Complete within two working days

Third Year B.S. Honours (Session: 2022-2023)

Department of Applied Mathematics, University of Dhaka

Course Title: Math Lab III (MATLAB), Course No.: AMTH 350

Assignment 01

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Instructions

1. Create a folder in **Third year drive** and rename it as your **Class Roll**.
2. All of your tasks must be stored in the newly created folder.
3. Solve each of the following problems using MATLAB.
4. Use Excel/Notepad files for any kind of input and output unless specified otherwise.

1. Input an integer n from the keyboard, then
   (a) write a function m-file to find the divisors of n.
   (b) write a function m-file to test whether n is prime.
   (c) separates the digits of n and stores those digits in a vector.
   (d) create a row matrix of n random integers, now print the positive integers from 1 to n with three numbers to a line, i.e. the output looks like as:

   1 2 3
   4 5 6
   7 8 9
   .....

   (e) create a Round-robin schedule for n teams.

2. Write a function m-file to find the greatest common divisor (GCD) of two numbers using the Euclidean algorithm.

3. To check a number $N = (a_{k-1}a_{k-2}\ldots a_1a_0)_{10}$ is divisible by 7 or 13, we need only to check whether $S = (a_2a_1a_0)_{10} - (a_5a_4a_3)_{10} + (a_8a_7a_6)_{10} - \ldots$ is divisible by 7 or 13. Using the above hypothesis test whether $N = 63371627111$ is divisible by 7 or 13 or not?

4. *Maruf* and *Arnob* bought a cake, and they weighed it in milligrams-the weight of the cake W is always **even**< 30. Now they wish to divide the cake between them in some way so that both of them are satisfied.

   Maruf challenges *Arnob* that if he can divide the weight of the cake as the sum of twin prime numbers, *Arnob* can have the entire cake - and if he fails to do so, *Maruf* will get the cake. Determine for what values of W, *Arnob* can have the entire cake.

5. Solve the linear Diophantine equation $ax + by = c$, for your choice of a, b, c.

6. Find all solutions of $x^2 \equiv 1 \pmod{144}$.

7. Using the Chinese remainder theorem solve the following simultaneous congruences:

$$x \equiv 6 \pmod{11}$$
$$x \equiv 13 \pmod{16}$$
$$x \equiv 9 \pmod{21}$$
$$x \equiv 19 \pmod{25}$$

8. Suppose ten students have been admitted into the MS program in the Department of Applied Mathematics, University of Dhaka, for the session 2022 – 2023. All the students have consecutive roll numbers which start from 1 and end at 10. Recently, the Applied Mathematics Dept. has decided to offer some fully funded scholarships to MS students. Also, the Dept. has assigned a number between 100 to 115 for each of the students randomly. Moreover, Dept. sets the following requirements for the applicants for the scholarships:

(i) He/she must have CGPA> 3.40 out of 4 in BS in Applied Mathematics.

(ii) He/she who has the number 111 will be eligible for this scholarship.

(iii) A student must satisfy the conditions given in (i) and (ii) to get the scholarship.

Then,

(a) create a matrix that contains the roll numbers (1 to 10) and the CGPA of the students.

(b) create another matrix that contains the random numbers (100 to 115).

(c) design the following table with proper information:

Roll Number	CGPA	Random Number	Winner/Looser

– The End –

```
n=69;
fprintf("The value of n is %d\n",n)
%(A)
disp('(a)')
divisors=[];
for i=1:n
    if(mod(n,i)==0)
        divisors=[divisors,i];
            end
end
divisors

%B
disp('(b)')
if (numel(divisors)==2)
    fprintf('%i is a prime number.\n',n)
else
    fprintf('%i is not a prime number.\n',n)
end
```

```
The value of n is 69
(a)

divisors =

     1     3    23    69

(b)
69 is not a prime number.
```

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```
function digitvector=digitSeparate(n)
n=65865;
fprintf('The value of n is %d\n',n)
numstr=num2str(n);
digitvector=zeros(1,length(numstr));
for i=1:length(numstr)
    digitvector(i)=str2double(numstr(i));
end
end
```

```
The value of n is 65865

ans =

     6     5     8     6     5
```

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```
n=9
fprintf('The value of n is %d\n',n)
randomMatrix=randi(100,1,n);
disp('Random Matrix : ');
for i=1:n
    fprintf("%4d",randomMatrix(i));
    if rem(i,3)==0|| i==n
        fprintf("\n");
    end
end
```

```
n =

     9

The value of n is 9
Random Matrix :
  97   1  78
  82  87   9
  40  26  81
```

