Lab #2

Matrices, solution of matrices and their operations using MATLAB

Objective:

_____
_____
_____

Matrix:

MATLAB treats every thing as a matrix

- 1-by-1 matrices are interpreted as scalars
- Matrices with only one row or one column are known as vectors
- A matrix is a rectangular array of numbers.

Example:

```
>> f = [ 1 2 3; 4 5 6]
f=
1  2 3
4 5 6
>> h = [ 2 4 6;1 3 5]
h=
2 4 6
1 3 5
```

Accessing Matrices:

- The matrix element located in the i-th row and j-th column of "A" is referred to as, A(i,j)

Some useful commands:

a) Magic Function

It generates a matrix whose elements are such that the sum of all elements in its rows, columns and diagonal elements are same. You can generate a matrix by entering

```
>> m=magic(4)
```

b) Sum Function

You can verify the above magic square by entering

>>sum(m)

For rows take the transpose and then take the sum

>>sum(m')

c) Diag

You can get the diagonal elements of a matrix by entering

>> d=diag(m)

>>sum(d)

d) Matrix Addressing:

-- matrixname(row, column)

-- colon may be used in place of a row or column reference to select the entire row or column.

Example:

```
>>f(2,3)
ans =
6
>>h(:,1)
ans =
2
1
```

Where

```
f=
1    2    3
4    5    6
```

```
h=
2    4    6
1    3    5
```

More Useful Commands

zeros(n)	returns a n x n matrix of zeros
zeros(m,n)	returns a m x n matrix of zeros
ones(n)	returns a n x n matrix of ones

ones(m,n)	returns a m x n matrix of ones
rand(n)	returns a n x n matrix of random number
rand(m,n)	returns a m x n matrix of random number
size (A)	for a m x n matrix, returns the row vector [m,n] containing the number of rows and columns.
length(A)	returns the larger of the number of rows or columns in A.
Transpose	B = A'
Identity Matrix	eye(n) → returns an n x n identity matrix
	eye(m,n) → returns an m x n matrix with ones on the main diagonal and zeros elsewhere.
Addition	C=A+B
Subtraction	C=A–B
Scalar Multiplication	B = αA, where α is a scalar.
Matrix Multiplication	C = A.*B
Matrix Inverse	B = inv(A), A must be a square matrix in this case.
Matrix Powers	B = A.^2 → squares each element in the matrix
C = A * A →	computes A*A, and A must be a square matrix.

Determinant det (A), and A must be a square matrix.

Note: A, B, C are matrices, and m, n, α are scalars.

Array Operations:

a) Scalar-Array Mathematics

- For addition, subtraction, multiplication, and division of an array by a scalar simply apply the operations to all elements of the array.

Example:

```
>> f = [ 1 2; 3 4]

f=

12

34

>> g = 2*f – 1 // Each element in the array f is multiplied by 2, then subtracted by 1.

g=

13

57
```

Element-by-Element Array-Array Mathematics

Operation	***Algebraic Form***	***MATLAB***
Addition	a + b	a + b
Subtraction	a – b	a – b
Multiplication	a x b	a .* b
Division	a ÷ b	a ./ b
Exponentiation	ab	a .^ b

Example:

```
>> x = [ 1 2 3 ];

>> y = [ 4 5 6 ];

>> z = x .* y // Each element in x is multiplied by the corresponding element in y.

z= 4 10 18
```

b) Solutions to Systems of Linear Equations

Example:

A system of 3 linear equations with 3 unknowns (x1, x2, x3):

$$3x1 + 2x2 – x3 = 10$$

$$-x1 + 3x2 + 2x3 = 5$$

$$x1 – x2 – x3 = -1$$

Let:

$$A = \begin{bmatrix} 3 & 2 & 1 \\ -1 & 3 & 2 \\ 1 & -1 & -1 \end{bmatrix} \qquad x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \qquad b = \begin{bmatrix} 10 \\ 5 \\ -1 \end{bmatrix}$$

Ax = b

Solution by left division in MATLAB:

```
>> A = [ 3 2 -1; -1 3 2; 1 -1 -1];
>> B = [ 10; 5; -1];
>> x = A\B
x=
-2.0000
5.0000
-6.0000
```

Solution by Matrix Inverse in MATLAB:

```
>> A = [3 2 -1; -1 3 2; 1 -1 -1];
>> B = [10; 5; -1];
>> x = inv (A)*B
x=
-2.0000
5.0000
-6.0000
```

Post Lab Questions

1. **The command eye(2) generates;**

   _____

2. **If f=[5,6,7;9,0,1;6,3,2] then find f^2-1/10.**

   _____

3. **What do the following basic Matrix functions represent**

det	
zeros	
ones	
rand	

Lab Tasks

Task 1

a) Generate a vector of 50 elements having random values between 0 and 50.

b) What do the following commands generate:

- m=magic(4)
- sum(m)
- diag(m)
- ones(3),ones(3,2)
- zeros(3),zeros(3,2)

Task 2

A =

1	2	3
4	5	6
7	8	9

B =

1	1	1
2	2	2
3	3	3

C =

1	2	1	2

a) Practice the following Matrix operations on the given Matrices A, B and C:

- A+B
- A'
- A*B
- 2*A
- A/2
- C.^2

b) Find the size of Matrix C and also generate an identity Matrix.