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Discrete Mathematics
LabSheet 05
Year 2 , Semester 2

Vectors and Matrices

Vectors

Row Vector

A row vector can be initialized with numbers inside braces separated by comma “,” or spaces ” “.

```
>> rv1 = [1,2,3,4]
rv1 =
   1   2   3   4
>> rv2 = [1 2 3 4]
rv2 =
   1   2   3   4
```

linspace function can also be used to create a row vector with equally distanced elements.

vectorName **= *linspace(****startValue, endValue, numberOfElements****)***

```
>>rv3 = linspace(1, 10, 5)
rv3 =
    1.0000    3.2500    5.5000    7.7500   10.0000
```

Column Vector

Column vector are initialized with numbers inside braces separated by semicolon “;” or newline(enter key).

```
>>cv1 = [1;2;3;4]
cv1 =
   1
   2
   3
   4
```

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```
>>cv2 =
 [1
2
3
4]
cv2 =
   1
   2
   3
   4
```

Excersice 01

1. Create a variable that is a row vector with the following elements: 9, 1,3^2 , 7/4, 0, $2.25 * 8.5$, 0.8, and $sin(\pi/8)$.
2. Create a variable that is a column vector with the following elements: $2.1 * 10^{-2}$, sin(1.7π), 28.5, $2.7^{4/3}$, and e3.
3. Define the variables x = 3.4 and y = 5.8, and then use them to create a row vector (assign it to a variable named "e") that has the following elements: x/y, x+y, x^y,x*y, y^2, and x.
4. Define the variables c = 4.5 and d = 2.8, and then use them to create a column vector (assign it to a variable named "f") that has the following elements: d^2, c, (c+d),c^d, and d.
5. Create a variable "g" that is a row vector in which the first element is 3 and the last element is 27, with an increment of 4 between the elements (3, 7, 11, …, 27).
6. Create a variable h that is a row vector with eight equally spaced elements in which the first element is 68 and the last element is 12.
7. Use a single command to create a row vector (assign it to a variable named R) with 10 elements such that R = -4 -1 2 5 8 14 18 22 26 30 (Do not type the vector elements explicitly).

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Matrix

Matrix can be initialized using row vector and column vector initialization method together.

```
>>mx1 =[1,2,3;4,5,6;7,8,9]
mx1 =
   1   2   3
   4   5   6
   7   8   9
>>mx2 = [1 2 3 4
5 6 7 8]
mx2 =
   1   2   3   4
   5   6   7   8
```

Another method of creating a matrix is by use of a colon ":" operator along with the assignment. if a variable is defined with row and column number parameters, the program automatically creates a matrix with a size defined by the parameter and assigns the value at the place.

```
>> mx3(1:2,1:2) =8
mx3 =
   8   8
   8   8
>>mx4(2,2) = 7
mx4 =
   0   0
   0   7
```

One important thing to note here is that indexing starts from '1' in Matlab/Octave, unlike other programming languages.

Special Utility Matrices

For common utility related to matrices, there are several functions developed which are collectively known as special utility matrices.

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zeros/ones

Matrices can be initialized with all zeros or ones using the function with same name.

*matName = **zeros**(numRows, numColumns)*

```
>>mx5 = zeros(2,4)
mx5 =
   0   0   0   0
   0   0   0   0
>> mx6 = ones(4, 2)
mx6 =
   1   1
   1   1
   1   1
   1   1
```

Using the same method one can also generate the vector by selecting row number == 1 for row vector, or column number == 1 for column vector.

```
>>rv4 = zeros(1, 4)
rv4 =
   0   0   0   0
>>cv3 = ones(3,1)
cv3 =
   1
   1
   1
```

For creating square matrices it is not needed to give both row count and column count.

```
>>mx7 = zeros(5)
mx7 =
   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
```

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eye

Identity matrix can be formed with ***eye*** function.

```
>>mx8 = eye(3)
mx8 =

Diagonal Matrix
   1   0   0
   0   1   0
   0   0   1
```

repmat

To create a matrix with same number as each element ***repmat*** is the function to use.

*matrixName = **repmat**(number, sizeOfMatrix)*

```
>>mx8 = repmat(5,2)
mx8 =
   5   5
   5   5
```

to make non square matrix, dimension may also be supplied as vector.

```
>>mx9 = repmat(5,[2,4])
mx9 =
   5   5   5   5
   5   5   5   5
```

rand

rand function used for generating a random number can also be used for generating random matrix.

```
>>rand()
ans =  0.99085
>> mx10 = rand(3)
```


```
mx10 =
  0.167886   0.890964   0.399979
  0.893061   0.014076   0.589449
  0.749548   0.517955   0.743926
>> mx11 = rand([2,3])
mx11 =
  0.584307   0.061261   0.875626
  0.840153   0.528905   0.793453
```

Exercise 02

1. Create the following matrix by assigning vectors with constant spacing to the rows (use the "linspace" command for the third row). Do not type individual elements explicitly.

```
A =
    1.0000 2.0000 3.0000 4.0000 5.0000 6.0000 7.0000
    7.0000 6.0000 5.0000 4.0000 3.0000 2.0000 1.0000
    2.0000 3.1667 4.3333 5.5000 6.6667 7.8333 9.0000
```

2. Create the following matrix by typing one command. (Do not type individual elements explicitly).

```
C =
    6    8
    6    8
    6    8
    6    8
    6    8
```

3. Create the following matrix by typing one command. (Do not type individual elements explicitly).

```
D =
    1    1    1    1
    1    1    1    1
    1    1    1    1
    8    6    4    2
```

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4. Create the following matrix by typing one command. (Do not type individual elements explicitly).

```
G =
     1     1     1     1     1
     1     1     1     1     1
     1     1     1     1     1
     0     0     0     1     1
     0     0     0     1     1
     0     0     0     1     1
```

5. Create the following matrix N.

```
N =
     0     3     6     9    12    15
    18    21    24    27    30    33
    36    39    42    45    48    51
```

(It can be done by typing: N=reshape(0:3:51,6,3)'.) By writing one command and using the colon to address the range of elements (do not type individual elements explicitly), use the matrix N to:

(a) Create a six-element row vector named "Ua" that contains the first three elements of the first row of N followed by the last three elements of the third row of N.

(b) Create a nine-element column vector named "Ub" that contains the elements of the first column of N, followed by the elements of the third column of N, followed by the elements of the sixth column of N.

(c) Create a six-element column vector named "Uc" that contains elements 2, 3, 4, and 5 of the second row of N, followed by elements 2 and 3 of the fifth column of N.

6. Using the "zeros", "ones", and "eye" commands, create the following arrays by typing one command:

(*a*) $\begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \end{bmatrix}$ (*b*) $\begin{bmatrix} 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 \end{bmatrix}$ (*c*) $\begin{bmatrix} 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$

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7. Use the “eye”, “ones”, and “zeros” commands to create the following arrays:

$$A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \qquad B = [1 \quad 1] \qquad C = \begin{vmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{vmatrix}$$

Using the variables A, B, and C, write a command that creates the following matrix D:

$$D = \begin{bmatrix} 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 \end{bmatrix}$$