A - Approximation

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 150 points

Problem Statement

You are given a positive integer A and a positive odd integer B.

Output the integer whose difference from the real number $\frac{A}{B}$ is the smallest.

It can be proved that, under the constraints, such an integer is unique.

Constraints

- $1 \leq A \leq 407$
- $1 \leq B \leq 407$
- B is odd.
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$A \quad B$

Output

Output the integer that minimizes the difference from $\frac{A}{B}$.

Sample Input 1

```
4 7
```

Sample Output 1

```
1
```

We have $\frac{A}{B} = \frac{4}{7} = 0.5714\ldots$. The difference between $\frac{A}{B}$ and 1 is $\frac{3}{7} = 0.4285\ldots$, and no integer has a smaller difference.

Thus, print `1`.

Sample Input 2

```
407 29
```

Sample Output 2

```
14
```

We have $\frac{A}{B} = \frac{407}{29} = 14.0344\ldots$. The difference between $\frac{A}{B}$ and 14 is $\frac{1}{29} = 0.0344\ldots$, and no integer has a smaller difference.

Thus, print `14`.

Sample Input 3

```
22 11
```

Sample Output 3

```
2
```

$\frac{A}{B}$ may itself be an integer.

B - P(X or Y)

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 250 points

Problem Statement

Two dice, each with six faces $1, 2, 3, 4, 5, 6$, are rolled. Find the probability that at least one of the following two conditions holds:

- The sum of the two outcomes is at least X.
- The absolute difference of the two outcomes is at least Y.

Each face of each die is equally likely, and the two dice are independent.

Constraints

- $2 \leq X \leq 13$
- $0 \leq Y \leq 6$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

```
X Y
```

Output

Output the probability that the two outcomes satisfy at least one of the two conditions. Your answer is accepted if its absolute error from the true value is at most 10^{-9}.

Sample Input 1

```
9 3
```

Sample Output 1

```
0.55555555555555555555555555555
```

Let (x, y) denote the event that the dice show x and y.

- The sum is at least 9 for $(3, 6), (4, 5), (4, 6), (5, 4), (5, 5), (5, 6), (6, 3), (6, 4), (6, 5), (6, 6)$.
- The difference is at least 3 for $(1, 4), (1, 5), (1, 6), (2, 5), (2, 6), (3, 6), (4, 1), (5, 1), (5, 2), (6, 1), (6, 2), (6, 3)$.

At least one of these conditions holds for the following 20 pairs:
$(1, 4), (1, 5), (1, 6), (2, 5), (2, 6), (3, 6), (4, 1), (4, 5), (4, 6), (5, 1), (5, 2), (5, 4), (5, 5), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)$.

Thus, the answer is $\frac{20}{36} = \frac{5}{9} = 0.5555555555\ldots$.

Because an absolute error of at most 10^{-9} is allowed, outputs such as `0.5555555565` or `0.55555555456789` are accepted.

Sample Input 2

```
13 6
```

Sample Output 2

```
0
```

Neither the sum of two dice can be 13 or greater, nor can their difference be 6 or greater.

Thus, the answer is 0.

Sample Input 3

```
10 3
```

Sample Output 3

```
0.5
```

C - Security 2

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 300 points

Problem Statement

At the entrance of AtCoder Inc., there is a special pass-code input device. The device consists of a screen displaying one string, and two buttons.

Let t be the string shown on the screen. Initially, t is the empty string. Pressing a button changes t as follows:

- Pressing **button A** appends `0` to the end of t.
- Pressing **button B** replaces every digit in t with the next digit: for digits `0` through `8` the next digit is the one whose value is larger by 1; the next digit after `9` is `0`.

For example, if t is `1984` and button A is pressed, t becomes `19840`; if button B is then pressed, t becomes `20951`.

You are given a string S. Starting from the empty string, press the buttons zero or more times until t coincides with S. Find the minimum number of button presses required.

Constraints

- S is a string consisting of `0`, `1`, `2`, `3`, `4`, `5`, `6`, `7`, `8`, and `9`.
- $1 \leq |S| \leq 5 \times 10^5$, where $|S|$ is the length of S.

Input

The input is given from Standard Input in the following format:

```
S
```

Output

Output the answer.

Sample Input 1

```
21
```

Sample Output 1

```
4
```

The following sequence of presses makes t equal to `21`.

1. Press button A. t becomes `0`.
2. Press button B. t becomes `1`.
3. Press button A. t becomes `10`.
4. Press button B. t becomes `21`.

It is impossible to obtain `21` with fewer than four presses, so output `4`.

