TE2401 Linear Algebra & Numerical Methods

Matlab Experiment Part I: Linear Algebra

A=13	B=12	C=11	D=10	E=09	F=08	G=07	H=06	I=05	J=04	K=03	L=02	M=01
N=14	O=15	P=16	Q=17	R=18	S=19	T=20	U=21	V=22	W=23	X=24	Y=25	Z=26

Use the first letter of your family name and the first letter of your given name to find out your own lucky number a from the above table. For example, the lucky number for Ben M. Chen is $a = \mathrm{C}(11) + \mathrm{B}(12) = 23$.

Write a short program in Matlab that performs the following computations:

1. If your luck number $a < 5$, let $n = 2a$. If $5 \le a < 10$, let $n = a$. If $10 \le a < 20$, let $n = \mathrm{round}(a/2)$. If $20 \le a < 35$, $n = \mathrm{round}(a/3.9)$. If $a \ge 35$, $n = \mathrm{round}(a/6)$.
2. Generate an $n \times n$ matrix A and an $n \times 1$ vector b using the random number generating function **rand**.
3. Compute the **det**erminant, **rank**, **eig**envalues, **eig**envectors, **inv**erse and the characteristic **poly**nomial or equation of the matrix A. Compute A^{135} and e^A (using **expm**) directly and find a matrix P such that $D = P^{-1}AP$ is diagonal.
4. Repeat item 3 for A^{T} and verify that the eigenvectors of A and A^{T} are orthogonal to each other.
5. Solve the linear system $A\,x = b$.

You may wish to store you answers in a diary file and then print it out from a printer.

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Matlab Experiment Part II: Numerical Methods

Compute zero or root for the following nonlinear function

$$f(x) = e^{0.05ax} - 3.9 + 2x.$$

where a is your lucky number found in Part That is to find a scalar x_* over [0, 1.6] such that $f(x_*) = e^{0.05ax_*} - 3.9 + 2x_* = 0$, using

- Bisection Method (see page 12 of the second of the lecture notes);
- False Position Method (see page 15 of the second part of the lecture notes); and
- Newton Method (see page 18 of the second part of the lecture notes).

For each method, implement the algorithm in Matlab and then run it up to 20 steps. Print or record down all the iteration results up to 10 digits (using **format long** within Matlab) in the following table:

Fill in your personal lucky number $a =$.			
Step	**Bisection**	**False Position**	**Newton**
1	$x_{01} =$	$x_{01} =$	$x_{01} =$
2	$x_{02} =$	$x_{02} =$	$x_{02} =$
3	$x_{03} =$	$x_{03} =$	$x_{03} =$
4	$x_{04} =$	$x_{04} =$	$x_{04} =$
5	$x_{05} =$	$x_{05} =$	$x_{05} =$
6	$x_{06} =$	$x_{06} =$	$x_{06} =$
7	$x_{07} =$	$x_{07} =$	$x_{07} =$
8	$x_{08} =$	$x_{08} =$	$x_{08} =$
9	$x_{09} =$	$x_{09} =$	$x_{09} =$
10	$x_{10} =$	$x_{10} =$	$x_{10} =$
11	$x_{11} =$	$x_{11} =$	$x_{11} =$
12	$x_{12} =$	$x_{12} =$	$x_{12} =$
13	$x_{13} =$	$x_{13} =$	$x_{13} =$
14	$x_{14} =$	$x_{14} =$	$x_{14} =$
15	$x_{15} =$	$x_{15} =$	$x_{15} =$
16	$x_{16} =$	$x_{16} =$	$x_{16} =$
17	$x_{17} =$	$x_{17} =$	$x_{17} =$
18	$x_{18} =$	$x_{18} =$	$x_{18} =$
19	$x_{19} =$	$x_{19} =$	$x_{19} =$
20	$x_{20} =$	$x_{20} =$	$x_{20} =$

Give a brief comment on the convergence rates of these methods.