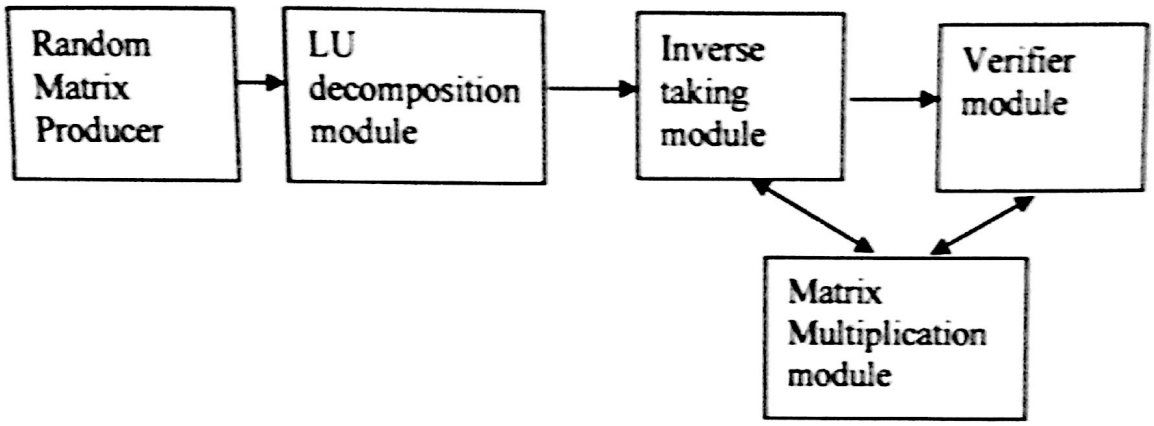
Gebze Institute of Technology
Department of Computer Engineering
CSE 244 Systems Programming
(Thanks to YSA)

In this homework, you will write an application that calculates the inverse of a matrix using LU decomposition. The overall structure of the system will be as follows:



Random Matrix Producer (RMP) module produces NxN random matrices (matrix A) of real numbers. The LU decomposition module (LUDM) calculates the L and U matrices for the given matrix A such that A = LU. The inverse taking module (ITM) calculates A^{-1} by $U^{-1}L^{-1}$. The verifier module (VM) verifies that $A\ A^{-1} = I$. The Matrix Multiplication Module (MMM) works as a worker for the ITM and VM.

Each module will be implemented by a different process or a thread. The single directional arrows represent the producer/consumer directions. The double directional arrows shows the boss/worker relation between the modules.

Your main function will have the following command line parameters:

- N: Size of the produced matrices
- K: # of total matrices to be inverted and verified (some random matrices will not be invertable).
- L: # of available positions in each queue between the modules
- P: # of available matrix multiplication threads. Number P can be viewed as number of available threads in matrix inversion thread pool.
- T: (Trace) if this option is on (=1) your program will print debugging information on
    - # of messages waiting in each of queue and the number of matrices processed so far. (and any other useful information)

As a report, your program will print the total elapsed time, number of inverted matrices, and the number of non-invertable matrices.

Test your program with many different numbers of N, K, L, P values on different platform with Core2Duo CPUs, Pentium 4 CPUs, Pentium 4 with HyperThreading CPUs, and with QuadCore CPUs. Make a nice report and analyze your performance results.

Notes:

- If you don't remember LU decomposition, read http://en.wikipedia.org/wiki/LU_decomposition
- You may use any available code or library for LU decomposition and taking the inverse of a L or U matrix. The one at http://comp.cs.ehime-u.ac.jp/~ogata/nac/le_ludecomp.lzh is okay. The matrix library at http://www.math.uiowa.edu/~dstewart/meschach/meschach.html is also okay.
- Your verifier should really verify the I matrix but you should be careful about small roundoff errors.
- Note that any P value (including 1) should work with no problems.

DUE 24 May (23^{59})