MATH 2221A Mathematics Laboratory II

Lab Assignment 6

Name: _____   Student ID.: _____

In this assignment, you are asked to run `MATLAB` demos to see `MATLAB` at work. The color version of this assignment can be found in your own H:\ drive.

Instructions

1. Start `MATLAB`, until you see a window with the `MATLAB` prompt "»". This window is called the Command Window.

2. After you started have `MATLAB`, you will automatically be in the directory H:\. Please enter "`diary on`" after the `MATLAB` prompt » only once to record all your work in H:\diary. No marks will be given if no diary is found.

3. Enter "demo" after the prompt ». You will see a new window with many things to play with. This is the Demo Window.

4. In the Demo Window, try to locate figures or problems similar to those in the exercises below. Then locate the commands that generate these figures or problems. Try them in the Command Window. Just enter (or cut and paste) the commands after » to see what happens.

5. You should write your results on the lab sheet provided, and save the figures in the H: drive, in your personal drive.

6. Please read and sign the following declaration before handing in your assignment. Otherwise, no marks will be given.

I declare that the assignment here submitted is original except for source material explicitly acknowledged. I also acknowledge that I am aware of University policy and regulations on honesty in academic work, and of the disciplinary guidelines and procedures applicable to breaches of such policy and regulations, as contained in the website
http://www.cuhk.edu.hk/policy/academichonesty/

_____   _____
  Signature   Date

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1 (20 marks)			
2 (20 marks)			
3 (20 marks)			
4 (20 marks)			
5 (20 marks)			

Please read the following carefully:
General Guidelines for Lab Assignment Submission.

- Please sign and date the statement of Academic Honesty.

- Please go to the class and lab indicated by your registered course code via the CUSIS system. If you go to a different lab than the one you are registered for, you will not receive credit for the assignment even if you completed it.

- Write your COMPLETE name and student ID number legibly on the cover sheet (otherwise we will not take any responsibility for your lab). Please write your answers using a black or blue pen, NOT any other color or a pencil.

- Write your solutions on a double-sided printout of this pdf file. Try to fit your answers inside the available space.

- The use of computers/cellular phones/graphing calculators/iPads will NOT be permitted during tests and lab assignments. Please do not use our lab computer to recharge your cellar phone battery. No photo taking is allowed in the lab.

- In order to make it fair for all students, during the labs and tests, if you touch/press any icons on your cellular phone, our TA will check your phone to determine whether or not you are exchanging messages with another student. If you are found cheating (in the tests or in the lab or on homework assignments), you will automatically get an F grade in this course and your act will be reported to the Department for necessary disciplinary actions.

Exercises

1. (20 Marks) Write MATLAB programs to assign a letter grade ('A', 'B', 'C', 'F') using a given score (an integer in $[1, 100]$), according to the following table

$$
\begin{array}{rcllc}
90 & < & \text{score}, & & A \\
75 & < & \text{score} & \leq \ 90, & B \\
60 & < & \text{score} & \leq \ 75, & C \\
0 & < & \text{score} & \leq \ 60, & F
\end{array}
$$

In (a) and (b), the first and the last commands are given. Assume that the score is set as a random integer: MATLAB command score = randi(100). You should write down your commands to determine the grade (takes value in { 'A', 'B', 'C', 'F' }) according to the score.

(a) (10 Marks) Use if construct with multiple elseif clauses.

```
score = randi(100)
if score > 90
    grade = 'A';
elseif score > 75
    grade = 'B';
elseif score > 60
    grade = 'C';
else
    grade = 'F';
end
grade
```

(b) (10 Marks) Use nested if constructs, which has the following form

```
if ...
    statements...
else
    if ...
        statements...
    else
        if ...
            statements...

            ...
            (more if-statements if necessary)

        end
    end
end
```

```
score = randi(100)
if score > 90
```

```
            grade = 'A';
        else
            if score > 75
                grade = 'B';
            else
                if score > 60
                    grade = 'C';
                else
                    grade = 'F';
                end
            end
        end
        grade
```

2. (20 marks) The Fibonacci numbers are the sequence of integers $\{F_n\}_{n=1}^{\infty}$ defined by the linear recurrence equation

$$F_n = F_{n-1} + F_{n-2}$$

with $F_1 = F_2 = 1$.

