NAME-JYOTI
ROLL NO. -MAT/19/96

MATRICES

In mathematics,a matrix is a rectangular array or table of numbers, symbols,or expressions,arranged in rows and columns. For example , the matrix which has dimension 2× 3 has two rows and three columns.

Matrices are entered in "row form", such that

In[178]:=
```
mat1 = {{2, 1}, {-1, 2}}
```
Out[178]//MatrixForm=

$$\begin{pmatrix} 2 & 1 \\ -1 & 2 \end{pmatrix}$$

gives the following matrix (the // and "MatrixForm" displays the result so it looks like a matrix)

In[179]:=
```
mat1 // MatrixForm
```
Out[179]//MatrixForm=

$$\begin{pmatrix} 2 & 1 \\ -1 & 2 \end{pmatrix}$$

The command below will request Mathematica to provide every output in MatrixForm

In[180]:=
```
$Post := If[MatrixQ[#], MatrixForm[#], #] &
```
In[181]:=
```
mat1
```
Out[181]//MatrixForm=

$$\begin{pmatrix} 2 & 1 \\ -1 & 2 \end{pmatrix}$$

$Post is a global variable whose value ,if set , is a function that will be applied to every output generated in the current session.

The command IfMatrixQ[#],MatrixForm[#],#]& isan example of pure function.

The symbol # represents the argument of the function.

The symbol & is used to seperate the definition of the function from the argument.

The effect of the function will be to put matrix output into MatrixForm, but to leave non matrix output alone.

this is accomplished with the if command ,which takes 3 arguments.

1- The first is a condition.

2- The second is what is returned if the condition is true.

3- The third is what is returned if the condition is false.

In[182]:=
```
MatrixQ[mat1]
```
Out[182]=
```
True
```

In[183]:=
```
MatrixQ[x]
```
Out[183]=
```
False
```

Hence the condition is checked .

the Dimensions command returns a list containing the number of rows and columns in the matrix,respectively.

In[184]:=
```
Dimensions[mat1]
```
Out[184]=
```
{2, 2}
```

Other commands that produces matrices quickly.

below command is used to get 3×4 matrix with random integer entries between 0 to 10.

In[185]:=
```
RandomInteger[10, {3, 4}]
```
Out[185]//MatrixForm=

$$\begin{pmatrix} 5 & 9 & 0 & 5 \\ 3 & 9 & 5 & 10 \\ 10 & 1 & 7 & 2 \end{pmatrix}$$

The next command gives a 3×4 matrix whose i th , j th entry is i+5j

In[186]:=
```
Table[i + 5 j, {i, 3}, {j, 4}]
```
Out[186]//MatrixForm=

$$\begin{pmatrix} 6 & 11 & 16 & 21 \\ 7 & 12 & 17 & 22 \\ 8 & 13 & 18 & 23 \end{pmatrix}$$

Zero matrix

In[187]:=
```
Table[0, {5}, {5}]
```
Out[187]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

Constant matrix

In[188]:=
```
ConstantArray [2, {3, 4}]
```
Out[188]//MatrixForm=

$$\begin{pmatrix} 2 & 2 & 2 & 2 \\ 2 & 2 & 2 & 2 \\ 2 & 2 & 2 & 2 \end{pmatrix}$$

lower triangular matrix.

In[189]:=
```
Table[If[i > j, i + 2 j, 0], {i, 4}, {j, 4}]
```
Out[189]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 \\ 4 & 0 & 0 & 0 \\ 5 & 7 & 0 & 0 \\ 6 & 8 & 10 & 0 \end{pmatrix}$$

upper triangular matrix.

In[190]:=
```
Table[If[i < j, i + 2 j, 0], {i, 4}, {j, 4}]
```

Out[190]//MatrixForm=

$$\begin{pmatrix} 0 & 5 & 7 & 9 \\ 0 & 0 & 8 & 10 \\ 0 & 0 & 0 & 11 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

Array command

It works much like the Table command but uses a function (either built-in or user defined) rather than an expression to compute the entries.
using the built-in function Min for f produces a matrix with each entry is the minimum of the row number and column number of that entry's position:

In[191]:=
```
Array[Min, {3, 4}]
```

Out[191]//MatrixForm=

$$\begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 \\ 1 & 2 & 3 & 3 \end{pmatrix}$$

Max command:- entry will be maximum of the entry position. for eg-21 is the entry position then maximum value is 2 so output is 2.

