VECTORS

```
>> a = [ 7  2   5 ],    b = [ 9   0 3 ]
>>c=1:5
   c=  1  2  3  4  5

>>d=5:8
    d=  5   6   7   8

>>e=0:2:10
    0  2  4   6  8   10

>>f=0:0.1:0.6
   0   0.1   0.2    0.3   0.4  0.5   0.6

>>g=zeros(1,6)
  0   0   0   0   0   0

>>h=zeros(1,4)
      0   0   0   0

>>k=ones(1,7)
      1   1   1   1   1  1   1

>>m=ones(1,3)
      1    1    1
```

TOPLAMA ve CIKARMA

```
>>a=[ 2   8   10],   b=[  1  4  3]

>> c= a + b
       2     8     10
+      1     4      3
--------------------
       3     12    13

c=[  3    12     13]


>>d=10*a
   d=[  20   80   100]

>>e=5*b
       5    20   15

>>f=10*a + 5*b
       25    100   115

>>g= a-b
    2     4    7
```

VEKTORLERIN IC ICE KONULMASI

```
>>h = [ 1:5 ]
   1  2   3  4  5

>>k = [ 1:5     1:3 ]
   1   2  3  4   5    1   2  3

>>m = [ 0:2:10   10:3:22 ]
0  2  4   6  8    10   13   16   19    22

>> a = [ 8 10 3 ],  b= [4  7  8]
>> c= [ a  b ]
  8  10  3   4  7  8

>> d = [ a a  a ]
  8  10  3     8  10  3     8  10  3
```

Komplex vectors

```
>> a = [ 3+4*j    -6 +9j        2+5j      -7j    30]

>> w = abs(a)
          5     10.81       5.38     7    30
```

$\sqrt{3^2+4^2}$ =5, $\sqrt{6^2+9^2}$ =10.81 …

```
>> p=angle(a)
              0.92   2.15    1.19   -1.57     0

>> s=angle(a)*180/pi
       53.13     123.69     68.19     -90       0
```

$$\tan^{-1}(\frac{4}{3})=0.92^{\text{radian}} = 53.13^0$$

$$\tan^{-1}(\frac{9}{-6})=2.15^{\text{radian}} = 123.69^0$$

MATRISLER:

Asagidakileri yazin

```
>> a=[10 20 30; 40 50 60;  100 80 90];
>> b=[ 1 2 3;  4 5 6; -2 8 9];
c=[15 25 35];
```

$$a=\begin{bmatrix}10 & 20 & 30\\ 40 & 50 & 60\\ 100 & 80 & 90\end{bmatrix}, b=\begin{bmatrix}1 & 2 & 3\\ 4 & 5 & 6\\ -2 & 8 & 9\end{bmatrix},$$

$$c=[15 \quad 25 \quad 35],$$

Toplama, Cikarma, Carpma, Bolme, normal islemler gibi yapilir.

```
>>qq=a+b,  ww=a-b;  ee=a*d;
```

$$qq=\begin{bmatrix}11 & 22 & 33\\ 44 & 55 & 66\\ -98 & 88 & 99\end{bmatrix},\quad ww=\begin{bmatrix}9 & 18 & 27\\ 36 & 45 & 54\\ 102 & 72 & 81\end{bmatrix},\quad ee=\begin{bmatrix}200\\ 440\\ 710\end{bmatrix}$$

' isareti matris transpozesi icin kullanilir.

```
>>m=[1 2 3; 4 5 6],   n=a',    d=[1   2   5]'
```

$$m=\begin{bmatrix}1 & 2 & 3\\ 4 & 5 & 6\end{bmatrix} \qquad n=\begin{bmatrix}1 & 4\\ 2 & 5\\ 3 & 6\end{bmatrix}, \qquad d=\begin{bmatrix}1\\ 2\\ 5\end{bmatrix}$$

Satir ve Sutun islemleri

Asagidaki ifadeleri yazin ve G matrisini ekranda gorun

>> G=[10 20 30 40; 210 220 230; 310 320 330 340; 410 420; 430; 440];

$$G=\begin{bmatrix}10 & 20 & 30 & 40\\ 210 & 220 & 230 & 240\\ 310 & 320 & 330 & 340\\ 410 & 420 & 430 & 440\end{bmatrix}$$

