

## Question 1

In[1]:=

**A = {{0, 1}, {3, 2}, {4, 1}}**

Out[1]= {{0, 1}, {3, 2}, {4, 1}}

In[6]:= **A // MatrixForm**

Out[6]//MatrixForm=

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

In[2]:= **B = {{1, 2, -1}, {3, 0, 1}}**

Out[2]= {{1, 2, -1}, {3, 0, 1}}

In[7]:= **B // MatrixForm**

Out[7]//MatrixForm=

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

In[8]:= **A + B**

 **Thread:** Objects of unequal length in {{0, 1}, {3, 2}, {4, 1}} + {{1, 2, -1}, {3, 0, 1}} cannot be combined.

Out[8]= {{1, 2, -1}, {3, 0, 1}} + {{0, 1}, {3, 2}, {4, 1}}

In[9]:= **BT = Transpose[B]**

Out[9]= {{1, 3}, {2, 0}, {-1, 1}}

In[10]:= **MatrixForm[BT]**

Out[10]//MatrixForm=

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

In[11]:= **A + BT**

Out[11]= {{1, 4}, {5, 2}, {3, 2}}

In[12]:= **MatrixForm[%]**

Out[12]//MatrixForm=

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

In[14]:= **A.B // MatrixForm**

Out[14]//MatrixForm=

$$\begin{pmatrix} 3 & 0 & 1 \\ 9 & 6 & -1 \\ 7 & 8 & -3 \end{pmatrix}$$

In[15]:= **B.A // MatrixForm**

Out[15]//MatrixForm=

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

In[16]:= **A.BT**

 **Dot:** Tensors {{0, 1}, {3, 2}, {4, 1}} and {{1, 3}, {2, 0}, {-1, 1}} have incompatible shapes.

Out[16]=  $\{\{0, 1\}, \{3, 2\}, \{4, 1\}\} \cdot \{\{1, 3\}, \{2, 0\}, \{-1, 1\}\}$

### Question 2 (a)

In[25]:= **A = {{2, -4, 0, 1, 7, 11}, {1, -2, -1, 1, 9, 12},  
{-1, 2, 1, 3, -5, 16}, {4, -8, 1, -1, 6, -2}};**

In[26]:= **A // MatrixForm**

Out[26]//MatrixForm=

$$\begin{pmatrix} 2 & -4 & 0 & 1 & 7 & 11 \\ 1 & -2 & -1 & 1 & 9 & 12 \\ -1 & 2 & 1 & 3 & -5 & 16 \\ 4 & -8 & 1 & -1 & 6 & -2 \end{pmatrix}$$

In[29]:= **{{1, -2, 0, 0, 3, 2}, {0, 0, 1, 0, -5, -3},  
{0, 0, 0, 1, 1, 7}, {0, 0, 0, 0, 0, 0}} // MatrixForm**

Out[29]//MatrixForm=

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

$$x_1 = 2 + 2x_2 - 3x_5$$

$$x_3 = -3 + 5x_5$$

$$x_4 = 7 - x_5$$

$$\begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix} = \begin{pmatrix} 2 + 2x_2 - 3x_5 \\ x_2 \\ -3 + 5x_5 \\ 7 - x_5 \\ x_5 \end{pmatrix} = \begin{pmatrix} 2 \\ 0 \\ -3 \\ 7 \\ 0 \end{pmatrix} + x_2 \begin{pmatrix} 2 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix} + x_5 \begin{pmatrix} -3 \\ 0 \\ 5 \\ -1 \\ 1 \end{pmatrix}$$

### Question 2 (b)

The same matrix as in part (a) so the solution is:

$$\begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix} = \begin{pmatrix} 2x_2 - 3x_5 \\ x_2 \\ 5x_5 \\ x_5 \\ x_5 \end{pmatrix} = x_2 \begin{pmatrix} 2 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix} + x_5 \begin{pmatrix} -3 \\ 0 \\ 5 \\ -1 \\ 1 \end{pmatrix}$$

### Question 2 (c)

The augmented matrix is

In[33]:=

**A = {{1, -1, -3, 8, -2}, {3, 0, -3, 9, -1}, {1, 1, 1, -2, 1}};**

In[35]:= **RowReduce[A] // MatrixForm**

Out[35]//MatrixForm=

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

**The system is inconsistent, No Solution**

### Question 2 (d)

In[36]:= **A = {{-1, 1, 1, 9}, {2, 1, -1, -10}, {3, 0, -2, -19}, {-1, 2, -3, -10}}**

Out[36]= {{-1, 1, 1, 9}, {2, 1, -1, -10}, {3, 0, -2, -19}, {-1, 2, -3, -10}}

**RowReduce[A] // MatrixForm**

Out[38]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & -3 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

**Unique solution : x1 = -3, x2 = 1, x3 = 5**

### Question 3

**"Second row" subtract " first row" contradicts the third row.**

### Question 4

Out[28]= 4 Question

In[1]:= **A = {{2, 4, 6}, {4, 5, 5}, {3, 1, -3}}**

Out[1]= {{2, 4, 6}, {4, 5, 5}, {3, 1, -3}}

In[13]:= **A // MatrixForm**

Out[13]//MatrixForm=

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

In[7]:= **b = {1, 2, 3}**

In[14]:= **b // MatrixForm**

Out[14]//MatrixForm=

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

In[16]:= **LinearSolve[A, b] // MatrixForm**

Out[16]//MatrixForm=

$$\begin{pmatrix} -7 \\ 21 \\ 2 \\ -\frac{9}{2} \end{pmatrix}$$

In[17]:= **AgA = {{2, 4, 6, 1}, {4, 5, 5, 2}, {3, 1, -3, 3}} // MatrixForm**

Out[17]//MatrixForm=

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

In[18]:= **RowReduce[AgA]**

Out[18]= **RowReduce** $\left[\begin{pmatrix} 2 & 4 & 6 & 1 \\ 4 & 5 & 5 & 2 \\ 3 & 1 & -3 & 3 \end{pmatrix}\right]$

In[12]:= **{{1, 0, 0, -7}, {0, 1, 0,  $\frac{21}{2}$ }, {0, 0, 1,  $-\frac{9}{2}$ }} // MatrixForm**

Out[12]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & -7 \\ 0 & 1 & 0 & \frac{21}{2} \\ 0 & 0 & 1 & -\frac{9}{2} \end{pmatrix}$$

In[19]:= **Det[A]**

Out[19]= 2

In[40]:= **Inverse[{{2, 4, 6}, {4, 5, 5}, {3, 1, -3}}] // MatrixForm**

Out[40]//MatrixForm=

$$\begin{pmatrix} -10 & 9 & -5 \\ \frac{27}{2} & -12 & 7 \\ -\frac{11}{2} & 5 & -3 \end{pmatrix}$$

In[41]:= **RowReduce[{{2, 4, 6, 1, 0, 0}, {4, 5, 5, 0, 1, 0}, {3, 1, -3, 0, 0, 1}}]**

In[42]:= **{{1, 0, 0, -10, 9, -5}, {0, 1, 0,  $\frac{27}{2}$ , -12, 7}, {0, 0, 1,  $-\frac{11}{2}$ , 5, -3}} // MatrixForm**

Out[42]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & -10 & 9 & -5 \\ 0 & 1 & 0 & \frac{27}{2} & -12 & 7 \\ 0 & 0 & 1 & -\frac{11}{2} & 5 & -3 \end{pmatrix}$$

### Question 6

a) A, b) B, c) Yes, BAC= A

### Question 7

$$A = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$$