Sample Input 2

```
407
```

Sample Output 2

```
17
```

Sample Input 3

```
2025524202552420255242025524
```

Sample Output 3

```
150
```

D - Domino Covering XOR

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 425 points

Problem Statement

There is a grid with H rows and W columns. Let (i, j) denote the cell at the i-th row from the top $(1 \leq i \leq H)$ and the j-th column from the left $(1 \leq j \leq W)$.

Cell (i, j) $(1 \leq i \leq H, 1 \leq j \leq W)$ has a non-negative integer $A_{i,j}$ written on it.

Let us place zero or more dominoes on the grid. A domino covers two adjacent cells, namely one of the following pairs:

- cells (i, j) and $(i, j+1)$ for $1 \leq i \leq H, 1 \leq j < W$;
- cells (i, j) and $(i+1, j)$ for $1 \leq i < H, 1 \leq j \leq W$.

No cell may be covered by more than one domino.

For a placement of dominoes, define its **score** as the bitwise XOR of all integers written in cells **not** covered by any domino.

Find the maximum possible score.

▶ What is bitwise XOR?

Constraints

- $1 \leq H$
- $1 \leq W$
- $HW \leq 20$
- $0 \leq A_{i,j} < 2^{60}$ $(1 \leq i \leq H,\ 1 \leq j \leq W)$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$$
\begin{array}{l}
H \quad W \\
A_{1,1} \quad A_{1,2} \quad \ldots \quad A_{1,W} \\
A_{2,1} \quad A_{2,2} \quad \ldots \quad A_{2,W} \\
\vdots \\
A_{H,1} \quad A_{H,2} \quad \ldots \quad A_{H,W}
\end{array}
$$

Output

Output the answer.

Sample Input 1

```
3 4
1 2 3 8
4 0 7 10
5 2 4 2
```

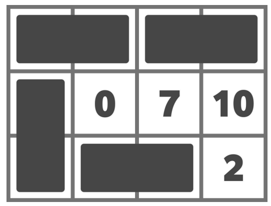
Sample Output 1

```
15
```

The grid is as follows:

1	2	3	8
4	0	7	10
5	2	4	2

For example, the placement below yields a score of 15.



No placement achieves a score of 16 or higher, so output `15`.

Sample Input 2

```
1 11
1 2 4 8 16 32 64 128 256 512 1024
```

Sample Output 2

```
2047
```

You may also choose to place no dominoes.

Sample Input 3

```
4 5
74832 16944 58683 32965 97236
52995 43262 51959 40883 58715
13846 24919 65627 11492 63264
29966 98452 75577 40415 77202
```

Sample Output 3

```
131067
```

E - Most Valuable Parentheses

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 450 points

Problem Statement

You are given a sequence of non-negative integers $A = (A_1, \ldots, A_{2N})$ of length $2N$.

Define the score of a parenthesis sequence s of length $2N$ as follows:

- For every position i where the i-th character of s is `)`, set A_i to 0, then take the sum of all elements of A.

Find the maximum possible score of a correct parenthesis sequence of length $2N$.

You are given T test cases; solve each.

▶ What is a correct parenthesis sequence?

Constraints

- $1 \leq T \leq 500$
- $1 \leq N \leq 2 \times 10^5$
- For each input file, the sum of N over all test cases is at most 2×10^5.
- $0 \leq A_i \leq 10^9$ ($1 \leq i \leq 2N$)
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$$
\begin{array}{l}
T \\
\mathrm{case}_1 \\
\mathrm{case}_2 \\
\vdots \\
\mathrm{case}_T
\end{array}
$$

case_i represents the i-th test case. Each test case is given in the following format:

$$
\begin{array}{l}
N \\
A_1 \\
A_2 \\
\vdots \\
A_{2N}
\end{array}
$$

Output

Output T lines. The i-th line ($1 \leq i \leq T$) should contain the answer for the i-th test case.

Sample Input 1

```
2
3
400
500
200
100
300
600
6
1000000000
1000000000
1000000000
1000000000
1000000000
1000000000
1000000000
1000000000
1000000000
1000000000
1000000000
1000000000
```

Sample Output 1

```
1200
6000000000
```

In the first test case, choosing the correct parenthesis string `(())()` gives a score of $400 + 500 + 0 + 0 + 300 + 0 = 1200$.

No correct parenthesis string yields a higher score, so the answer is 1200.

Note that, as in the second test case of this sample, the answer may exceed the 32-bit integer range.

F - Sums of Sliding Window Maximum

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 550 points

Problem Statement

You are given a sequence of non-negative integers $A = (A_1, \ldots, A_N)$ of length N.

For each $k = 1, \ldots, N$, solve the following problem:

- A has $N - k + 1$ (contiguous) subarrays of length k. Take the maximum of each of them, and output the sum of these maxima.