(a) (10 marks) Compute the F_{35}.

```
f = 1;
g = 1;
for i = 3:35
    t = f + g;
    f = g;
    g = t;
end
g


g =

      9227465
```

(b) (10 marks) Compute the first Fibonacci number that are bigger than 100000

```
f = 1;
g = 1;
while g <= 100000
    t = f + g;
    f = g;
    g = t;
end
```

```
g

g =

        121393
```

3. (20 Marks) This question concerns different methods to create a 3000×3000 square matrix A, where

$$A(i,j) = \begin{cases} i - j, & \text{if } i > j \\ j - i, & \text{if } i \leq j \end{cases}$$

(a) (5 Mark) Write codes that first defines A as an empty matrix by $\mathsf{A} = [\,]$. Then allocate each element of A by loop(s).

```
A = [ ];
for i = 1:3000
    for j = 1:3000
        A(i,j) = abs(i-j);
    end
end
```

(b) (5 Mark) Perform the same procedures as in part (a) except that you first declare A as the zero matrix with the suitable size.

```
A = zeros(3000);
for i = 1:3000
    for j = 1:3000
        A(i,j) = abs(i-j);
    end
end
```

(c) (5 Marks) Compare the computation time of the above two algorithms in (a) and (b). Write down your observation (no commands are required), and a reminder for MATLAB programming practice (i.e., based on your observation, give a suggestion on programming).

```
The first method is much slower than the second method.

We should pre-allocate an array first,
but not to extend its size during a loop.
```

(d) (5 Mark) Generate, without using any loop or directly inputting the entries, the matrix A by MATLAB.

Hint: if $[\mathsf{X}, \mathsf{Y}] = \mathsf{meshgrid}(1{:}3000)$; what is the relationship between A and X, Y?

```
[X, Y] = meshgrid(1:3000);
A = abs( X - Y );
```

4. (20 marks) The zero of a polynomial can be approximated by the method of bisection. Let
$$f(x) = 57 + 4x + 6x^3 - 2x^4$$
Given $f(3) \geq 0$, $f(4) \leq 0$. By continuity, There is a zero in the interval $[3, 4]$. Write codes to find the zero by the following algorithm:

(1) Let $a = 3$, $b = 4$

(2) Set $m = \frac{a+b}{2}$ ($=$ mid-point of a and b)

(3) While ($|f(m)| \geq 0.0001$ and $b - a \geq 0.0001$)

   Set $m = \frac{a+b}{2}$
   Calculate $f(m)$
   If $f(m) \geq 0$
      Replace a by m
   Else
      Replace b by m
   End If
   End While

(4) Display m

```
a = 3;
b = 4;
m = (a+b)/2;
f = 57 + 4*m + 6*m^3 - 2*m^4;
while abs(f) >= .0001 && b-a >= .0001
    m = (a+b)/2;
    f = 57 + 4*m + 6*m^3 - 2*m^4 ;
    if f >= 0
        a = m;
    else
        b = m;
    end
end
disp(['The zero is x = ' num2str(m)])
```

5. (20 Marks) Define a sequence $\{x_n\}$ by

$$x_{n+1} = \frac{x_n}{2} + \frac{1}{x_n}$$

where $x_1 = 2$.

(a) (10 Marks) Use a **for**-loop to compute x_n for $n = 1, 2, 3, 4$. You should store the values in a vector x.

```
x=zeros(4,1);
x(1)=2;
root=x(1);
for i=2:4
    root=root/2+1/root;
    x(i)=root;
end
```

(b) (10 Marks) Guess the limit of x_n as $n \to \infty$. You may assume that $\lim_{n\to\infty} x_n$ exists. What is the smallest n such that the distance between x_n and the limit you guess is smaller than 10^{-13}? Write down your guess and MATLAB commands.

```
limit=sqrt(2);


n = 1;
root=2;
while abs(root-limit)>=1e-13
    root=root/2+1/root;
    n = n + 1;
end
n

n =

     6
```