PRACTICING MATLAB

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Variable declaration

Write a simple command to create the following scalar, vectors and arrays

$$a = 3 \quad b = 0.5 \quad c = -2.7$$

$$u = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \quad v = \begin{pmatrix} -2 \\ 1.5 \\ 1 \end{pmatrix} \quad s = (-1 \quad -0.4 \quad 2 \quad 1) \quad w = (4 \quad -2 \quad 6 \quad 3)$$

$$A = \begin{pmatrix} 1 & 2 & 3 & 4 \\ -1 & 0 & 5 & 2 \\ -1 & 2 & 8 & 1 \\ 0 & 5 & 3 & 1 \end{pmatrix} \quad B = \begin{pmatrix} 0.28 & -0.45 & 0.84 & 1.01 \\ 0.83 & -0.30 & -0.45 & 1.99 \\ 0.46 & 0.83 & 0.29 & 3.03 \\ 0 & 0 & 0 & 1.00 \end{pmatrix} \quad C = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \end{pmatrix}$$

```
a = 3
```

```
a = 3
```

```
b = 0.5
```

```
b = 0.5000
```

```
c = -2.7
```

```
c = -2.7000
```

```
u = [1;2;3]
```

```
u = 3×1
     1
     2
     3
```

```
v = [-2;1.5;1]
```

```
v = 3×1
   -2.0000
    1.5000
    1.0000
```

```
s = [-1 -0.4 2 1]
```

```
s = 1×4
   -1.0000   -0.4000    2.0000    1.0000
```

```
w = [4, -2, 6, 3]
```

```
w = 1×4
     4    -2     6     3
```

```
A = [1:4; -1 0 5 2; -1 2 8 1; 0 5 3 1]
```

```
A = 4×4
     1     2     3     4
    -1     0     5     2
    -1     2     8     1
     0     5     3     1
```

```
B = [0.28 -0.45 0.84 1.01; 0.83 -0.30 -0.45 1.99; ...
    0.46 0.83 0.29 3.03; 0 0 0 1]
```

```
B = 4×4
    0.2800   -0.4500    0.8400    1.0100
    0.8300   -0.3000   -0.4500    1.9900
    0.4600    0.8300    0.2900    3.0300
         0         0         0    1.0000
```

```
C = [1:4; 5:8]
```

```
C = 2×4
     1     2     3     4
     5     6     7     8
```

