PopSwap (popswap)

For a given integer N, S_N is the set of all permutations of $(0, ..., N-1)$.
Furthermore, E_N is the set of all ordered pairs (p, q) where:

- p and q are elements of S_N;
- p and q can be obtained from each other by swapping two adjacent elements.

Note that, if $(p, q) \in E_N$, then $(q, p) \in E_N$.

Your goal is to label each element of S_N with an unique natural number in $[0, 2^{60})$, i.e. to produce an injective function[1] $\mathcal{L}$ (called a *labeling*) from S_N to the set of natural numbers less than 2^{60}.

The quality of a labeling is measured by two parameters which should minimized:

- the *magnitude* $M(\mathcal{L})$, defined to be the smallest natural k number such that $2^k > \mathcal{L}(p)$ for all elements p of S_N.
- the *closeness*, defined to be:

$$C(\mathcal{L}) = \sum_{(u,v) \in E_N} \text{popcount}(\mathcal{L}(u) \oplus \mathcal{L}(v)).$$

  where $\oplus$ is the bitwise exclusive or and $\text{popcount}(x)$ is the number of set bits in the binary representation of x.

Your task is to find a labeling $\mathcal{L}$ that achieves low values for both $M(\mathcal{L})$ and $C(\mathcal{L})$. Note that an optimal solution is not required.

Implementation

This is an output-only task. You should submit a separate output file for each input file. Input and output files should follow the following format.

Input format

The input files consist of a single line containing an integer N and the index G of the input.

Output format

The output files should consist of $N!$ lines, the i-th of which contains the label of the i-th permutation in lexicographical order.[2]

Scoring

This task has exactly 2 test cases: `input000.txt` and `input001.txt`, in both of which $N = 10$.

The score for your solution on each test case is determined as $S_M(\mathcal{L}) \times S_C(\mathcal{L})$, where $S_C(\mathcal{L})$ and $S_M(\mathcal{L})$ are functions of your output labeling $\mathcal{L}$.

- $S_C(\mathcal{L}) = \left(\min(1, 36 \cdot 10^6 / C(\mathcal{L}))\right)^2$ for every input.
- $S_M(\mathcal{L})$ is different for every input, according to the following tables. Between the values specified in the tables, S_M varies linearly.

A malformed output always scores zero points.

[1] A function is said to be injective if it maps distinct elements to distinct elements

[2] Formally, given two permutations $p \neq q$, we say that p is lexicographically smaller than q if and only if $p_k < q_k$ where k is the smallest index such that $p_k \neq q_k$.

input000.txt

$M(\mathcal{L})$	$S_M(\mathcal{L})$
> 60	0
60	6
≤ 25	60

input001.txt

$M(\mathcal{L})$	$S_M(\mathcal{L})$
> 25	0
25	0
≤ 22	40

The score for the task is the sum of the score on each test case.

Examples

input	output

`3 -1`	`32`
	`16`
	`8`
	`4`
	`2`
	`1`

Explanation

Note that the **first sample case** is not an official test case, since $N \neq 10$ and $G \notin \{0, 1\}$.
The sample output represents the following labeling:

$$\mathcal{L}(p) = \begin{cases} 32 \text{ if } p = (0,1,2) \\ 16 \text{ if } p = (0,2,1) \\ 8 \quad \text{if } p = (1,0,2) \\ 4 \quad \text{if } p = (1,2,0) \\ 2 \quad \text{if } p = (2,0,1) \\ 1 \quad \text{if } p = (2,1,0) \end{cases}$$

Since $2^5 \not> 32$ but $2^6 > 32$, the magnitude of the labeling is $M(\mathcal{L}) = 6$.
Since there are $3! \cdot (3-1) = 12$ elements in E_3 and since $\text{popcount}(\mathcal{L}(p), \mathcal{L}(q)) = 2$ for all $p, q \in S_N$, the closeness of the labeling is $C(\mathcal{L}) = 12 \cdot 2 = 24$.