Asagidaki ifadeleri yazin ve sonuclari ekranda gorun
>>h=G(:,1), k= G(:,2), m= G(:,4), n=G(1,:), p=G(2,:),

$$h=\begin{bmatrix}10\\ 210\\ 310\\ 410\end{bmatrix},\ k=\begin{bmatrix}20\\ 220\\ 320\\ 420\end{bmatrix},\ m=\begin{bmatrix}40\\ 240\\ 340\\ 440\end{bmatrix},$$

$$n=\begin{bmatrix}10 & 20 & 30 & 40\end{bmatrix}$$

,

$$p=\begin{bmatrix}410 & 420 & 430 & 440\end{bmatrix}$$

Ayrica , r=G(1:2,:), t=G(:,1:2), s=G(1:2,1:2)

$$r=\begin{bmatrix}10 & 20 & 30 & 40\\ 210 & 220 & 230 & 240\end{bmatrix},\ t=\begin{bmatrix}10 & 20\\ 210 & 220\\ 310 & 320\\ 410 & 420\end{bmatrix},$$

$$s=\begin{bmatrix}10 & 20\\ 210 & 220\end{bmatrix},$$

>> aa=1:10

$$aa=[1\ \ 2\ \ 3\ \ 4\ \ 5\ \ 6\ \ 7\ \ 8\ \ 9\ \ 10]$$

>> aa=1:7, bb=sin(aa),
bb=[0.84 0.9 0.14 -0.75 -0.95 -0.27 0.65]
her elemanin ayri ayri sinusu alinir
bb=[sin(1) sin(2) sin(3) sin(4) sin(5) sin(6) sin(7)];

Matrices can be nested into each other. Examine the following examples.
>>a=[1 2 3]; b=[10 100 200]; c=[11 22 33]; d=[a; b; c]; e=[a b c];

$$d=\begin{bmatrix}1 & 2 & 3\\ 10 & 100 & 200\\ 11 & 22 & 33\end{bmatrix},$$

$$e=[1\ \ 2\ \ 3\ \ 10\ \ 100\ \ 200\ \ 11\ \ 22\ \ 33]$$

>>a=[1 2; 3 4]; b=[a [10 20]'; 7 8 9]

$$a=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix},\quad b=\begin{bmatrix}1 & 2 & 10\\ 3 & 4 & 20\\ 7 & 8 & 9\end{bmatrix}$$

MATLAB da tanimlanmis fonksiyoanlar
zeros(n,m) n x m boyutlu, tum elemanlari sifir matrix
ones(n,m) n x m boyutlu, tum elemanlari 1 matrix
eye(n) n x n boyutlu birim matris. tum elemanlari 0 sadece kosegen elemanlari 1.
size(qq) Bir matrisin boyutlarini verir. m ve n yi verir
qq' Transpose of the matrix qq
inv(qq) matris tersi (inversi)
diag(qq) diagonal of the matrix qq
sum(qq) elemanlarin toplami
det(qq) determinant of the matrix qq.

Example 1)

>>ww=ones(2,3), ff=zeros(3,4), gg=eye(3),

$$ww=\begin{bmatrix}1 & 1 & 1\\ 1 & 1 & 1\end{bmatrix},\quad ff=\begin{bmatrix}0 & 0 & 0 & 0\\ 0 & 0 & 0 & 0\\ 0 & 0 & 0 & 0\end{bmatrix},$$

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

Example 2)
>>[wrow wcolumn]=size(ww),
wrow=2 wcolumn=3

>>[frow fcolumn]=size(ff),
frow=3 frow=4

Example 3)

>>q=[1 2; 3 4], p=[10 20; 30 40];

r=[[q zeros(2,2)] [ones(2,2) p]]

$$q=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix},\ q=\begin{bmatrix}10 & 20\\ 30 & 40\end{bmatrix},$$

$$r=\begin{bmatrix}1 & 2 & 0 & 0 & 1 & 1 & 10 & 20\\ 3 & 4 & 0 & 0 & 1 & 1 & 30 & 40\end{bmatrix}$$

Example 4)
>> e = [zeros(1,4) ones(1,3)]
0 0 0 0 1 1 1

>> e = [zeros(1,4) ones(1,3)]
0 0 0 0 1 1 1

```
>> f = [ ones(1,3)    10*ones(1,4)  ]
   1   1   1     10   10   10  10

>> g = 10*[1:3]
      10   20  30

>> h = [ ones(1,3)   10:2:20]
 1  1   1    10  12  14  16  18  29

>> k =[ 10*ones(1,3)  17   10:3:19 ]
    10  20  30    17  10   13   16  19
```


```
>> f = [ ones(1,3)    10*ones(1,4)  ]
   1   1   1     10   10   10  10

>> g = 10*[1:3]
      10   20  30

>> h = [ ones(1,3)   10:2:20]
 1  1   1    10  12  14  16  18  29

>> k =[ 10*ones(1,3)  17   10:3:19 ]
    10  20  30    17  10   13   16  19
```


