Training 3 - EXHSEARCH - 20211

A. 03. TSP

1 second, 256 megabytes

Một người du lịch xuất phát từ thành phố thứ nhất muốn đi thăm quan tất cả $n-1$ thành phố khác. mỗi thành phố đúng một lần, rồi quay trở lại thành phố xuất phát.

Yêu cầu: Cho biết chi phí đi lại giữa các thành phố, hãy giúp người du lịch tìm hành trình với tổng chi phí là nhỏ nhất.

Input

Dòng đầu tiên chứa hai số nguyên dương n, m cách nhau bởi dấu cách ($n \leq 20, m < 400$).

m dòng tiếp theo mỗi dòng chứa ba số nguyên dương i, j, c ($i, j \leq n, c \leq 10^6$) biểu thị chi phí đi trực tiếp từ thành phố i đến thành phố j là c.

Lưu ý: nếu từ thành phố i đến thành phố j nào không mô tả chi phí đi lại thì có nghĩa là không có đường đi trực tiếp từ i đến j.

Output

Ghi ra duy nhất một số là tổng chi phí hành trình nhỏ nhất tìm được.

input

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

output

```
5
```

B. 03. KNAPSAC

1 second, 256 megabytes

Một nhà thám hiểm cần đem theo một cái túi có trọng lượng không quá b. Có n đồ vật có thể đem theo. Đồ vật thứ j có trọng lượng a_j và giá trị sử dụng c_j. Hỏi nhà thám hiểm cần đem theo những đồ vật nào để cho tổng giá trị sử dụng là lớn nhất mà tổng trọng lượng đồ vật mang theo cái túi không vượt quá b?

Input

Dòng đầu tiên chứa hai số nguyên dương n, b ($n \leq 30, b \leq 10^6$).

Dòng thứ j trong số n dòng tiếp theo mỗi dòng ghi ra hai số nguyên dương $a_j, c_j \leq 10^6$.

Output

Ghi ra duy nhất một số là tổng giá trị lớn nhất tìm được của các đồ vật cho vào túi.

input

```
2 6
4 2
3 2
```

output

```
2
```

C. 03. BCA

1 second, 256 megabytes

At the beginning of the semester, the head of a computer science department D have to assign courses to teachers in a balanced way. The department D has m teachers $T = \{1, 2, \ldots, m\}$ and n courses $C = \{1, 2, \ldots, n\}$. Each teacher $t \in T$ has a preference list which is a list of courses he/she can teach depending on his/her specialization. We known a list of pairs of conflicting two courses that cannot be assigned to the same teacher as these courses have been already scheduled in the same slot of the timetable. The load of a teacher is the number of courses assigned to her/him. How to assign n courses to m teacher such that each course assigned to a teacher is in his/her preference list, no two conflicting courses are assigned to the same teacher, and the maximal load is minimal.

Input

The input consists of following lines

- Line 1: contains two integer m and n ($1 \leq m \leq 10$, $1 \leq n \leq 30$)
- Line i+1: contains an positive integer k and k positive integers indicating the courses that teacher i can teach ($\forall i = 1, \ldots, m$)
- Line $m + 2$: contains an integer k
- Line $i + m + 2$: contains two integer i and j indicating two conflicting courses ($\forall i = 1, \ldots, k$)

Output

The output contains a unique number which is the maximal load of the teachers in the solution found and the value -1 if not solution found.

input

```
4 12
5 1 3 5 10 12
5 9 3 4 8 12
6 1 2 3 4 9 7
7 1 2 3 5 6 10 11
25
1 2
1 3
1 5
2 4
2 5
2 6
3 5
3 7
3 10
4 6
4 9
5 6
5 7
5 8
6 8
6 9
7 8
7 10
7 11
8 9
8 11
8 12
9 12
10 11
11 12
```

output

```
3
```

D. 03. CBUS

1 second, 256 megabytes

There are n passengers $1, 2, \ldots, n$. The passenger i want to travel from point i to point $i + n(i = 1, 2, \ldots, n)$. There is a bus located at point 0 and has k places for transporting the passengers (it means at any time, there are at most k passengers on the bus). You are given the distance matrix c in which $c(i, j)$ is the traveling distance from point i to point $j(i, j = 0, 1, \ldots, 2n)$. Compute the shortest route for the bus, serving n passengers and coming back to point 0 without visiting any point more than once (except for the point 0).

