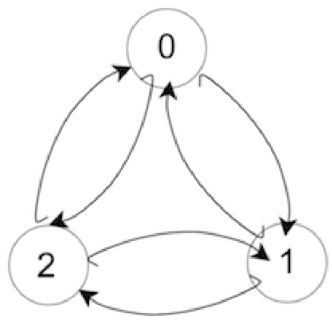
Diameter Minimization

HackerRank

We define the diameter of a strongly-connected oriented graph, $G = (V, E)$, as the minimum integer d such that for each $u, v \in G$ there is a path from u to v of length $\leq d$ (recall that a path's length is its number of edges).

Given two integers, n and m, build a strongly-connected oriented graph with n vertices where each vertex has outdegree m and *the graph's diameter is as small as possible* (see the *Scoring* section below for more detail). Then print the graph according to the *Output Format* specified below.

Here's a sample strongly-connected oriented graph with 3 nodes, whose outdegree is 2 and diameter is 1.



Note: Cycles and multiple edges between vertices are allowed.

Input Format

Two space-separated integers describing the respective values of n (the number of vertices) and m (the outdegree of each vertex).

Constraints

- $2 \leq n \leq 1000$
- $2 \leq m \leq \min(n, 5)$

Scoring

We denote the diameter of your graph as d and the diameter of the graph in the author's solution as s. Your score for each test case (as a real number from 0 to 1) is:

- 1 if $d \leq s + 1$
- $\frac{s}{d}$ if $s + 1 < d \leq 5 \times s$
- 0 if $5 \times s < d$

Output Format

First, print an integer denoting the diameter of your graph on a new line.
Next, print n lines where each line i ($0 \leq i < n$) contains m space-separated integers in the inclusive range from 0 to $n-1$ describing the endpoints for each of vertex i's outbound edges.

Sample Input 0

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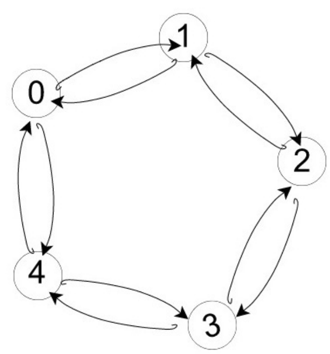
5 2
```

Sample Output 0

```
2
1 4
2 0
3 1
4 2
0 3
```

Explanation 0

The diagram below depicts a strongly-connected oriented graph with $n = 5$ nodes where each node has an outdegree of $m = 2$:



The diameter of this graph is $d = 2$, which is minimal as the outdegree of each node must be m. We cannot construct a graph with a smaller diameter of $d = 1$ because it requires an outbound edge from each vertex to each other vertex in the graph (so the outdegree of that graph would be $n-1$).