PC5215, Numerical Recipes with Applications

Lab 1, due Thursday, 6 September 2018

Submit in hard copy your codes in C with a report of steps and analysis, *as well as answers.*

1. Use the "Numerical Recipes" LU decomposition routines [ludcmp(), lubksb()] to solve the following linear equations, and verify (by hand or using other software, such as matlab, or a consistent check) that the answers are correct.

$$\begin{bmatrix} 1 & 3 & 3 & -5 \\ 2 & -4 & 7 & -1 \\ 7 & 1/2 & 3 & -6 \\ 9 & -2 & 3 & 8 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ w \end{bmatrix} = \begin{bmatrix} 0 \\ 2 \\ 3 \\ -10 \end{bmatrix}$$

2. Consider square grids of $L \times L$ resistor network shown below (for the case of L=4). Given that the point A has voltage 0 and B voltage 1, compute the current flowing from B to A, and the total resistance of the network. We assume that each link has a resistance $r = 1/\sqrt{L}$. Use the same linear solver as in problem 1 above. Report the results on L = 1, 2, 4, 8, 16, 32, …, (as large as you can), and the CPU times needed. [Specify the specs of processor used. Also check your computer answer against hand calculation for the case of L=1 and 2.]

To set up the linear equations, you need (1) Ohm's law $I_{ij} = (V_j - V_i)/r$ for each link, (2) conservation of current $\Sigma\, I_{ij} = 0$ at each node. Be careful about the sign of the current. The program should work for general L.