Input

Line 1 contains n and $k(1 \leq n \leq 11, 1 \leq k \leq 10)$. Line $i + 1(i = 1, 2, \ldots, 2n + 1)$ contains the $(i-1)^{th}$ line of the matrix c (rows and columns are indexed from $0, 1, 2, .., 2n$).

Output

Unique line contains the length of the shortest route.

input

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

output

```
25
```

E. 03. BACP

5 seconds, 256 megabytes

The BACP is to design a balanced academic curriculum by assigning periods to courses in a way that the academic load of each period is balanced . There are N courses $1, 2, \ldots, N$ that must be assigned to M periods $1, 2, \ldots, M$. Each courses i has credit c_i and has some courses as prerequisites. The load of a period is defined to be the sum of credits of courses assigned to that period. The prerequisites information is represented by a matrix $A_{N \times N}$ in which $A_{i,j}$ = 1 indicates that courses i must be assigned to a period before the period to which the course j is assigned. Compute the assignment such that the maximum load for all periods is minimal.

Input

- Line 1 contains N and M $(2 \leq N \leq 16, 2 \leq M \leq 5)$
- Line 2 contains $c_1, c_2, \ldots, c_N$
- Line $i + 2(i = 1, \ldots, N)$ contains the i^{th} line of the matrix A

Output

Unique line contains that maximum load for all periods of the solution found

input

```
6 2
4 4 4 4 2 4
0 0 0 0 0 0
0 0 0 0 0 0
0 0 0 0 0 0
0 0 1 0 0 0
0 0 1 0 0 0
1 0 0 0 0 0
```

output

```
12
```

F. 03. TAXI

1 second, 256 megabytes

There are n passengers $1, 2, \ldots, n$. The passenger i want to travel from point i to point $i + n(i = 1, 2, \ldots, n)$. There is a taxi located at point 0 for transporting the passengers. Given the distance matrix $c(2n+1) * (2n+1)$ in which $c(i, j)$ is the traveling distance from point i to point $j(i, j = 0, 1, \ldots, 2n)$ Compute the shortest route for the taxi, serving n passengers and coming back to point 0 such that at any moment, there are no more than one passenger in the taxi, and no point is visited more than once (except for point 0, which can be visited up to twice).

Input

Line 1 contains $n(1 \leq n \leq 11)$. Line $i + 1(i = 1, 2, \ldots, 2n+1)$ contains the ith line of the matrix c.

Output

Unique line contains the length of the shortest route.

input

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

output

```
17
```

G. 03. CVRPCOUNT

1 second, 256 megabytes

A fleet of K identical trucks having capacity Q need to be scheduled to delivery pepsi packages from a central depot 0 to clients $1, 2, \ldots, n$. Each client i requests $d[i]$ packages.

- Each client is visited exactly by one route
- Total number of packages requested by clients of each truck cannot exceed its capacity
- Each truck must visit at least one client

Goal

- Compute number R of solutions

Note that: the orders of clients in a route is important, e.g., routes 0 -> 1 -> 2 -> 3 -> 0 and 0 -> 3-> 2 -> 1 -> 0 are different.

Input

- Line 1: n, K, Q $(2 \leq n \leq 10, 1 \leq K \leq 5, 1 \leq Q \leq 20)$
- Line 2: $d[1], \ldots, d[n]$ $(1 \leq d[i] \leq 10)$

Output

R mod $10^9 + 7$

input

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

output

```
4
```

There are 4 solutions

- route[1] = 0 -> 1 -> 0 and route[2] = 0 -> 2 -> 3 -> 0
- route[1] = 0 -> 1 -> 3 -> 0 and route[2] = 0 -> 2 -> 0
- route[1] = 0 -> 1 -> 0 and route[2] = 0 -> 3 -> 2 -> 0
- route[1] = 0 -> 2 -> 0 and route[2]= 0 -> 3 -> 1 -> 0

H. 03. CVRP OPT

1.5 seconds, 256 megabytes

A fleet of K identical trucks having capacity Q need to be scheduled to delivery pepsi packages from a central depot 0 to clients $1, 2, \ldots, n$. Each client i requests $d[i]$ packages. The distance from location i to location j is $c[i, j]$, $0 \leq i, j \leq n.$. A delivery solution is a set of routes: each truck is associated with a route, starting from depot, visiting some clients and returning to the depot for deliverying requested pepsi packages such that:

- Each client is visited exactly by one route
- Total number of packages requested by clients of each truck cannot exceed its capacity
- Each truck must visit at least one client

Goal

- Find a solution having minimal total travel distance

Note that: the orders of clients in a route is important, e.g., routes 0 -> 1 -> 2 -> 3 -> 0 and 0 -> 3-> 2 -> 1 -> 0 are different.

