

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

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

In[16]:= **MatrixForm**[A]

Out[16]//MatrixForm=

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

In[21]:= **b** =  $\begin{pmatrix} 2 \\ 1 \\ 4 \end{pmatrix}$

Out[21]= {{2}, {1}, {4}}

In[23]:= **x** = **LinearSolve**[A, b]

Out[23]=  $\left\{ \left\{ -\frac{59}{13} \right\}, \left\{ \frac{45}{13} \right\}, \left\{ \frac{25}{13} \right\} \right\}$

In[24]:= **A.x == b**

Out[24]= True

In[29]:= **A1** =  $\begin{pmatrix} 1 & -2 & 2 & 2 \\ 3 & -4 & 1 & 1 \\ -2 & 3 & 5 & 4 \end{pmatrix}$

Out[29]= {{1, -2, 2, 2}, {3, -4, 1, 1}, {-2, 3, 5, 4}}

In[32]:= **RowReduce**[A1] // **MatrixForm**

Out[32]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & -\frac{6}{13} \\ 0 & 1 & 0 & -\frac{5}{13} \\ 0 & 0 & 1 & \frac{11}{13} \end{pmatrix}$$

In[33]:= **A2** = {{1, 3, -2}, {-2, -4, 3 a}, {2, 1, 5 a}}

Out[33]= {{1, 3, -2}, {-2, -4, 3 a}, {2, 1, 5 a}}

In[34]:= **b2** =  $\begin{pmatrix} 2 \\ 1 \\ 4 \end{pmatrix}$

**x** = **LinearSolve**[A2, b2]

Out[34]= {{2}, {1}, {4}}

Out[35]=  $\left\{ \left\{ \frac{-34 - 25 a}{-12 + 25 a} \right\}, \left\{ \frac{5 (4 + 5 a)}{-12 + 25 a} \right\}, \left\{ \frac{25}{-12 + 25 a} \right\} \right\}$

In[42]:= **c** = {{2, -3}, {-1, 4}} // **MatrixForm**

Out[42]//MatrixForm=

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

In[44]:= **Det**[A -  $\lambda$  \* **IdentityMatrix**[3]]

Out[44]=  $13 + 12 \lambda + 2 \lambda^2 - \lambda^3$

In[45]:= **CharacteristicPolynomial**[A, λ]

Out[45]=  $13 + 12 \lambda + 2 \lambda^2 - \lambda^3$

In[46]:= **Eigenvalues**[A]

Out[46]=  $\left\{ \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 1\right], \right.$   
 $\left. \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 3\right], \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 2\right] \right\}$

In[47]:= **Eigenvectors**[A]

Out[47]=  $\left\{ \left\{ -\frac{11}{4} + \frac{7}{4} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 1\right] - \frac{1}{4} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 1\right]^2, \right.$   
 $\left. \frac{1}{2} - \frac{5}{2} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 1\right] + \frac{1}{2} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 1\right]^2, 1 \right\},$   
 $\left\{ -\frac{11}{4} + \frac{7}{4} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 3\right] - \frac{1}{4} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 3\right]^2, \right.$   
 $\left. \frac{1}{2} - \frac{5}{2} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 3\right] + \frac{1}{2} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 3\right]^2, 1 \right\},$   
 $\left\{ -\frac{11}{4} + \frac{7}{4} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 2\right] - \frac{1}{4} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 2\right]^2, \right.$   
 $\left. \frac{1}{2} - \frac{5}{2} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 2\right] + \frac{1}{2} \text{Root}\left[-13 - 12 \#1 - 2 \#1^2 + \#1^3 \ \&, 2\right]^2, 1 \right\} \right\}$