Practice Exercise #25: Diagonal Matrix and Upper Triangular Matrix

http://www.comp.nus.edu.sg/~cs1010/4_misc/practice.html

Reference: Week 6

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Objective: Two-dimensional array

Task statement:

A **square matrix** is a two-dimensional array where the number of rows and columns are the same. Write a program **square_matrix.c** to read in values for an $n \times n$ square matrix containing integer values, and check whether the matrix is (a) a diagonal matrix, or (b) an upper-triangular matrix.

A **diagonal matrix** is a square matrix in which the elements outside the main diagonal (↘) are all zeroes, for example:

$$\begin{bmatrix} 3 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & -2 \end{bmatrix} \qquad \begin{bmatrix} 12 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & -5 & 0 \\ 0 & 0 & 0 & 7 \end{bmatrix}$$

An **upper triangular matrix** (or right triangular matrix) is a square matrix U of the form:

$$U_{ij} = \begin{cases} a_{ij} & \text{for } i \le j \\ 0 & \text{for } i > j. \end{cases}$$

Written explicitly,

$$\mathbf{U} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ 0 & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & a_{nn} \end{bmatrix}$$

Note that a diagonal matrix is also an upper triangular matrix.

You may assume that the matrix contains at most 10 rows and 10 columns.

Sample run:

A sample run is shown below. The first line contains a single integer indicating the size of the square matrix, *n*. The next *n*×*n* values are the elements of the matrix.

```
5
2 -1 3 4 1
0 7 5 -2 0
0 0 6 0 4
0 0 0 0 8
0 0 0 0 2
Matrix read:
   2  -1   3   4   1
   0   7   5  -2   0
   0   0   6   0   4
   0   0   0   0   8
   0   0   0   0   2
Matrix is not a diagonal matrix.
Matrix is an upper triangular matrix.
```