Example 5)

```
>>  aa=[4 6 0  0 2   2   40    60]
 >>bb=sum(aa)
   bb=114
```

vektorun tum elemanlari toplandi.
4 + 6 + 0 + 0 + 2 + 2 + 40 +60=114

Example 6)

Most built-in functions (sin,cos,tan, exp..) also works for matrices.

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

   >> b=sin(a);
```

$$b=\begin{bmatrix}\sin(1) & \sin(2)\\ \sin(3) & \sin(4)\end{bmatrix}=\begin{bmatrix}0.841 & 0.909\\ 0.141 & -0.756\end{bmatrix},$$

```
>> c=exp(a);
```

$$c=\begin{bmatrix}e^1 & e^2\\ e^3 & e^4\end{bmatrix}=\begin{bmatrix}2.718 & 7.389\\ 20.08 & 54.59\end{bmatrix}$$

Exercise 2)Asagidaki matrisleri MATLAB komutlariyla elde edin.

$$A=\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\end{bmatrix},$$

$$B=\begin{bmatrix}0 & 0 & 0 & 0\\ 0 & 0 & 0 & 0\\ 0 & 0 & 0 & 0\\ 0 & 0 & 0 & 0\end{bmatrix},\ \mathrm{C}=\begin{bmatrix}1 & 1\\ 1 & 1\end{bmatrix},\quad D=\begin{bmatrix}100 & 100\\ 100 & 100\end{bmatrix},$$

Exercise 3)