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```
function schedule=roundRobin(n)
n=8;
fprintf('The value of n is %d\n',n)
teams=1:n;
rounds=n-1;
schedule=zeros(rounds,n);
for round=1:rounds
    for i=1:n/2
        schedule(round,i)=teams(i);
        schedule(round,n-i+1)=teams(n-i+1);
    end
    teams=[teams(1) teams(n) teams(2:n-1)];
end
```

```
The value of n is 8

ans =

     1     2     3     4     5     6     7     8
     1     8     2     3     4     5     6     7
     1     7     8     2     3     4     5     6
     1     6     7     8     2     3     4     5
     1     5     6     7     8     2     3     4
     1     4     5     6     7     8     2     3
     1     3     4     5     6     7     8     2
```

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```
function euclidean_divisors=greatest_common_div(a,b)
% a=input('');
% b=input('');
fprintf('The gcd of a=%d and b=%d is : \n',a,b)
 if b==0
    euclidean_divisors=a;
else
 while   b~=0
    temp=b;
    b=mod(a,b);
    a=temp;
end
euclidean_divisors=a;
end
end
```

```
The gcd of a=12 and b=14 is :

ans =

     2
```

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```
N=63371627111;
S=0;
C=0;
while N~=0
    S=(-1).^C*mod(N,1000)+S;
    N=floor(N/1000);
    C=C+1;
end
if mod(S,7)==0
    disp('N is divisible by 7.')
elseif mod(S,13)==0
    disp('N is divisible by 13.')
end
```

```
N is divisible by 13.
```

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```
fprintf('The weight of the cake is %d\n',n)
twinprimes=[];
s=0;
for i=3:n
    if isprime(i) && isprime(i+2)
        s=2*i+2;
        if s>=n
            break
        end
        twinprimes=[twinprimes;[i,i+2]];
    end
end

if n==s
    disp('Arnob will get the cake.')
else
    disp("Maruf will get the cake.")
end
disp('')
disp('Arnob will get the cake if it is divided in the way: ')
disp(twinprimes);
```

```
The weight of the cake is 28
Maruf will get the cake.
Arnob will get the cake if it is divided in the way:
     3     5
     5     7
    11    13
```

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```
%A1q5 about linear Diophantine equation
syms x y integer
eqn=13*x+21*y==1791;
[x,y,parameter,conditions]=solve(eqn,[x,y],'ReturnConditions',true)
assume(conditions);
restrictions=[x>0,y>0];
solk=solve(restrictions,parameter);
fprintf('   x        y\n')
for i=1:numel(solk)
xSol=subs(x,parameter,solk(i));
ySol=subs(y,parameter,solk(i));
fprintf('%5d   %5d\n',xSol,ySol)
end
```

```
x =

23283 - 21*k


y =

13*k - 14328


parameter =

k


conditions =

in(k, 'integer')

   x        y
  120       11
   99       24
   78       37
   57       50
   36       63
   15       76
```

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```
modulus=144;
solutions=[];
for x=0:modulus-1
    if mod(x^2,modulus)==1
        solutions=[solutions,x];
    end
end
disp('Solutions: ');
disp(solutions);
```

```
Solutions:
     1    17    55    71    73    89   127   143
```

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```
moduli=[11,16,21,25];
residues=[6,13,9,19];
M=prod(moduli);
Mi=M./moduli;
invMi=arrayfun(@(a, m) modinv(a, m), Mi,moduli);
x=mod(sum(residues .* Mi .* invMi),M);
disp(['The solution is x ' num2str(x) ' (mod ' num2str(M) ')'])

function inva=modinv(a,m)
[~,inva,~]=gcd(a,m);
end
```

```
The solution is x 89469 (mod 92400)
```

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```
roll=1:10;
cgpa=randi([2 3],1,10)+rand(1,10);
rn=randi([100 115],1,10);
D=[];
for i=1:10
    if(cgpa(i)>3.4 & rn(i)==111)
        D(i)=1;
    else
        D(i)=0;
    end
end
table(roll',cgpa',rn',D','variableName',{'Roll';'CGPA';'Random
number';'Winner/Looser'})
```

```
ans =

  10x4 table

    Roll     CGPA     Random number    Winner/Looser
    ____    ______    _____________    _____________

      1     3.5005         111              1
      2     3.4711         102              0
      3     2.0596         110              0
      4      2.682         108              0
      5     3.0424         115              0
      6     2.0714         110              0
      7     2.5216         112              0
      8     2.0967         107              0
      9     3.8181         106              0
     10     3.8175         113              0
```

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