Constraints

- $1 \leq N \leq 2 \times 10^5$
- $0 \leq A_i \leq 10^7$ $(1 \leq i \leq N)$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

N
$A_1 \quad A_2 \quad \ldots \quad A_N$

Output

Output N lines. The i-th line $(1 \leq i \leq N)$ should contain the answer for $k = i$.

Sample Input 1

```
4
5 3 4 2
```

Sample Output 1

```
14
13
9
5
```

For $k = 1$, there are four subarrays of length $k = 1$:

- (5), whose maximum is 5;
- (3), whose maximum is 3;
- (4), whose maximum is 4;
- (2), whose maximum is 2.

The sum is $5 + 3 + 4 + 2 = 14$.

For $k = 2$, there are three subarrays of length $k = 2$:

- $(5, 3)$, whose maximum is 5;
- $(3, 4)$, whose maximum is 4;
- $(4, 2)$, whose maximum is 4.

The sum is $5 + 4 + 4 = 13$.

For $k = 3$, there are two subarrays of length $k = 3$:

- $(5, 3, 4)$, whose maximum is 5;
- $(3, 4, 2)$, whose maximum is 4.

The sum is $5 + 4 = 9$.

For $k = 4$, there is one subarray of length $k = 4$:

- $(5, 3, 4, 2)$, whose maximum is 5.

The sum is 5.

Sample Input 2

```
8
2 0 2 5 0 5 2 4
```

Sample Output 2

```
20
28
27
25
20
15
10
5
```

Sample Input 3

```
11
9203973 9141294 9444773 9292472 5507634 9599162 497764 430010 4152216 3574307 430010
```

Sample Output 3

```
61273615
68960818
69588453
65590626
61592799
57594972
47995810
38396648
28797486
19198324
9599162
```

G - Domino Covering SUM

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 600 points

Problem Statement

There is a grid with H rows and W columns. Let (i, j) denote the cell at the i-th row from the top $(1 \leq i \leq H)$ and the j-th column from the left $(1 \leq j \leq W)$.

Cell (i, j) $(1 \leq i \leq H, 1 \leq j \leq W)$ has an integer $A_{i,j}$ written on it.

Let us place zero or more dominoes on the grid. A domino covers two adjacent cells, namely one of the following pairs:

- cells (i, j) and $(i, j+1)$ for $1 \leq i \leq H, 1 \leq j < W$;
- cells (i, j) and $(i+1, j)$ for $1 \leq i < H, 1 \leq j \leq W$.

No cell may be covered by more than one domino.

For a placement of dominoes, define its **score** as the sum of all integers written in cells **not** covered by any domino.

Find the maximum possible score.

Constraints

- $1 \leq H$
- $1 \leq W$
- $HW \leq 2000$
- $-10^{12} \leq A_{i,j} \leq 10^{12}$ $(1 \leq i \leq H, 1 \leq j \leq W)$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$$
\begin{array}{l}
H \quad W \\
A_{1,1} \quad A_{1,2} \quad \ldots \quad A_{1,W} \\
A_{2,1} \quad A_{2,2} \quad \ldots \quad A_{2,W} \\
\vdots \\
A_{H,1} \quad A_{H,2} \quad \ldots \quad A_{H,W}
\end{array}
$$

Output

Output the answer.

Sample Input 1

```
3 4
3 -1 -4 1
-5 9 -2 -6
-5 3 -5 8
```

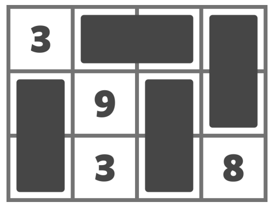
Sample Output 1

```
23
```

The grid is as follows:

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

For example, the placement below yields a score of 23.



No placement achieves a score of 24 or higher, so output `23`.

Sample Input 2

```
5 5
-70 11 -45 -54 -30
-99 39 -83 -69 -77
-48 -21 -43 -96 -24
-54 -65 21 -88 -44
-90 -33 -67 -29 -62
```

Sample Output 2

```
39
```

Sample Input 3

```
8 9
-74832 16944 58683 32965 97236 -52995 43262 -51959 40883
-58715 13846 24919 65627 -11492 -63264 29966 -98452 -75577
40415 77202 15542 -50602 83295 85415 -35304 46520 -38742
37482 56721 -38521 63127 55608 95115 42893 10484 70510
53019 40623 25885 -10246 70973 32528 -33423 19322 52097
79880 74931 -58277 -33783 91022 -53003 11085 -65924 -63548
78622 -77307 81181 46875 -81091 63881 11160 -82217 -55492
62770 39530 -95923 92440 -69899 77737 89392 -14281 84899
```

Sample Output 3

```
2232232
```