

SyDe312 Numerical Methods - Test 1

4 February 2005, 12:30-1:20

Read the questions CAREFULLY. You can make them much more difficult than they need to be!

1. (a) Describe all the holes in the floating point number line and why they are there?
(b) Determine the exponent bits and the first four mantissa bits in the IEEE double precision floating point representation of the following: (i) -1 (ii) -realmax (iii) -inf (iv) 0.
(c) Write a segment of Matlab code to find the value of machine epsilon without using the built-in eps variable.
2. The matlab function `rand(m,n)` will generate an $m \times n$ matrix with entries normally distributed random numbers between -1 and 1. For a sequence of increasing values of $n = 1, 2, 4, 8, 16, 32, 64, 128$ use Matlab to:
 - (a) generate a few random square matrices A_n of size $n \times n$,
 - (b) calculate the average condition number $\kappa(A_n)$ for each size n
 - (c) create a semilog plot of $\kappa(A_n)$ against n and use it to sketch a similar plot in your solutions
 - (d) estimate from your plot some simple (rough) relationship expressing $\kappa(A_n)$ in terms of n
3. (a) Using hand calculations and strict partial pivoting find a permuted LU decomposition $A = PLU$ where:

$$A = \begin{bmatrix} -3 & -3 & 8 \\ 1 & 2 & 4 \\ 2 & 4 & -2 \end{bmatrix}$$

- (b) Using *only* the decomposition matrices P , L , and U found in (a) write a *single* line of Matlab code to generate a solution x to the system $Ax = b$, where b is a given vector. [Hint: You can check your answer using Matlab].