Input

- Line 1: n, K, Q $(2 \leq n \leq 12, 1 \leq K \leq 5, 1 \leq Q \leq 50)$
- Line 2: $d[1], \ldots, d[n]$ $(1 \leq d[i] \leq 10)$
- Line $i+3$: the i^{th} row of the distance matrix $c(i = 0, \ldots, n)$ ($1 \leq c[i, j] \leq 30$)

Output

Minimal total travel distance

input

```
4 2 15
7 7 11 2
0 12 12 11 14
14 0 11 14 14
14 10 0 11 12
10 14 12 0 13
10 13 14 11 0
```

output

```
70
```

K. CNK

1 second, 256 megabytes

Cho hai số nguyên dương n, k và một số nguyên tố m sao cho $k < n, m$. Tính giá trị $C_n^k \ mod \ m$.

Input

Dòng đầu tiên chứa số test T.

T dòng tiếp theo, mỗi dòng chứa ba số nguyên n, k, m.

Output

Gồm T dòng, mỗi dòng chứa một số nguyên duy nhất là kết quả phép toán $C_n^k \ mod \ m$.

input

```
2
7 3 7
5 2 7
```

output

```
0
3
```

Số test $T <= 10$

Subtask 1 (30%) : $n, k <= 100$.

Subtask 2 (30%) : $n * k <= 10^5$.

Subtask 3 (20%) : $m <= 10^9 + 7$, $k <= 10^5$

Subtask 4 (20%) : $m, n <= 10^{18}$, $k <= 10^5$

M. DIGITS

1 second, 256 megabytes

Write C program that reads an integer value N from stdin, prints to stdout the number Q ways to assign values 1, 2, …, 9 to characters I, C, T, H, U, S, K (characters are assigned with different values) such that: $ICT - K62 + HUST = N$

Input

Unique line contains an integer N $(1 \leq N \leq 10^5)$

Output

Write the value Q

input
2000
output
28

N. PERMUTATIONGEN

1 second, 256 megabytes

Cho 1 một hoán vị H độ dài n với các thành phần nằm trong tập $\{1, 2, \ldots, n\}$. Tìm hoán vị kế tiếp của hoán vị H trong thứ tự từ điển.

Input

Dòng đầu ghi 1 số nguyên dương $n \leq 10^4$.

Dòng thứ 2 ghi n số nguyên dương $\leq n$ cách nhau bởi dấu cách là hoán vị H.

Output

Ghi ra hoán vị H trên một dòng duy nhất, các thành phần cách nhau bởi dấu cách. Nếu không tồn tại thì ghi ra -1.

input
5 3 2 1 5 4
output
3 2 4 1 5

O. PERMUTATIONLIST

1 second, 256 megabytes

Cho 1 một số n. Đưa ra hoán vị độ dài n thứ k trong thứ tự từ điển.

Input

Dòng đầu ghi 2 số nguyên dương n, k $(n \leq 10^4, k \leq 10^9)$ cách nhau bởi dấu cách.

Output

Ghi ra hoán vị thứ k trên một dòng duy nhất, các thành phần cách nhau bởi dấu cách. Nếu không tồn tại thì ghi ra -1.

input
1 2
output
-1

input
3 4
output
2 3 1

P. COMBINATIONGEN

1 second, 256 megabytes

Cho 1 một chuỗi tổ hợp C độ dài m với các thành phần nằm trong tập $\{1, 2, \ldots, n\}$. Tìm chuỗi tổ hợp kế tiếp của chuỗi C trong thứ tự từ điển.

Input

Dòng đầu 2 số nguyên dương $n, m \leq 10^4$.

Dòng thứ 2 ghi m số nguyên dương $\leq n$ cách nhau bởi dấu cách.

Output
Ghi ra chuỗi C trên một dòng duy nhất, các thành phần cách nhau bởi dấu cách. Nếu không tồn tại thì ghi ra -1.

input
```
5 3
2 3 5
```
output
```
2 4 5
```

Q. COMBINATIONLIST

1 second, 256 megabytes

Cho 2 số nguyên dương n, m. Đưa ra chuỗi tổ hợp chập m của n phần tử trong tập $\{1, 2, \ldots n\}$ thứ k trong thứ tự từ điển.

