(7,6)$
$H = 126.$