

## Experiment:2 Mathematical Operations

### 1. Basic Operations of matrices

Evaluate the following problems by writing a program in a script file and then execute it:

$$A = \begin{bmatrix} 1 & 3 & 4 \\ 5 & -9 & -8 \\ 4 & 7 & 8 \end{bmatrix}, B = \begin{bmatrix} 1 & 6 & 7 \\ -1 & -5 & 1 \\ 1 & 9 & 0 \end{bmatrix}$$

- Create the matrices  $A$  and  $B$ .
- Check the size of both matrices.
- Find  $A + B, A - B, AB, A^2, A(A - 2B)$ .
- Write the command to display only the first row and second row of matrix  $A$ .
- Write the command to display only the first column and second column of matrix  $B$ .
- Find the determinant of both matrices and inverse (if exist).
- Find the transpose of  $A$  and assign it to new matrix  $C$ .
- Display the element  $C_{13}$ .
- Display the second row of the transpose of  $A$ .
- Find the determinant of transpose of  $A$ .

*Solution.*

```
A=[1 3 4;5 -9 -8;4 7 8]
```

```
A = 3x3
```

```
    1     3     4
    5    -9    -8
    4     7     8
```

```
B=[1 6 7;-1 -5 1;1 9 0]
```

```
B = 3x3
  1   6   7
 -1  -5   1
  1   9   0
```

```
size(A)
```

```
ans = 1x2
     3   3
```

```
size(B)
```

```
ans = 1x2
     3   3
```

```
A+B
```

```
ans = 3x3
  2   9  11
  4  -14  -7
  5  16   8
```

```
A-B
```

```
ans = 3x3
  0  -3  -3
  6  -4  -9
  3  -2   8
```

```
A*B
```

```
ans = 3x3
  2  27  10
  6   3  26
  5  61  35
```

```
A^2
```

```
ans = 3x3
    32     4    12
   -72    40    28
    71     5    24
```

```
A*(A-2*B)
```

```
ans = 3x3
    28   -50    -8
   -84    34   -24
    61  -117   -46
```

```
A(1,:)
```

```
ans = 1x3
     1     3     4
```

```
A(2,:)
```

```
ans = 1x3
     5    -9    -8
```

```
B(:,1)
```

```
ans = 3x1
     1
    -1
     1
```

```
B(:,2)
```

```
ans = 3x1
     6
    -5
     9
```

```
det(A)
```

```
ans = 52.0000
```

```
det(B)
```

```
ans = -31
```

```
inv(A)
```

```
ans = 3x3
    -0.3077    0.0769    0.2308
    -1.3846   -0.1538    0.5385
     1.3654    0.0962   -0.4615
```

```
inv(B)
```

```
ans = 3x3
     0.2903   -2.0323   -1.3226
    -0.0323    0.2258    0.2581
     0.1290    0.0968   -0.0323
```

```
C=A'
```

```
C = 3x3
     1     5     4
     3    -9     7
     4    -8     8
```

```
C(1,3)
```

```
ans = 4
```

```
C(2,:) 
```

```
ans = 1x3
     3    -9     7
```

`det(C)`

`ans = 52`



## 2. Matrix manipulation

Given are a  $5 \times 6$  matrix  $A$ , a  $3 \times 6$  matrix  $B$ , and a 9-element vector  $v$

$$(a) A = \begin{bmatrix} 2 & 5 & 8 & 11 & 14 & 17 \\ 3 & 6 & 9 & 12 & 15 & 18 \\ 4 & 7 & 10 & 13 & 16 & 19 \\ 5 & 8 & 11 & 14 & 17 & 20 \\ 6 & 9 & 12 & 15 & 18 & 21 \end{bmatrix}$$

$$(b) B = \begin{bmatrix} 5 & 10 & 15 & 20 & 25 & 30 \\ 30 & 35 & 40 & 45 & 50 & 55 \\ 55 & 60 & 65 & 70 & 75 & 80 \end{bmatrix}$$

$$(c) v = [99 \ 98 \ 97 \ 96 \ 95 \ 94 \ 93 \ 92 \ 91]$$

Create the three arrays in the script, and then, by writing one command, replace the last four columns of the first and third rows of  $A$  with the first four columns of the first two rows of  $B$ , the last four columns of the fourth row of  $A$  with the elements 5 through 8 of  $v$ , and the last four columns of the fifth row of  $A$  with columns 3 through 5 of the third row of  $B$ .

*Solution.* `A=[2:3:17; 3:3:18; 4:3:19; 5:3:20; 6:3:21]`

A = 5x6

2	5	8	11	14	17
3	6	9	12	15	18
4	7	10	13	16	19
5	8	11	14	17	20
6	9	12	15	18	21

Input the Matrix B

`B=[5:5:30; 30:5:55; 55:5:80]`

B = 3x6

5	10	15	20	25	30
30	35	40	45	50	55
55	60	65	70	75	80

Input the vector v

```
v=[99:-1:91]
```

```
v = 1x9
    99    98    97    96    95    94    93    92    91
```

Replacing the rows of A with rows of B and V

```
A([1 3 4 5],3:6)=[B([1 2],1:4); v(5:8); B(3,2:5)]
```

```
A = 5x6
    2     5     5    10    15    20
    3     6     9    12    15    18
    4     7    30    35    40    45
    5     8    95    94    93    92
    6     9    60    65    70    75
```

### 3. Calculus and functional operations

Define the following function in the variables x and y

(a)  $f(x) = 2\sin^2(x) + \log(x)$  and evaluate  $f$  when  $x = 10$  and  $x = \pi$

(b) find the derivative of  $\sin(x) + x^3 + 2x + \cos(4x)$

(c)  $g(x, y) = \frac{x^2}{y} + \frac{y^3}{x+y}$  and evaluate  $g$  when  $x = -2$  and  $y = -7$

(d) Define the inverse function and evaluate the inverse of matrix in two ways.

*Solution.*

```
f = @(x) (sin(x))^2 + log(x)
```

```
f(10)
ans = 2.5985
f(pi)
ans = 1.1447
```

*Solution.*

```
syms x
h=sin(x)+x^3+2*x+cos(4*x)
```

```
h =
 2 x + cos(4 x) + sin(x) + x^3
```

```
diff(h)
```

```
ans =
cos(x) - 4 sin(4 x) + 3 x^2 + 2
```

*Solution.*

```
g = @(x,y) x^2 / y + y^3/(x + y)
```

```
g(1,2)
ans = 3.1667
f(pi)
ans = 1.1447
```

*Solution.*

```
g = @ inv
h = feval(g,A)
```

```
-0.6000    0.4000
 0.8000   -0.2000
```

```
g(A)
```

```
-0.6000    0.4000
 0.8000   -0.2000
```