Lecture-2b
Matrix algebra

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Real And Complex Matrix

A real matrix is a matrix whose elements consist entirely of real numbers.

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 6 & 7 & 8 \end{bmatrix}$$

A Complex matrix is a matrix whose elements contain complex numbers.

$$A = \begin{bmatrix} 2+3i & i & 6-4i \\ 7 & 2-3i & -i \end{bmatrix}$$

= Real Matrix + Imaginary Matrix = $\begin{bmatrix} 2 & 0 & 6 \\ 7 & 2 & 0 \end{bmatrix} + i\begin{bmatrix} 3 & 1 & -4 \\ 0 & -3 & -1 \end{bmatrix}$

Multiplication of Matrices

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 1 \\ 2 & 1 & 1 \end{bmatrix} \qquad B = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 4 \\ 1 & 2 & 1 \end{bmatrix}$$

$$A \times B = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 1 \\ 2 & 1 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 4 \\ 1 & 2 & 1 \end{bmatrix}$$

$$A \times B = \begin{bmatrix} 1\times1 + 2\times2 + 3\times1 & 1\times1 + 2\times3 + 3\times2 & 1\times1 + 2\times4 + 3\times1 \\ 1\times1 + 2\times2 + 1\times1 & 1\times1 + 2\times3 + 1\times2 & 1\times1 + 2\times4 + 1\times1 \\ 2\times1 + 1\times2 + 1\times1 & 2\times1 + 1\times3 + 1\times2 & 2\times1 + 1\times4 + 1\times1 \end{bmatrix}$$

$$A \times B = \begin{bmatrix} 8 & 13 & 12 \\ 6 & 9 & 10 \\ 5 & 7 & 7 \end{bmatrix}$$

```
octave:4> A = [1 2 3; 1 2 1; 2 1 1]
A =

   1   2   3
   1   2   1
   2   1   1

octave:5> B = [1 1 1; 2 3 4; 1 2 1]
B =

   1   1   1
   2   3   4
   1   2   1

octave:6> C = A*B
C =

    8   13   12
    6    9   10
    5    7    7
```

Unitary Matrix

Quiz No: 1

State and explain the properties of Unitary Matrix with one numerical example?

Online Submission last Date 9th May, 2020

Mode of Submission: Online

Format: Only Handwritten acceptable

Write a MATLAB Code/Programs of Different Matrices

Create 4 rows and 5 columns matrix

```
>> a = [ 1 2 3 4 5; 2 3 4 5 6; 3 4 5 6 7; 4 5 6 7 8]
a =

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

Create Diagonal matrix

```
>> v = [2 1 -1 -2 -5];
>> D = diag(v)
D =

Diagonal Matrix

   2   0   0   0   0
   0   1   0   0   0
   0   0  -1   0   0
   0   0   0  -2   0
   0   0   0   0  -5
```

Create Upper And Lower Triangular matrix

```
>> A = ones(4)
A =

   1   1   1   1
   1   1   1   1
   1   1   1   1
   1   1   1   1

>> B = triu(A)
B =

   1   1   1   1
   0   1   1   1
   0   0   1   1
   0   0   0   1
```

Upper Triangular Matrix

```
>> A = ones(4)
A =

   1   1   1   1
   1   1   1   1
   1   1   1   1
   1   1   1   1

>> B = tril(A)
B =

   1   0   0   0
   1   1   0   0
   1   1   1   0
   1   1   1   1
```

Lower Triangular Matrix

Identity Matrix

```
I = eye(3)
I =

     1     0     0
     0     1     0
     0     0     1
```

Null or Empty Matrix

```
>> N = zeros(3,3)
N =

     0     0     0
     0     0     0
     0     0     0
```

Transpose Matrix

```
>> A = [2 3 4;5 6 7;8 9 6]
A =

     2     3     4
     5     6     7
     8     9     6

>> A'
ans =

     2     5     8
     3     6     9
     4     7     6
```

Symmetric Matrix

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

   1   5   3
   5   2   6
   3   6   4

>> tf = issymmetric(A)
tf = 1
```

Skew-Symmetric Matrix

```
>> A = [0 -5 3;5 0 6;-3 -6 0]
A =

   0  -5   3
   5   0   6
  -3  -6   0

>> tf = issymmetric(A)
tf = 0
```

Check whether matrix is orthogonal or not

```
>> A=[2 4 6;4 6 8;2 6 8]
A =

   2   4   6
   4   6   8
   2   6   8

>> B=A'
B =

   2   4   2
   4   6   6
   6   8   8

>> C=A*B
C =

   56    80    76
   80   116   108
   76   108   104
```

It is not orthogonal matrix

Conjugate Matrix

```
>> B = [1+2i 2-3i 3+4i;4-5i 5+6i 6-7i;8 7+8i 7]
B =

   1 + 2i   2 - 3i   3 + 4i
   4 - 5i   5 + 6i   6 - 7i
   8 + 0i   7 + 8i   7 + 0i

>> C = conj(B)
C =

   1 - 2i   2 + 3i   3 - 4i
   4 + 5i   5 - 6i   6 + 7i
   8 - 0i   7 - 8i   7 - 0i
```

Check whether matrix is Hermitian matrix or not

```
>> A =[4 1-i 7;1+i 6 -i;7 i 5]
A =

   4 + 0i   1 - 1i   7 + 0i
   1 + 1i   6 + 0i  -0 - 1i
   7 + 0i   0 + 1i   5 + 0i

>> A = ishermitian(A)
A = 1
```

Yes, it is Hermitian

```
>>B  =[3i 2+i;-2+i -i]
B =

   0 + 3i   2 + 1i
  -2 + 1i  -0 - 1i

>> B = ishermitian(A)
B = 0
```

No, it is not Hermitian

Multiplication of Two Matrices

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

>> B=[1 1 1;2 3 4;1 2 1]
   1   1   1
   2   3   4
   1   2   1
>> C= A*B
   8   13   12
   6    9   10
   5    7    7
```