Matrix and array arithmetic

Syntax

```
A+B      A-B          A*B    A.*B         A/B    A./B         A\B    A.\B
A^B      A.^B         A'     A.'
```

```
A + B
```

```
ans = 4×4
    1.2800    1.5500    3.8400    5.0100
   -0.1700   -0.3000    4.5500    3.9900
   -0.5400    2.8300    8.2900    4.0300
         0    5.0000    3.0000    2.0000
```

```
A - B
```

```
ans = 4×4
    0.7200    2.4500    2.1600    2.9900
   -1.8300    0.3000    5.4500    0.0100
   -1.4600    1.1700    7.7100   -2.0300
         0    5.0000    3.0000         0
```

```
A*B
```

```
ans = 4×4
    3.3200    1.4400    0.8100   18.0800
```

```
    2.0200    4.6000    0.6100   16.1400
    5.0600    6.4900    0.5800   28.2100
    5.5300    0.9900   -1.3800   20.0400
```

```
A.*B
```

```
ans = 4×4
    0.2800   -0.9000    2.5200    4.0400
   -0.8300         0   -2.2500    3.9800
   -0.4600    1.6600    2.3200    3.0300
         0         0         0    1.0000
```

```
A/B
```

```
ans = 4×4
    1.9173   -1.1276    3.0415   -4.9083
    3.9415   -3.0982    1.0171    1.1026
    5.5653   -5.0736    3.5931   -5.4116
    0.2481   -2.9133    5.1056   -8.9231
```

```
A./B
```

```
ans = 4×4
    3.5714   -4.4444    3.5714    3.9604
   -1.2048         0  -11.1111    1.0050
   -2.1739    2.4096   27.5862    0.3300
       NaN       Inf       Inf    1.0000
```

```
A\B
```

```
ans = 4×4
   -0.5015    0.7246    1.2046   -0.1137
   -0.0302   -0.0694   -0.0994   -0.0245
   -0.0264    0.2693    0.2393    0.3686
    0.2303   -0.4609   -0.2209    0.0167
```

```
A.\B
```

```
ans = 4×4
    0.2800   -0.2250    0.2800    0.2525
   -0.8300      -Inf   -0.0900    0.9950
   -0.4600    0.4150    0.0362    3.0300
       NaN         0         0    1.0000
```

```
A^B
```

```
ans = 4×4 complex
   1.0000 + 0.0000i   0.7320 + 0.0000i   2.5164 + 0.0000i   4.0558 + 0.0000i
  -0.8607 + 0.5090i      Inf + 0.0000i   0.4847 + 0.0000i   3.9724 + 0.0000i
   0.1253 + 0.9921i   1.7777 + 0.0000i   1.8277 + 0.0000i   1.0000 + 0.0000i
   1.0000 + 0.0000i   1.0000 + 0.0000i   1.0000 + 0.0000i   1.0000 + 0.0000i
```

```
A.^B
```

```
ans = 4×4 complex
   1.0000 + 0.0000i   0.7320 + 0.0000i   2.5164 + 0.0000i   4.0558 + 0.0000i
```

```
  -0.8607 + 0.5090i      Inf + 0.0000i   0.4847 + 0.0000i   3.9724 + 0.0000i
   0.1253 + 0.9921i   1.7777 + 0.0000i   1.8277 + 0.0000i   1.0000 + 0.0000i
   1.0000 + 0.0000i   1.0000 + 0.0000i   1.0000 + 0.0000i   1.0000 + 0.0000i
```

```
A'
```

```
ans = 4×4
     1    -1    -1     0
     2     0     2     5
     3     5     8     3
     4     2     1     1
```

```
A'
```

```
ans = 4×4
     1    -1    -1     0
     2     0     2     5
     3     5     8     3
     4     2     1     1
```

Operations

Write commands to carry out the following operations (check and analyze the operation's result)

u+v, u-v, conjugate transpose of vector u, a*v, u*v, u.*v, u*v', dot product of vectors u and v, cross product of vectors u and v, dot product of vectors s and w, cross product of vectors w and w, transpose of matrix A, inverse of matrix A, A+B, A-B, matrix multiplication of A and B, array multiplication of A and B, matrix multiplication of A and C, matrix multiplication of C and A, array multiplication of A and C, array multiplication of C and A, w*A, A*w.

```
u+v
```

```
ans = 3×1
   -1.0000
    3.5000
    4.0000
```

```
u-v
```

```
ans = 3×1
    3.0000
    0.5000
    2.0000
```

```
u'
```

```
ans = 1×3
     1     2     3
```

```
a*v
```

```
ans = 3×1
   -6.0000
    4.5000
    3.0000
```

```
u.*v
```

```
ans = 3×1
    -2
     3
     3
```

```
u.*v
```

```
ans = 3×1
    -2
     3
     3
```

```
u*v'
```

```
ans = 3×3
   -2.0000    1.5000    1.0000
   -4.0000    3.0000    2.0000
   -6.0000    4.5000    3.0000
```

```
s.*w
```

```
ans = 1×4
   -4.0000    0.8000   12.0000    3.0000
```

```
w.*w
```

```
ans = 1×4
    16     4    36     9
```

```
A^(-1)
```

```
ans = 4×4
    0.5408   -1.1939    0.7347   -0.5102
   -0.0612    0.0408   -0.1020    0.2653
    0.0714   -0.2143    0.2857   -0.1429
    0.0918    0.4388   -0.3469    0.1020
```

```
A+B
```

```
ans = 4×4
    1.2800    1.5500    3.8400    5.0100
   -0.1700   -0.3000    4.5500    3.9900
   -0.5400    2.8300    8.2900    4.0300
         0    5.0000    3.0000    2.0000
```

```
A-B
```

```
ans = 4×4
    0.7200    2.4500    2.1600    2.9900
   -1.8300    0.3000    5.4500    0.0100
   -1.4600    1.1700    7.7100   -2.0300
```

```
         0    5.0000    3.0000         0
```

```
A*B
```

```
ans = 4×4
    3.3200    1.4400    0.8100   18.0800
    2.0200    4.6000    0.6100   16.1400
    5.0600    6.4900    0.5800   28.2100
    5.5300    0.9900   -1.3800   20.0400
```

```
A.*B
```

```
ans = 4×4
    0.2800   -0.9000    2.5200    4.0400
   -0.8300         0   -2.2500    3.9800
   -0.4600    1.6600    2.3200    3.0300
         0         0         0    1.0000
```

```
C*A
```

```
ans = 2×4
    -4    28    49    15
    -8    64   125    47
```

```
w*A
```

```
ans = 1×4
     0    35    59    21
```

```
```