Input
Dòng đầu ghi 3 số nguyên dương n, m, k cách nhau bởi dấu cách, $n, m \leq 10^4; k \leq 10^9$.

Output
Ghi ra chuỗi tổ hợp chập m của n phần tử thứ k trên một dòng duy nhất, các thành phần cách nhau bởi dấu cách. Nếu không tồn tại thì ghi ra -1.

input
```
1 1 1
```
output
```
1
```

input
```
4 3 6
```
output
```
-1
```

R. BINARYGEN

1 second, 256 megabytes

Cho 1 một xâu nhị phân S độ dài n. Tìm xâu nhị phân kế tiếp của xâu S trong thứ tự từ điển.

Input
Dòng đầu 1 số nguyên dương $n \leq 10^4$.

Dòng thứ 2 ghi n số 0 hoặc 1 liên tiếp nhau.

input
```
5
00100
```
output
```
00101
```

Ghi ra xâu nhị phân kế tiếp của xâu S trên một dòng duy nhất. Nếu không tồn tại thì ghi ra -1.

S. BINARYLIST

1 second, 256 megabytes

Cho 1 số nguyên dương n. Đưa ra xâu nhị phân độ dài n thứ k trong thứ tự từ điển mà không có i số 0 liên tiếp.

Input
Dòng đầu ghi 3 số nguyên dương n, k, i trong đó $n, i \leq 10^4, k \leq 10^9$ cách nhau bởi dấu cách

Output

Ghi ra xâu nhị phân độ dài n thứ k mà không có i số 0 liên tiếp trên một dòng duy nhất, các thành phần cách nhau bởi dấu cách. Nếu không tồn tại thì ghi ra -1.

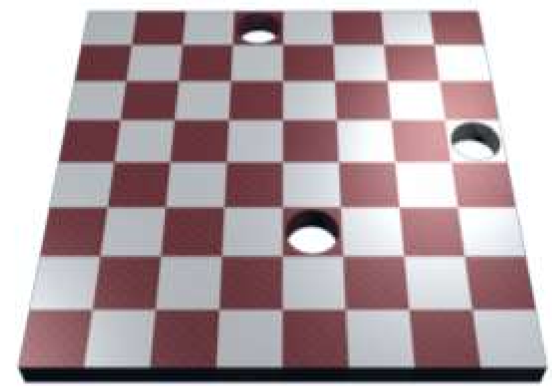
input
6 4 2
output
0 1 1 0 1 0

input
2 3 10
output
1 0

T. HOLEY N QUEENS

1 second, 256 megabytes

The N-queens problem is the problem of placing N queens on a N × N chessboard so that no queen shares a row, column or a diagonal with any other queen. Essentially, we are trying to place the queens without any queen threatening another. For example, the first image below (without holes in the board) is a solution to the 8-queens problem.



For this problem, consider the problem we'll call the 'holey N-queens problem'. Instead of having an everyday chessboard (of arbitrary size), your chessboard is like the second image above (without queens): it has holes through some of the squares. You can't place a queen on a square that has a hole, but a queen can threaten another even if there is a hole on the path between them. Given a holey chessboard, you must find placements for the N queens so that no queen threatens another. The third image above (with holes and queens) shows one such solution.

Input

Input consists of up to 1000 board descriptions. Each description starts with a line containing a pair of integers, 3 ≤ N ≤ 12 and 0 ≤ M ≤ N2, indicating respectively the size of one side of the board, and the number of holes. The next M lines each describe the location of a unique hole in the board. A hole is described by its row and column, each in the range [1, N]. The end of input is marked by values of zero for N and M.

Output

For each problem description, print out the number of unique N-queens solutions that are possible. Two solutions are considered different if any space is occupied by a queen in one solution but not in the other.

input

```
8 0
8 3
1 4
6 5
4 8
0 0
```

output

```
92
50
```

U. 05. NURSE

1 second, 256 megabytes

The director of a hospital want to schedule a working plan for a nurse in a given period of N consecutive days 1,..., N. Due to the policy of the hospital, each nurse cannot work all the days 1,..., N. Instead, there must be days off in which the nurse need to take a rest. A working plan is a sequence of disjoint working periods. A working period of a nurse is defined to be a sequence of consecutive days on which the nurse must work and the length of the working period is the number of consecutive days of that working period. The hospital imposes two constraints:

- Each nurse can take a rest only one day between two consecutive working periods. it means that if the nurse takes a rest today, then she has to work tomorrow (1)
- The length of each working period must be greater or equal to K_1 and less than or equal to K_2 (2)

The director of the hospital want to know how many possible working plans satisfying above constraint?

