Lab 6

Minimum Cost Maximum Flow

You are given a directed graph $G = (V, E)$ containing n nodes and m edges (referred to as a "network" below). The nodes in the network are numbered from 1 to n, and the edges are numbered from 1 to m. The network has a source node s and a sink node t. Each edge (u, v) has a capacity $w(u, v)$ and a cost per unit of flow $c(u, v)$.

Your task is to determine a flow $f(u, v)$ for each edge (u, v), such that:

1. $0 \leq f(u, v) \leq w(u, v)$ (the flow on each edge does not exceed its capacity);
2. $\forall p \in \{V \setminus \{s, t\}\}$, $\sum_{(i,p)\in E} f(i, p) = \sum_{(p,i)\in E} f(p, i)$ (for every node other than the source and sink, the inflow equals the outflow);
3. $\sum_{(s,i)\in E} f(s, i) = \sum_{(i,t)\in E} f(i, t)$ (the total flow out of the source equals the total flow into the sink).

Define the total flow of the network as $F(G) = \sum_{(s,i)\in E} f(s, i)$, and the total cost of the network as

$$C(G) = \sum_{(i,j)\in E} f(i, j) \times c(i, j).$$

You need to find the **minimum cost maximum flow** of the network, i.e., maximize $F(G)$, and minimize $C(G)$ under the condition that $F(G)$ is maximized.

Input Format

The first line contains four integers n, m, s, t, representing the number of nodes n, the number of edges m, the source node s, and the sink node t, respectively.

The next m lines each contain four integers u_i, v_i, w_i, c_i, representing the starting node, ending node, capacity, and cost per unit of flow for the i-th edge.

Output Format

Output two integers, representing the maximum flow $F(G)$ and the minimum cost $C(G)$ when $F(G)$ is maximized.

Example

Sample Input

```
4 5 4 3
4 2 30 2
4 3 20 3
2 3 20 1
2 1 30 9
1 3 40 5
```

Sample Output

```
50 280
```