Indexing

4) Indexing. Write commands to extract the given element or submatrix of a given matrix

extract cell (2,4) of matrix A, extract row 2 of matrix A, extract column 4 of matrix B, to extract 3x3 submatrix from the three first rows and three first column of B.

```
x = A(2,4)
```

```
x = 2
```

```
x = A(2, :)
```

```
x = 1×4
    -1     0     5     2
```

```
x = B(:, 4)
```

```
x = 4×1
```

```
    1.0100
    1.9900
    3.0300
    1.0000
```

```
x = B([1:3], [1:3])
```

```
x = 3×3
    0.2800   -0.4500    0.8400
    0.8300   -0.3000   -0.4500
    0.4600    0.8300    0.2900
```

Special Matrices

Generate some “special” matrix using commands zeros, ones, eye, rand, radn, and magic. Analyze results.

```
zeros(5)
```

```
ans = 5×5
     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
```

```
ones(3, 2)
```

```
ans = 3×2
     1     1
     1     1
     1     1
```

```
eye(2, 5)
```

```
ans = 2×5
     1     0     0     0     0
     0     1     0     0     0
```

```
rand(2)
```

```
ans = 2×2
    0.6324    0.2785
    0.0975    0.5469
```

```
randn(4)
```

```
ans = 4×4
    3.5784    0.7254   -0.1241    0.6715
    2.7694   -0.0631    1.4897   -1.2075
   -1.3499    0.7147    1.4090    0.7172
    3.0349   -0.2050    1.4172    1.6302
```

```
magic(4)
```

```
ans = 4×4
    16     2     3    13
     5    11    10     8
     9     7     6    12
```

```
     4    14    15     1
```

Systems of Linear Equations

One of the most important problems in technical computing is the solution of systems of simultaneous linear equations.

In matrix notation, the general problem takes the following form: Given two matrices A and B, does there exist a unique matrix X so that AX = B ?

It is instructive to consider a 1-by-1 example. For example, the equation

7x = 21 has the solution x=21/7=3.

An example of a system of 3 equations with 3 unknowns is:

$$\begin{aligned} 2x - y + 3z &= 11.5 \\ x + 2y + 2z &= 6 \\ -x + 5y - 2z &= -9.5 \end{aligned}$$ that can be represented as $$\begin{pmatrix} 2 & -1 & 3 \\ 1 & 2 & 2 \\ -1 & 5 & -2 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 11.5 \\ 6 \\ -9.5 \end{pmatrix}$$

So as A*X=B, the solution is compute as X=A\B

Solve the previous equations using this method.

```
X = A\B
```

```
X = 4×4
   -0.5015    0.7246    1.2046   -0.1137
   -0.0302   -0.0694   -0.0994   -0.0245
   -0.0264    0.2693    0.2393    0.3686
    0.2303   -0.4609   -0.2209    0.0167
```