Input

The input consists of one line which contains 3 positive integers $N, K_1, K_2 (N \leq 1000, K_1 < K_2 \leq 400)$

Output

The output consists of only one single integer M modulo $10^9 + 7$ where M is the total working plans satisfying the above constraints.

input
6 2 3
output
4

V. KPATH

1 second, 256 megabytes

A k-path on a given undirected graph is a path having exactly k edges and containing no repeated nodes. Given an undirected graph G and an integral value k, count how many k-paths on G.

Input

The input consists of following lines

- Line 1: contains two integer n and k ($1 \le n \le 30, 1 \le k \le 10$) in which n is the number of nodes of the graph G (nodes are numbered 1,2,...,n)
- Line 2: contains an integer m ($1 \le m \le 60$) which is the number of edges of G
- Line $i + 2$: contains two integers u and v representing two end points of the i^{th} edge of G ($\forall i = 1, \ldots, m$)

Output

The output contains the number of k-paths of G

input
4 3 5 1 2 1 3 1 4 2 3 3 4
output
6

W. ROUTING

1 second, 256 megabytes

Superior Island is a very picturesque island and only bicycles are allowed on the island. Therefore, there are many one-way bicycle roads connecting the different best photo-shooting spots on the island. To help the visitors plan their trip to the island, the tourism commission wants to designate r different bicycle routes that go through some of the best photo-shooting spots on the island. Given a map of all the bicycle roads on the island and a list of the best photo-shooting spots to be included on each of the three planned routes (non-listed spots must not be included in the route), please write a program to plan each of the r routes so that the distance on each route is minimal. Note that each best photo-shooting spot may only appear at most once on the route.

Input

There are two parts to the input. The first part of input gives the information of the bicycle roads on the island. The first line contains two integer n and r , $n \le 100$ and $r \le 10$, indicating that there are n best photo-shooting spots on the island and there are r routes to be planned. The next n lines (line 2 through line $n + 1$) contains $n \times n$ integers (n lines with n integers on each line), where the j -th integer on line i denotes the distance from best photo-shooting spot $i - 1$ to best photo-shooting spot j ; the distances are all between 0 and 10, where 0 indicates that there is no one-way road going from best photo-shooting spot $i - 1$ to spot j.

The second part of input has r lines, denoting the r sightseeing routes to be planed. Each line lists the best photo-shooting stops to be included in that route. The integers on each line denote the recommended photo-shooting stops on that particular sightseeing route. The first integer on the line is the starting point of the route and the last integer is the last stop on the route. However, the stops in between can be visited in any order.

Output

Output r integers on r lines (one integer per line) indicating the distance of each of the r planned routes. If a route is not possible, output '0'.

input

```
6 3
0 1 2 0 1 1
1 0 1 1 1 0
0 2 0 1 3 0
4 3 1 0 0 0
0 0 1 1 0 0
1 0 0 0 0 0
1 3 5
6 3 2 5
6 1 2 3 4 5
```

output

```
5
0
7
```

X. CNK RM

1 second, 256 megabytes

Cho các số nguyên dương k, n $(k < n)$. Hãy tính giá trị C_n^k module $10^9 + 7$

Input

Một dòng chứa 2 số nguyên dương k và n $(1 \leq k < n \leq 1000)$

Output

Ghi ra giá trị C_n^k module $10^9 + 7$

input

```
3 5
```

output

```
10
```

Z. CONTAINER

1 second, 256 megabytes

There is a container having horizontal size W and vertical size H. There are N rectangle items 1, 2, ..., N in which item i has horizontal size w_i and vertical size h_i. Find the way to place these N items into the container such that

- The sides of items are packed in parallel with the sides of the container
- The items cannot rotated
- No two items overlap.

Input

The input consists of following lines

- Line 1: contains two integer H and W $(1 \leq H, W \leq 30)$
- Line 2: contains N $(1 \leq N \leq 12)$
- Line $i + 2$ $(\forall i = 1, \ldots, N)$: contains two integers h_i and w_i

Output

The output contains a unique number 0 (if we cannot place items) or 1 (if we can place items)

input

```
6 4
3
2 3
6 1
4 3
```

output
1

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