

Gauss Elimination

Ques-1.

In[]:=

```
A = {{1, 2, 3}, {2, 6, 10}, {3, 14, 28}};
```

In[]:=

```
A // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} 1 & 2 & 3 \\ 2 & 6 & 10 \\ 3 & 14 & 28 \end{pmatrix}$$

In[]:=

```
x = {x1, x2, x3};
```

In[]:=

```
x // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} x1 \\ x2 \\ x3 \end{pmatrix}$$

In[]:=

```
b = {{1}, {0}, {-8}};  
b // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} 1 \\ 0 \\ -8 \end{pmatrix}$$

In[]:=

```
aug = ArrayFlatten[{{A, b}}];
```

In[]:=

```
aug // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} 1 & 2 & 3 & 1 \\ 2 & 6 & 10 & 0 \\ 3 & 14 & 28 & -8 \end{pmatrix}$$

In[]:=

```
aug[[2]] = aug[[2]] - 2 aug[[1]];
```

In[]:=

```
aug[[3]] = aug[[3]] - 3 aug[[1]];  
aug // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} 1 & 2 & 3 & 1 \\ 0 & 2 & 4 & -2 \\ 0 & 8 & 19 & -11 \end{pmatrix}$$

```
In[ ]:= aug[[3]] = aug[[3]] - 4 aug[[2]];
aug // MatrixForm
```

Out[]//MatrixForm=

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

```
In[ ]:= upper = Take[aug, 3, 3];
```

```
upper // MatrixForm
```

Out[]//MatrixForm=

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

```
In[ ]:= c = Take[aug, 3, -1];
c // MatrixForm
```

Out[]//MatrixForm=

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

```
In[ ]:= upper.x == c
```

Out[]:= {x1 + 2 x2 + 3 x3, 2 x2 + 4 x3, 3 x3} == {{1}, {-2}, {-3}}

```
In[ ]:= Solve[upper.x == c]
```

Out[]:= {{x1 -> 2, x2 -> 1, x3 -> -1}}

Ques-2.

```
In[ ]:= Q2 = {{2, 3, 1}, {1, 2, 2}, {1, 3, 1}};
Q2 // MatrixForm
```

Out[]//MatrixForm=

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

```
In[ ]:= x = {x1, x2, x3};
x // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} x1 \\ x2 \\ x3 \end{pmatrix}$$

```
In[ ]:= b = {{1}, {4}, {3}};
b // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} 1 \\ 4 \\ 3 \end{pmatrix}$$

```
In[ ]:= aug = ArrayFlatten[{{Q2, b}}];
aug // MatrixForm
```

Out[]//MatrixForm=

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

```
In[ ]:= aug[[2]] = aug[[2]] - 1/2 aug[[1]];
aug[[3]] = aug[[3]] - 1/2 aug[[1]];
aug // MatrixForm
```

Out[]//MatrixForm=

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

```
In[ ]:= aug[[3]] = aug[[3]] - 3 aug[[2]];
aug // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} 2 & 3 & 1 & 1 \\ 0 & \frac{1}{2} & \frac{3}{2} & \frac{7}{2} \\ 0 & 0 & -4 & -8 \end{pmatrix}$$

```
In[ ]:= upper = Take[aug, 3, 3];
upper // MatrixForm
```

Out[]//MatrixForm=

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

```
In[ ]:= c = Take[aug, 3, -1];
c // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} 1 \\ \frac{7}{2} \\ -8 \end{pmatrix}$$

In[]:= **Solve[upper.x == c]**

Out[]:= **{ {x1 → -2, x2 → 1, x3 → 2} }**

Ques-3.

In[]:= **Q3 = {{1, 4, 1}, {2, 2, 1}, {3, 6, 1}};**
Q3 // MatrixForm

Out[]//MatrixForm=

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

In[]:= **x = {x1, x2, x3};**
x // MatrixForm

Out[]//MatrixForm=

$$\begin{pmatrix} x1 \\ x2 \\ x3 \end{pmatrix}$$

In[]:= **b = {{1}, {2}, {3}};**
b // MatrixForm

Out[]//MatrixForm=

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

In[]:= **aug = ArrayFlatten[{{Q3, b}}];**
aug // MatrixForm

Out[]//MatrixForm=

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

In[]:= **aug[[2]] = aug[[2]] - 2 aug[[1]];**
aug[[3]] = aug[[3]] - 3 aug[[1]];
aug // MatrixForm

Out[]//MatrixForm=

$$\begin{pmatrix} 1 & 4 & 1 & 1 \\ 0 & -6 & -1 & 0 \\ 0 & -6 & -2 & 0 \end{pmatrix}$$

```
In[ ]:=  
aug[[3]] = aug[[3]] - aug[[2]];  
aug // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} 1 & 4 & 1 & 1 \\ 0 & -6 & -1 & 0 \\ 0 & 0 & -1 & 0 \end{pmatrix}$$

```
In[ ]:=  
upper = Take[aug, 3, 3];  
upper // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} 1 & 4 & 1 \\ 0 & -6 & -1 \\ 0 & 0 & -1 \end{pmatrix}$$

```
In[ ]:=  
c = Take[aug, 3, -1];  
c // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$

```
In[ ]:=  
Solve[upper.x == c]
```

Out[]:= { {x1 → 1, x2 → 0, x3 → 0} }

```
In[ ]:=
```

Ques-4

```
In[ ]:=  
Q4 = {{1, 1, -1}, {0, 1, 3}, {-1, 0, 2}};
```

```
In[ ]:=  
Q4 // MatrixForm
```

Out[]//MatrixForm=

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

```
In[ ]:=  
x = {x1, x2, x3};  
x // MatrixForm
```

Out[]//MatrixForm=

$$\begin{pmatrix} x1 \\ x2 \\ x3 \end{pmatrix}$$

In[6] :=

```
b = {{9}, {3}, {2}};
aug = ArrayFlatten[{{Q4, b}}];
aug // MatrixForm
```

Out[6] // MatrixForm =

$$\begin{pmatrix} 1 & 1 & -1 & 9 \\ 0 & 1 & 3 & 3 \\ -1 & 0 & 2 & 2 \end{pmatrix}$$

In[7] :=

```
aug[[3]] = aug[[3]] + aug[[1]];
aug[[3]] = aug[[3]] - aug[[2]];
aug // MatrixForm
```

Out[7] // MatrixForm =

$$\begin{pmatrix} 1 & 1 & -1 & 9 \\ 0 & 1 & 3 & 3 \\ 0 & 0 & -2 & 8 \end{pmatrix}$$

In[8] :=

```
upper = Take[aug, 3, 3];
c = Take[aug, 3, -1];
```

In[9] :=

```
Solve[upper.x == c]
```

Out[9] =

```
{ {x1 → -10, x2 → 15, x3 → -4} }
```