Problem D

Cholesky Decomposition[1]

Every symmetric, positive matrix A can be decomposed into a product of an unique lower triangular matrix L and its transpose:

$$A = LL^T \tag{2}$$

L is called the *Cholesky factor* of A, and can be interpreted as a generalized square root of A.

Your task is to improve performance of the source-code using parallel strategies. We are not interested in finding out which decomposition is better, therefore is not allowed to change the Cholesky decomposition algorithm.

Input

The input file contains only one test case. The first line contains the size of a square matrix ($0 < N \leq 10^4$). Next, N lines are the rows of the matrix, N real numbers per row.

The input must be read from the standard input.

Output

The output must have the lower Cholesky factor L from the symmetric matrix A.

The output must be written from the standard input.

Example

Input	Output
4 4.84019 0.39438 0.78310 0.79844 0.39438 4.19755 0.33522 0.76823 0.78310 0.33522 4.47740 0.62887 0.79844 0.76823 0.62887 4.91620	2.20004 0.39438 0.78310 0.79844 0.17926 2.04094 0.33522 0.76823 0.35595 0.13298 2.08159 0.62887 0.36292 0.34453 0.21804 2.14901

[1]Source: `https://rosettacode.org/wiki/Cholesky_decomposition`

Problem E

Black-Scholes

An *European all option* gives its holder the opportunity to purchase from the writer an asset at an agreed expiry time t at an agreed exercise price E. Given a time t, we will let $S(t)$ denote the asset value at time t, so $S(t)$ is the value of the asset at the expiry time.

The final payoff to the purchaser is $max\{S(t) - E, 0\}$ because

- if $S(t) > E$ the option will be exercised for a profit of $S(t) - E$, whereas
- if $S(t) \leq E$, the option will not be exercised.

In 1973, Robert C. Merton published a paper presenting a mathematical model which can be used to calculate a rational price for trading options. In that same year, options were first traded in the open market. Since then, the demand for option contracts has grown to the point that trading options typically far outstrips that for the underlyng assets. Merton's work expanded on that of two other researches. Fischer Black and Myron Scholes, and the pricing model became known as the *Black-Scholes model*. The model depends on a constant σ representing how volatile the market is for the given asset, as well as the continuously compounded interest rate r.

Write a parallel version of this problem that uses the Monte Carlo technique to calculate the Black-Scholes pricing model to a set of assets.

Input

The input contains only one test case. The first line contains only one integer: the number of assets N ($1 \leq N \leq 32.768$).

The input must be read from the standard input.

Output

The output contains the asset price, each one in separate line.

The output must be written from the standard input.

Example

Input	Output

`10`	`30.39`
	`19.67`
	`1.78`
	`16.03`
	`8.17`
	`30.74`
	`0.00`
	`6.57`
	`0.04`
	`0.00`