```
>>A=[1 2 3; 10 20 30; 40 50 60],
```

$$A=\begin{bmatrix}1 & 2 & 3\\ 10 & 20 & 30\\ 40 & 50 & 60\end{bmatrix}$$

B matrisini A matrisinin satir ve sutunlarini degistirerek elde edin.
C matrisini A matrisinin satir ve sutunlarini degistirerek elde edin.

$$B=\begin{bmatrix}1 & 2 & 3\\ 40 & 50 & 60\\ 10 & 20 & 30\end{bmatrix},\qquad C=\begin{bmatrix}1 & 3 & 20\\ 40 & 60 & 50\\ 10 & 30 & 20\end{bmatrix}$$

Exercise 5) Asagidaki matrisi zeros ve ones komutlari ile elde edin.

$$\mathrm{q}\left\{\begin{bmatrix}\overbrace{1\ 1\ ..\ 1\ 1}^{n}\ \overbrace{0\ 0\ ..\ 0}^{\mathrm{m}}\\ 1\ 1\ ..\ 1\ 1\ 0\ 0\ ..\ 0\\ ..\ \ ..\ ..\ \ ..\ ..\ ..\\ 1\ 1\ ..\ 1\ 1\ 0\ 0\ ..\ 0\end{bmatrix}\right.$$

a)

$$\mathrm{q}\left\{\begin{bmatrix}\overbrace{1\ 1\ ..\ 1\ 1}^{n}\ \overbrace{0\ 0\ ..0}^{\mathrm{m}}\ \overbrace{2\ \ 2\ \ ...\ 2}^{\mathrm{k}}\\ 1\ 1\ ..\ 1\ 1\ 0\ 0\ ..\ 0\ \ 2\ \ 2\ \ ...\ 2\\ ..\ \ ..\ ..\ \ ..\ ..\ ..\\ 1\ 1\ ..\ 1\ 1\ 0\ 0\ ..\ 0\ \ 2\ \ 2\ \ ...\ 2\end{bmatrix}\right.$$

b)

$$\begin{bmatrix} q\{\overbrace{1\ 1\ ..\ 1\ 1}^{n} \\ 1\ 1\ ..\ 1\ 1 \\ ..\ ..\ ..\ ..\ .. \\ 1\ 1\ ..\ 1\ 1 \\ m\{0\ 0\ ..\ 0\ 0 \\ 0\ 0\ ..\ 0\ 0 \\ ..\ ..\ ..\ ..\ .. \\ 0\ 0\ ..\ 0\ ..\ 0 \\ k\{1\ 0\ ..\ 0\ ..\ 0 \\ 0\ 1\ ..\ 0\ ..\ 0 \\ ..\ ..\ ..\ 0\ ..\ 0 \\ 0\ 0\ ..0\ 1\ ..\ 0 \\ p\{0\ 0\ ..\ 0\ 0\ ..\ 0 \end{bmatrix}$$

C)

$$\begin{bmatrix} \overbrace{1\ 1\ ..\ 1\ 1}^{n}\ \overbrace{0\ 0\ ..0}^{m}\ \overbrace{0..\ 0}^{k} \\ p\{1\ 1\ ..\ 1\ 1\ 0\ 0\ ..\ 0\ \ 0..\ 0 \\ ..\ ..\ ..\ ..\ ..\ ..\ ..\ ..\ \ . \\ 1\ 1\ ..\ 1\ 1\ 0\ 0\ ..0\ \ 0\ ..0 \\ q\{4\ 4\ ..\ 4\ 4\ 1\ 0\ ..0\ \ 0..\ 0 \\ 4\ 4\ ..\ 4\ 4\ 0\ 1\ ..0\ \ 0..\ 0 \\ ..\ ..\ ..\ ..\ ..\ ..\ ..\ ..\ \ . \\ 4\ 4\ ..\ 4\ 4\ 0\ 0\ ..1\ \ 0..\ 0 \\ r\{0\ 0\ ..\ 0\ 0\ 0\ 0..\ 0\ \ 0..\ 0 \\ ..\ ..\ ..\ ..\ ..\ ..\ ..\ ... \\ 0\ 0..\ 0\ 0\ ..\ 0\ 0\ 0..\ 0 \end{bmatrix}$$

d)

MATRISLERDE SCALAR CARPMA VE BOLME

x=a.*b , a ve b vectorlerinin scalar carpimini verir.

Normal carpmada kullanilan * yerine .* kullanildigina dikkat ediniz.

>> a = [15 16 12 20], b =[10 4 6 5], x=a.*b

x = [150 64 72 100]

15 * 10 = 150

16 * 4 = 64

12 * 6 = 72

20 * 5 =100

>> a = [15 16 12 20], b =[10 4 6 5], y=a./b

Normal bolmede kullanilan / yerine ./ kullanildigina dikkat ediniz.

y = [1.5 4 2 4]

15 / 10 = 1.5

16 / 4 = 4

12 / 6 = 2

20 / 5 = 4

>>q=[1 2; 3 4], p=[10 20; 30 40]; w=p+q

$$p=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix},\ q=\begin{bmatrix}10 & 20\\ 30 & 40\end{bmatrix},\quad w=\begin{bmatrix}11 & 22\\ 33 & 44\end{bmatrix}$$

>>q=[1 2; 3 4], p=[10 20; 30 40]; z=q.*p, k=p./q

$$z=\begin{bmatrix}10 & 20\\ 90 & 160\end{bmatrix}, k=\begin{bmatrix}10 & 10\\ 10 & 40\end{bmatrix}$$

DIMENSION ERROR

>> a = [2 5 4], b = [8 3 12 5]

>>x = a + b

?? Error using ==> plus

Matrix dimensions must agree.

scalar islemlerde a ve b ayni boyutta olmalidir.

x = a*b, y = a.*b, z = a/b w=a./b

hepsi hatalidir.

MATRIS CARPIMLARI

$$\begin{bmatrix}b_{11} & b_{12}\\ b_{21} & b_{22}\\ b_{31} & b_{32}\end{bmatrix}$$

$$\begin{bmatrix}a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\end{bmatrix}\quad\begin{bmatrix}a_{11}b_{11}+a_{12}b_{21}+a_{13}b_{31} & a_{11}b_{12}+a_{12}b_{22}+a_{13}b_{32}\\ a_{21}b_{11}+a_{22}b_{21}+a_{23}b_{31} & a_{21}b_{12}+a_{22}b_{22}+a_{23}b_{32}\end{bmatrix}$$

$$\begin{bmatrix}2 & 3 & 4\\ 5 & 6 & 7\end{bmatrix}\begin{bmatrix}10 & 20\\ 30 & 40\\ 50 & 60\end{bmatrix}=\begin{bmatrix}310 & 400\\ 580 & 760\end{bmatrix}$$

>>aa=[2 3 4; 5 6 7], bb=[10 20; 30 40; 50 60], x=aa*bb

$$x=\begin{bmatrix}310 & 400\\ 580 & 760\end{bmatrix}$$

$$\begin{bmatrix}2 & 3 & 4\end{bmatrix}\begin{bmatrix}10\\ 20\\ 30\end{bmatrix}=200$$

>>a=[2 3 4], b=[10 20 30]', x=a*b
x=200

$$\begin{bmatrix}10\\20\\30\end{bmatrix}\begin{bmatrix}2 & 3 & 4\end{bmatrix}=\begin{bmatrix}20 & 30 & 40\\40 & 60 & 80\\60 & 90 & 120\end{bmatrix}$$

>>a=[2 3 4], b=[10 20 30]', x=b*a

$$x=\begin{bmatrix}20 & 30 & 40\\40 & 60 & 80\\60 & 90 & 120\end{bmatrix}$$

$\begin{bmatrix}2 & 3 & 4\end{bmatrix}\begin{bmatrix}10 & 20 & 30\end{bmatrix}$ = HATALI ISLEM

>>a=[2 3 4], b=[10 20 30], x=a*b

??? Error using ==> mtimes
Inner matrix dimensions must agree.

Matris boyutlari uyusmazsa carpma tanimsizdir.

MATRIS KARESI VE USTEL ISLEMLER

>> a=[2 5 7 -8], b=a^2
??? Error using ==> mpower
Matrix must be square.

>> a=[2 5 7 -8], b=a.^2
b=[4 25 49 64]

$2^2 = 4$ $5^2 = 25$ $7^2 = 49$ $(-)8^2 = 64$

>> a=[2 5 7 -8], b=a.^3
b=[8 125 343 -512]

>>a=[1 2; 3 4]; d=a.^2;

$$d=\begin{bmatrix}1^2 & 2^2\\3^2 & 4^2\end{bmatrix}=\begin{bmatrix}1 & 4\\9 & 16\end{bmatrix},$$

>> g=a^2

$$g=\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}=\begin{bmatrix}7 & 10\\15 & 22\end{bmatrix}$$

a.^2 ile a^2 arasindaki farki gozelemleyin.

Ornek 431 : x=0; x=1; x=8 x=5; icin $y=3x^2+5x+7$ degerini hesaplayin bir matris halinde gosterin.

Method 1.

