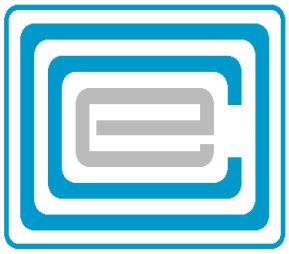

ECOO 2018

Programming Contest Questions

Regional Competition (Round 2)

April 28, 2018

Problem 1: Artificial Photosynthesystem

The technology world is currently working on a way to generate oxygen so that we can combat the effects of climate change. One of the ways that this is being done is through the creation of an artificial photosynthesystem.

The basic idea behind the process is that you need an artificial "leaf" and an artificial "fish" submerged into a vat of carbonated sugar water, which consists of sugar (S), water (W), oxygen (O), and carbon dioxide (C). The leaf is capable of photosynthesis, meaning it consumes some amount of carbon dioxide and water and produces sugar and oxygen. Likewise, the fish is capable of respiration, meaning that it consumes sugar and oxygen to produce carbon dioxide and water.

The plan is to create as much oxygen as possible in order to release it into the environment. There have been different experiments completed on the use of this technique, and each of the leaves and fish that were used have generated a different set of data.

Given the following input experimentation data, you are tasked with calculating the largest amount of oxygen that can be generated with this simple artificial photosynthesystem. Someone has already crunched through the data for you, and has calculated the approximate ratios of inputs versus outputs.

Input Specifications

DATA11.txt (DATA12.txt for the second try) will contain 10 datasets. Each data set consists of three lines.

- The first line contains four integers **C**, **O**, **W**, **S** ($1 \le \mathbf{C}, \mathbf{O}, \mathbf{W}, \mathbf{S} \le 10$), the number of units of each molecule in the initial carbonated sugar water solution.
- The second line contains four integers $\mathbf{C_i}$, $\mathbf{W_i}$, $\mathbf{S_o}$, $\mathbf{O_o}$ ($1 \le \mathbf{C_i}, \mathbf{W_i}, \mathbf{S_o}, \mathbf{O_o} \le 10$, $\mathbf{C_i} + \mathbf{W_i} > \mathbf{S_o} + \mathbf{O_o}$) representing the photosynthesis reaction: the leaf can consume $\mathbf{C_i}$ units of carbon dioxide and $\mathbf{W_i}$ units of water to produce $\mathbf{S_o}$ units of sugar and $\mathbf{O_o}$ units of oxygen.
- The third line contains four integers $\mathbf{S_i}$, $\mathbf{O_i}$, $\mathbf{C_o}$, $\mathbf{W_o}$ ($1 \le \mathbf{S_i}, \mathbf{O_i}, \mathbf{C_o}, \mathbf{W_o} \le 10$, $\mathbf{S_i} + \mathbf{O_i} > \mathbf{C_o} + \mathbf{W_o}$) representing the respiration reaction: the fish can consume $\mathbf{S_i}$ units of sugar and $\mathbf{O_i}$ units of oxygen to produce $\mathbf{C_o}$ units of carbon dioxide and $\mathbf{W_o}$ units of water.

Output Specifications

For each data set, output the maximum number units of oxygen that can be produced using the system.

Sample Input (Two Datasets Shown)

```
4 4 4 4
2 1 1 1
2 1 1 1
3 4 4 4
2 2 1 2
2 1 1 1
```

Sample Output

```
6
7
```

Explanation for Sample Dataset

In case one, photosynthesizing twice gives you 6 oxygen. In case two, respiring once gives enough carbon dioxide to photosynthesize twice, resulting in a total of 7 oxygen.

Problem 2: Homework

George has procrastinated too much on his **N** homework assignments, and now he is running out of time to finish them all.

Each of George's **N** assignments has a weight that it contributes to his grade and a deadline in days from today. George will need one day to finish any of the assignments and he must complete an assignment before it's deadline in order to submit it (he can't complete it the day an assignment is due).

Help George figure out the order in which he should complete his assignments such that the total weight of the assignments he completes is maximized.

Input Specifications

DATA21.txt (DATA22.txt for the second try) will contain 10 datasets. Each dataset begins with an integer **N** ($1 \le N \le 1{,}000{,}000$).

The next **N** lines contain an integer **D** and decimal **W** ($1 \le D \le 1{,}000{,}000$ $0 < W \le 100$), representing an assignment that has a deadline that is **D** days from today and a weight of **W**.

For the first seven cases, $N \le 1000$.

Output Specifications

For each dataset, output the maximum total weight of the assignments that George can complete, rounded to 4 decimal places (George is very meticulous about his grade).

Sample Input (Two Datasets Shown)

```
3
1 1.0
2 1.0
3 1.0
5
1 2.0
1 1.0
3 3.0
7 10.0
3 2.0
```

Sample Output

```
3.0000
17.0000
```

Problem 3: Factorial

The factorial of a number **N**, denoted as **N**!, is equal to the product of all natural numbers up to and including **N**. For example,

- 1! = 1
- 2! = 1x2 = 2
- 3! = 1x2x3 = 6
- 4! = 1x2x3x4 = 24

Given two numbers **K** and **M**, what is the smallest value of **N** such that **N**! has at least **M** factors of **K** (that is, $\mathbf{K}^{\mathbf{M}}$ divides evenly into **N**!)?

Input Specifications

DATA31.txt (DATA32.txt for the second try) will contain 10 datasets. Each dataset contains two integers **K, M** ($2 \le$ **K, M** $\le 1{,}000{,}000$).

For the first 4 cases, **K** is prime and **K*M** $\le 1{,}000$.
For the first 7 cases, **K*M** $\le 1{,}000{,}000$.

Output Specifications

For each dataset, output the minimum value of **N** such that **N!** has at least **M** factors of **K**.

Sample Input (Five Datasets Shown)

```
2 2
2 3
3 1
4 2
10 10
```

Sample Output

```
4
4
3
6
45
```

Problem 4: Three Squares

Given **N** distinct points on a 2D plane, you would like to place three identical, axis-aligned squares on the plane such that every point is either inside or on the border on one of the squares.

Let **L** be the side length of the squares. What is the minimum possible value of **L** such that all the points can be covered?

Input Specifications

DATA41.txt (DATA42.txt for the second try) will contain 10 datasets. Each dataset begins with an integer **N** ($4 \le \mathbf{N} \le 100{,}000$). The next **N** lines each contain two integers **X, Y** ($-10^9 \le \mathbf{X,Y} \le 10^9$), the points in the plane.

For the first 4 cases, $\mathbf{N} \le 30$.

Output Specifications

For each dataset, output the value of **L**.

Sample Input (Two Datasets Shown)

```
4
1 1
2 2
3 3
4 4
5
1 1
2 1
-2 -1
4 4
-4 -2
```

Sample Output

```
1
2
```


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