ENME 303 LAB

Week 5: Vectors & Matrices II

Nameless Lab

Week 6: Matrices II

I. Defining Matrices
II. Matrix Addition
III. Scalar Multiplication
IV. Matrix Multiplication
V. The Identity Matrix
VI. Number of Solution
VII. Inverse and Pseudoinverse

I. Defining Matrices

Referencing (aka indexing) elements in Matrix.

```
%To reference elements in i rows and j columns of matrix use: A(i,j)

A = [1 2 3; 4 5 6];

A(2,3)
```

6

I. Defining Matrices

Referencing all elements in j column of Matrix.

```
%To reference all elements in j columns of matrix use: A(:,j)

A = [1 2 3; 4 5 6];

col3= A(:,3)
```

col3 =

3
6

Referencing all elements in i rows of Matrix.

```
%To reference all elements in i rows of matrix use: A(i,:)

A = [1 2 3; 4 5 6];

row2= A(2,:)
```

row2 =

4 5 6

I. Defining Matrices

Creating a smaller matrix from a larger one using referencing

```
Abig=[1:6;7:12;14:19]

%Create a new matrix taking all elements from 2nd to 3rd column

Asmall=Abig(:,2:3)
```

Abig =

1	2	3	4	5	6
7	8	9	10	11	12
14	15	16	17	18	19

Asmall =

2	3
8	9
15	16

II. Matrix Addition & Subtraction

- Two built-in ways to do Matlab addition:

```
C = A + B
C =plus(A,B)
```

Where C in the added matrix, and A and B are **matrices that are the same size**

- Two built-in ways to do Matlab subtraction:

```
C = A - B
C =minus(A,B)
```

Where C in the subtracted matrix, and A and B are **matrices that are the same size**

II. Matrix Addition & Subtraction

```
%% Matrix Addition and Subtraction

% Matrices must have the same dimensions to add or subtract

A= [1 2 3 4; 5 6 7 8; 9 10 11 12; 13 14 15 16]

B= ones(4)

C_add=A+B

C_sub=A-B
```

C_add =

2	3	4	5
6	7	8	9
10	11	12	13
14	15	16	17

C_sub =

0	1	2	3
4	5	6	7
8	9	10	11
12	13	14	15

III. Scalar Multiplication

```
%% Scalar Multiplication: Multiplying a scalar value by a
Matrix

A = [6:2:12;14:2:20;22:2:28]

A_1= 2*A

A_2= pi*A
```

A =

6	8	10	12
14	16	18	20
22	24	26	28

A_1 =

12	16	20	24
28	32	36	40
44	48	52	56

A_2 =

18.8496	25.1327	31.4159	37.6991
43.9823	50.2655	56.5487	62.8319
69.1150	75.3982	81.6814	87.9646

IV. Matrix Multiplication

The rules of Matrix Multiplication:

$$\begin{bmatrix} 3 & 5 \\ 1 & 7 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ 2 & 9 \end{bmatrix} = \begin{bmatrix} 3(1)+5(2) & 3(2)+5(9) \\ 1(1)+7(2) & 1(2)+7(9) \end{bmatrix} = \begin{bmatrix} 13 & 51 \\ 15 & 65 \end{bmatrix}$$

A
2 x 2

B
2 x 2

Two matrices, A and B, can be multiplied if and only if the **number of columns in A** is equal to the **number of rows in B**.

IV. Matrix Multiplication

```
A=[3 5; 1 7];

B=[1 2; 2 9];

%Matrix multiplication

AB= A*B

%Matrix element wise multiplication. multiplies element by
element rather than follow typical matrix mult.

AB_ = A.*B
```

AB =

13	51
15	65

AB_ =

3	10
2	63

V. Identity Matrix

In Matlab we can create the identity matrix using the following built-in:

$$Identity\ matrix\ I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

I = [eye(n)] or [eye(n,m)]

Where it returns an n-by-n or n-by-m identity matrix with ones on the main diagonal and zeros elsewhere.

V. Identity Matrix

```
%% Identity Matrix

I = eye(5)

I5= eye(5)*5
```

I =

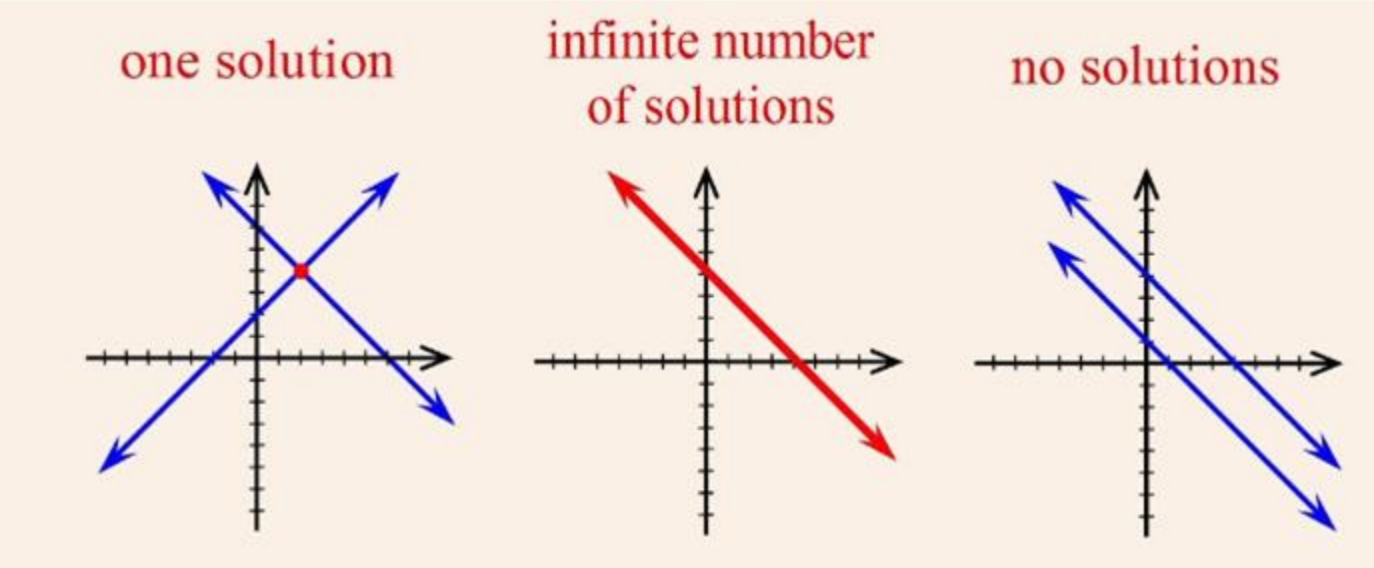
1	0	0	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1

I5 =

5	0	0	0	0
0	5	0	0	0
0	0	5	0	0
0	0	0	5	0
0	0	0	0	5

VI.Number of Solutions

The easiest method to find the solution and its type is using the **rref** function.



VII. Inverse & Pseudoinverse

- **inv()** is used to find the inverse of a square matrix whose inverse exists

```
A= [2 3; 2 4]

B= [5; 6]

x = inv(A)x B
```

- **pinv()** is used to find the inverse of any matrix whose inverse may not exist (similar to A\b)

```
A = [9 5 24; 7 8 31; 9 4 21];

B = [3; 8 ;4];

x = pinv(A)x B
```

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