MATRIX LAB

Task 1:

Write a java program that creates an M by N matrix, where M and N are values given by the user. The user will provide values for the matrix. Print the values in the matrix (each of the M rows should be on separate lines) to the standard output.

Hint: Look at http://mathbits.com/MathBits/Java/arrays/Matrices.htm and elsewhere on the internet.

Obviously you need to use a 2 dimensional array here to keep the matrix values.

Task 2:

Write a java program that creates an M by N matrix of 0's, where M and N are provided by the user.

In other words, you create a 2D array with the given dimensions, and then print it out. It is a matrix of all zeros, but if you remember that integer and double array is initialized with 0, nothing more needs to be done here.

Task 3:

Write a java program that creates an M by N matrix from a 2D array provided by the user.

Assume the following exists in your main method:

double array[][]={{1.0,2.0,3.0},{3.0,1.0,2.5},{1.5,6.5,7.25},{5.5,6.5,7.5}};

There is a 2D array provided, or you take one as input from the user, and then copy the data from that to a matrix (which is off course just another 2D array :P)

Task 4:

Write a java program that creates an M by N matrix, where M and N will be given by the user, containing random values between 0 and 1.

You need to make use of a random number generator here that generates values between 0 and 1 and assign that to the cells of the matrix. Find out how to generate random numbers from the internet. Note that your matrix should be able to hold real numbers as well as integers.

Task 5:

Write a java program that creates the N by N identity matrix where N is given by the user.

You should already know from high school math what an identity matrix is. If you do not know, or you have forgotten, then Google is your friend.

Task 6:

Write a java program that, given an M x N matrix, swap the rows i and j, where i and j are provided by the user

Assuming that there is matrix (i.e. you create one with hard coded values or better still take one from the user as input) you ask the user to enter the row numbers to be swapped … ;-) you should be able to figure out the rest :P

Task 7:

Write a java program that, given an M x N matrix, creates the transpose of the matrix.

If you do not know what the transpose of a matrix is, take a look at http://www.mathwords.com/t/transpose_of_a_matrix.htm

Task 8:

Write a java program that, given two M x N matrices, adds them.

Note that for this and all questions before this, it is up to you to check the validity of your input, i.e. before actually adding the two matrices, you need to check their dimensions to see if the can actually be added.

Task 9:

Write a java program that, given two M x N matrices, subtracts the second one from the first.

Task 10:

Write a java program that, given two matrices, check if they are equal.

Here you need to compare two matrices value by value and find out if they are equal or not.

Task 11:

Write a java program that, given two matrices, finds out their product (first one times second one)

If you forgot how matrices are multiplied, again Google is your friend.

Task 12:

Write a java program, given two matrices, use Gaussian elimination with partial pivoting and back substitution to solve for x = A^-1 b, assuming A is square and has full rank.

*Here, your task is to solve the equation ax = b. Here a, x and b are matrices. You need to find the matrix x that would transform the matrix a into b. You know that if you multiply a with it's inverse (that is a^-1), you will get the unity matrix, which is like the 1 of the matrix world, that is anything multiplied by the unity matrix remains unchanged. So we multiply a with it's inverse to get the unity matrix and then multiply it with b to get b. Hence the equation can be written as a * a^-1 * b = b. From this you can easily deduce that x = a^-1 * b. So the task here is to find out the inverse of a and then multiply it with b to get x. How to find the inverse of a matrix? What conditions need to be satisfied for a matrix to be invertible? This question should tell you (that is if you do not already know) that not all matrices can be inverted, so there are certain conditions that a must satisfy. Google is your friend … :P*

This lab is more of a math problem than a computer science problem. You need to understand the underlying mathematical process first. If you understand the mathematical steps, writing the code should be extremely easy :P

Task 13:

To be given once you have completed all the tasks above. You are to contact me (you know who) to get the last task after you have completed the ones above. ☺

I think only one person emailed me about this so far. Send me an email and I will send you the last task. It is inherently simple.. if you have done all the other tasks, then you should be done with Task 13 in 5~10 minutes.