MA423 Lab-01

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Question 1

(a)

3*3 Wilkinson matrix:

$$\begin{bmatrix} 1 & 0 & 1 \\ -1 & 1 & 1 \\ -1 & -1 & 1 \end{bmatrix}$$

(b)

4*4 Hamiltonain matrix with random entries:

$$\begin{bmatrix} -1.0616 & -0.6156 & -0.3848 & 0.8886 \\ 2.3505 & 0.7481 & 0.8886 & -2.8045 \\ -2.8448 & 0.4882 & 1.0616 & -2.3505 \\ 0.4882 & -0.3921 & 0.6156 & -0.7481 \end{bmatrix}$$

Question 2

Summing up (1/n) from n = 1 to 1000 :
(a) s = 7.485471
(b) scf = 7.484600
(c) scb = 7.484900

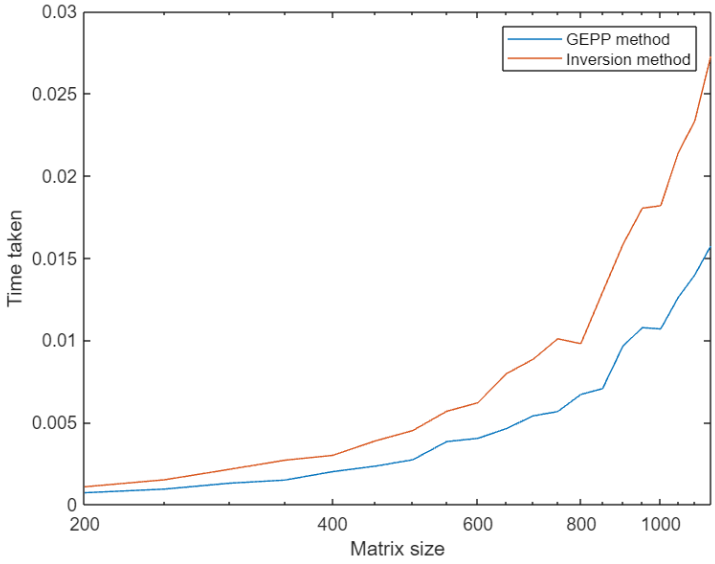
Here, s is the actual sum while scf and scb are the values obtained by summing chopped k digit numbers forward and backward respectively.

The deviations of scf and scb from s are:
$| s - scf | = 0.000871$
$| s - scb | = 0.000571$

As $| s - scb |$ is smaller, scb is closer to s than scf.

Question 3

We measure the time taken to find solutions to linear systems using GEPP and inversion method for matrices of increasing sizes.
The following graph depicts the time taken in both methods against the matrix size on a semilog scale.



Question 4

(a)

Column oriented forward substitution to solve Ux = b:
U is upper triangular matrix with randomly filled values:

$$\mathrm{U} = \begin{bmatrix} 1.4193 & 1.5877 & 0.8351 \\ 0 & -0.8045 & -0.2437 \\ 0 & 0 & 0.2157 \end{bmatrix}$$

$$\mathrm{b} = \begin{bmatrix} -1.1658 \\ -1.1480 \\ 0.1049 \end{bmatrix}$$

$$\mathrm{x} = \begin{bmatrix} -2.5390 \\ 1.2797 \\ 0.4863 \end{bmatrix}$$

(b)

Row oriented forward substitution to solve Lx = b:
L is lower triangular matrix with randomly filled values:

$$\mathrm{L} = \begin{bmatrix} 0.4550 & 0 & 0 \\ -0.8487 & 1.0391 & 0 \\ -0.3349 & -1.1176 & -0.0679 \end{bmatrix}$$

$$\mathrm{b} = \begin{bmatrix} -0.1952 \\ -0.2176 \\ -0.3031 \end{bmatrix}$$

$$\mathrm{x} = \begin{bmatrix} -0.4290 \\ -0.5598 \\ 15.8031 \end{bmatrix}$$

Question 5

LU factorization of a matrix A with random entries by Gaussian elimination with no pivoting:

$$A = \begin{bmatrix} 0.0230 & 0.4669 & -1.0298 & 0.5152 \\ 0.0513 & -0.2097 & 0.9492 & 0.2614 \\ 0.8261 & 0.6252 & 0.3071 & -0.9415 \\ 1.5270 & 0.1832 & 0.1352 & -0.1623 \end{bmatrix}$$

$$L = \begin{bmatrix} 1.0000 & 0 & 0 & 0 \\ 2.2256 & 1.0000 & 0 & 0 \\ 35.8447 & 12.9005 & 1.0000 & 0 \\ 66.2589 & 24.6253 & 2.4921 & 1.00 \end{bmatrix}$$

$$U = \begin{bmatrix} 0.0230 & 0.4669 & -1.0298 & 0.5152 \\ 0 & -1.2489 & 3.2411 & -0.8853 \\ 0 & 0 & -4.5928 & -7.9891 \\ 0 & 0 & 0 & 7.4094 \end{bmatrix}$$