In[192]:=
```
Array[Max, {3, 4}]
```

Out[192]//MatrixForm=

$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 2 & 3 & 4 \\ 3 & 3 & 3 & 4 \end{pmatrix}$$

user-defined function:

In[193]:=
```
f[i_, j_] := i + 2 j;
Array[f, {3, 3}]
```

Out[194]//MatrixForm=

$$\begin{pmatrix} 3 & 5 & 7 \\ 4 & 6 & 8 \\ 5 & 7 & 9 \end{pmatrix}$$

Identity Matrix:-

In[195]:=
```
IdentityMatrix [3]
```

Out[195]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Diagonal Matrix:-

In[196]:=
```
DiagonalMatrix [{1, 2, 3, 4}]
```

Out[196]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 4 \end{pmatrix}$$

Superdiagonal Matrix

In[197]:=
```
DiagonalMatrix [{1, 2, 3}, 1]
```

Out[197]//MatrixForm=

$$\begin{pmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 3 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

Subdiagonal Matrix

In[198]:=
```
DiagonalMatrix[{1, 2, 3}, -1]
```

Out[198]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 3 & 0 \end{pmatrix}$$

Matrix operations

In[199]:=
```
mat1 = {{1, 2, 3}, {4, 5, 6}, {2, 0, 1}}
```

Out[199]//MatrixForm=

$$\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 2 & 0 & 1 \end{pmatrix}$$

In[200]:=
```
mat2 = {{2, 3, 4}, {5, 5, 5}, {6, 7, 8}}
```

Out[200]//MatrixForm=

$$\begin{pmatrix} 2 & 3 & 4 \\ 5 & 5 & 5 \\ 6 & 7 & 8 \end{pmatrix}$$

Addition

In[201]:=
```
mat1 + mat2
```

Out[201]//MatrixForm=

$$\begin{pmatrix} 3 & 5 & 7 \\ 9 & 10 & 11 \\ 8 & 7 & 9 \end{pmatrix}$$

Difference

In[202]:=
```
mat1 - mat2
```

Out[202]//MatrixForm=

$$\begin{pmatrix} -1 & -1 & -1 \\ -1 & 0 & 1 \\ -4 & -7 & -7 \end{pmatrix}$$

Multiplication

In[203]:= `mat1.mat2`

Out[203]//MatrixForm=

$$\begin{pmatrix} 30 & 34 & 38 \\ 69 & 79 & 89 \\ 10 & 13 & 16 \end{pmatrix}$$

Scalar multiplication

In[204]:= `7 * mat1`

Out[204]//MatrixForm=

$$\begin{pmatrix} 7 & 14 & 21 \\ 28 & 35 & 42 \\ 14 & 0 & 7 \end{pmatrix}$$

In[205]:= `7 * mat2`

Out[205]//MatrixForm=

$$\begin{pmatrix} 14 & 21 & 28 \\ 35 & 35 & 35 \\ 42 & 49 & 56 \end{pmatrix}$$

Transpose

In[206]:= `Transpose[mat1]`

Out[206]//MatrixForm=

$$\begin{pmatrix} 1 & 4 & 2 \\ 2 & 5 & 0 \\ 3 & 6 & 1 \end{pmatrix}$$

In[207]:= `Transpose[mat2]`

Out[207]//MatrixForm=

$$\begin{pmatrix} 2 & 5 & 6 \\ 3 & 5 & 7 \\ 4 & 5 & 8 \end{pmatrix}$$

Inverse

In[208]:= `Inverse[mat1]`

Out[208]//MatrixForm=

$$\begin{pmatrix} -\frac{5}{9} & \frac{2}{9} & \frac{1}{3} \\ -\frac{8}{9} & \frac{5}{9} & -\frac{2}{3} \\ \frac{10}{9} & -\frac{4}{9} & \frac{1}{3} \end{pmatrix}$$

Determinant

In[210]:= `Det[mat1]`

Out[210]= -9

In[211]:= `Det[mat2]`

Out[211]= 0

Thank you