```
    a1=0;  b1=3*a1^2 + 5*a1 +7

    a2=1;  b2=3*a2^2 + 5*a2 +7

    a3=8;  b3=3*a3^2 + 5*a3 +7

    a4=5;  b4=3*a4^2 + 5*a4 +7

tt=[a1 b1;  a2 b2;  a3 b3; a4 b4]
    tt=
     0     7
     1    15
     8   239
     5   107
---------------------------------
Method  2.
    aa=[0 1 8  5]
    aa_Length=length(aa);
 for kk=1:aa_Length,
bb(kk)= 3* aa(kk) ^2 + 5*aa(kk) +7
 end;
bb=[7    15   239   107]

tt=[aa' bb']

 tt=
     0     7
     1    15
     8   239
     5   107
----------------------
  Method  3.
    aa=[0 1 8  5]
    bb=3*aa.^2 + 5*aa +7
----------------------
  Method  4.

    aa=[0 1 8  5]
    pol_coef =[3 5 7]



  b1=polyval(pol_coef,0)

  b2=polyval(pol_coef,0)

  b3=polyval(pol_coef,0)

  b4=polyval(pol_coef,0)
bb=[ b1 b2 b3 b4]
-------------------------
   Method  5.
  aa=[0 1 8  5]
  pol_coef =[3 5 7]
  bb=polyval(pol_coef,aa)
--------------------
-----------------------------------
```

Problem: $y = 3x^2 + e^{0.1x} - 20\sin(x)$
Calculate y for x=0, x=0.5 , x=1, and x=2

Long method:

>> x=0, y = 3*x^2 + exp(0.1*x) -20*sin(x)
1

>> x=0.5, y = 3*x^2 + exp(0.1*x) -20*sin(x)
-7.78

>> x=1, y = 3*x^2 + exp(0.1*x) -20*sin(x)
-12.72

Short method

>> x=[0 0.5 1 2],

>> y = 3* x.^2 + exp(0.1*x) - 20*sin(x)
1 -7.78 -12.72 -4.96

Notice **the dot .** in x.^2

for

```
  >> for kk=1:4,  aa(kk)=kk^3; end;

 aa=[1^3   2^3   3^3  4^3 ]

 aa=[  1   8  27  64]
------------------------
```