

DP Weekly Question, Week 2

1. A matrix is a rectangular table of elements. Matrices are very important in both mathematics and computer science. In Math, they can be used to solve a system of equations or solve differential equations. In Computer Science, they are used in Computer Graphics and in Graph theory, just to name a few.

There are a number of operations that can be done to matrices including scalar multiplication, matrix addition, matrix multiplication, finding powers of matrices, and finding the inverse of a matrix. A scalar multiplication is a matrix multiplied by an integer such that every entry in the matrix is multiplied by that integer. A power of a matrix is defined to be the same as over integers - it is just the matrix multiplied by itself n times. Matrix addition is only defined over two matrices that have the same dimensions. The inverse of a matrix is a matrix such that multiplied by the original, the product is the identity matrix. To learn more about these operations, visit:

[http://en.wikipedia.org/wiki/Matrix_\(mathematics\)](http://en.wikipedia.org/wiki/Matrix_(mathematics)).

A matrix can be represented in Java as a 2-dimensional array of $m \times n$ entries. m represents the number of rows and n the number of columns. Therefore `matrix[3][2]` is the 3rd row, 2nd column entry. In this problem we will deal only with square matrices such that $m = n$. Implement the scalar multiplication, matrix multiplication, powers of matrices, and finding the inverse of a matrix for square matrices in Java. Finding the inverse of an arbitrary matrix is very complicated, so only deal with the 2x2 and 3x3 cases.

A neat application using matrices is to find the Fibonacci numbers. This is defined as:

$$\begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}^n = \begin{pmatrix} F_{n+1} & F_n \\ F_n & F_{n-1} \end{pmatrix}$$

Implement another method that given an integer n , it calculates the n th fibonacci number using powers of matrices.

Please submit all answers to knichel@seas.upenn.edu before April 11th, and include the title [DP Weekly Question] in the subject.