In [25]:

```
from sympy.interactive import printing
printing.init_printing(use_latex=True)
from sympy import Eq,solve_linear_system,Matrix,det,transpose
from time import time

import sympy as sp

print("------------- Welcome! To Find linear combination dependancy and basis formation checking ---------------")
no=int(input("No of Times you going to execute the program : "))
for j in range(0,no):
    n=int(input('Number of vectors : '))
    m,a,e,g=sp.symbols('* + = -->')
    if n==2:
            x,y,m,a,e,g=sp.symbols("x1 x2 * + = -->")
            a11,a12=map(int,input("Enter 1st row : ").split())
            a21,a22=map(int,input("Enter 2nd row : ").split())
            vect1,vect2=[a11,a12],[a21,a22]
            display(x,m,vect1,a,y,m,vect2)
            amat=Matrix((vect1,vect2))
            print("Given Matrix")
            display(amat)
            print('now')
            display(amat,m,Matrix((x,y)),e,Matrix((0,0)),g)
            r1,r2=[a11,a21,0],[a12,a22,0]

            eq1,eq2,eqn,eqm=sp.Function("eq1"),sp.Function("eq2"),sp.Function("eqn"),sp.Function("eqm")
            eqm=(a11*x,a12*x)
            eqn=(a21*y,a22*y)
            display(eqm,a,eqn,e,(0,0))
            eq1,eq2=Eq(a11*x+a21*y,0),Eq(a12*x+a22*y,0)
            print("arranged matrix")
            display(transpose(amat))
            display(eq1,eq2)
            system=Matrix((r1,r2))
            print("augmented form")
            display(system)

            print("\n\n\nThe two vectors are ")
            if(det(amat)==0):
                print("linearly dependant")
                display(solve_linear_system(system,x,y))
                print("dim R2 != 2, The given vectors NOT form a basis of R^2")
            else:
                print("linearly independant")
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                display(solve_linear_system(system,x,y))
                print("The given vectors does form a basis of R^2")
    if n==3:
            x,y,z=sp.symbols("x1 x2 x3")
            a11,a12,a13=map(int,input("Enter 1st row : ").split())
            a21,a22,a23=map(int,input("Enter 2nd row : ").split())
            a31,a32,a33=map(int,input("Enter 3rd row : ").split())
            vect1,vect2,vect3=[a11,a12,a13],[a21,a22,a23],[a31,a32,a33]
            display(x,m,vect1,a,y,m,vect2,a,z,m,vect3,e,(0,0,0))
            amat=Matrix((vect1,vect2,vect3))
            print("Given Matrix")
            display(amat)
            print('now')
            display(amat,m,Matrix((x,y,z)),e,Matrix((0,0,0)),g)
            r1,r2,r3=[a11,a21,a31,0],[a12,a22,a32,0],[a13,a23,a33,0]
            eq1,eq2,eq3,eqn,eqm,eqo=sp.Function("eq1"),sp.Function("eq2"),sp.Function("eq3"),sp.Function("eqn"),sp.Functi
            eqm=(a11*x,a12*x,a13*x)
            eqn=(a21*y,a22*y,a23*y)
            eqo=(a31*z,a32*z,a33*z)
            display(eqm,a,eqn,a,eqo,e,(0,0,0),g)
            eq1,eq2,eq3=Eq(a11*x+a21*y+a31*z,0),Eq(a12*x+a22*y+a32*z,0),Eq(a13*x+a23*y+a33*z,0)
            display(eq1,eq2,eq3)
            print("arranged matrix")
            display(transpose(amat))
            system=Matrix((r1,r2,r3))
            print("augmented form")
            display(system)

            print("\n\n\nThe two vectors are ")
            if(det(transpose(amat))==0):
                print("linearly dependant")
                display(solve_linear_system(system,x,y,z))
                print("dim R3 != 3, The given vectors NOT form a basis of R^3")
            else:
                print("linearly independant")
                display(solve_linear_system(system,x,y,z))
                print("The given vectors does form a basis of R^3")
    if n==4:
            x,y,z,w=sp.symbols("x1 x2 x3 x4")
            a11,a12,a13,a14=map(int,input("Enter 1st row : ").split())
            a21,a22,a23,a24=map(int,input("Enter 2nd row : ").split())
            a31,a32,a33,a34=map(int,input("Enter 3rd row : ").split())
            a41,a42,a43,a44=map(int,input("Enter 4th row : ").split())
            vect1,vect2,vect3,vect4=[a11,a12,a13,a14],[a21,a22,a23,a24],[a31,a32,a33,a34],[a41,a42,a43,a44]
            display(x,m,vect1,a,y,m,vect2,a,z,m,vect3,a,w,m,vect4)
            amat=Matrix((vect1,vect2,vect3,vect4))
```

```
            print("Given Matrix")
            display(amat)
            print('now')
            display(amat,m,Matrix((x,y,z,w)),e,Matrix((0,0,0,0)),g)
            r1,r2,r3,r4=[a11,a21,a31,a41,0],[a12,a22,a32,a42,0],[a13,a23,a33,a43,0],[a14,a24,a34,a44,0]
            eq1,eq2,eq3,eq4=sp.Function("eq1"),sp.Function("eq2"),sp.Function("eq3"),sp.Function("eq4")
            eqm=(a11*x,a12*x,a13*x,a14*x)
            eqn=(a21*y,a22*y,a23*y,a24*y)
            eqo=(a31*z,a32*z,a33*z,a34*z)
            eqp=(a41*z,a42*z,a43*z,a44*z)
            display(eqm,a,eqn,a,eqo,a,eqp,e,(0,0,0,0),g)
            eq1,eq2,eq3,eq4=Eq(a11*x+a21*y+a31*z+a41*w,0),Eq(a12*x+a22*y+a32*z+a42*w,0),Eq(a13*x+a23*y+a33*z+a43*w,0),Eq(
            display(eq1,eq2,eq3,eq4)
            system=Matrix((r1,r2,r3,r4))
            print('rearranged matrix')
            display(transpose(amat))
            print("augmented form")
            display(system)

            print("\n\n\nThe two vectors are ")
            if(det(transpose(amat))==0):
                print("linearly dependant")
                display(solve_linear_system(system,x,y,z,w))
                print("dim R4 != 4, The given vectors NOT form a basis of R^4")
            else:
                print("linearly independant")
                display(solve_linear_system(system,x,y,z,w))
                print("The given vectors does form a basis of R^4")
```

```
------------- Welcome! To Find linear combination dependancy and basis formation checking ---------------
No of Times you going to execute the program : 3
Number of vectors : 2
Enter 1st row : 1 4
Enter 2nd row : 5 1
```

x_1

$*$

$[1, 4]$

$+$

x_2

$*$

$[5,\ 1]$

Given Matrix

$$\begin{bmatrix} 1 & 4 \\ 5 & 1 \end{bmatrix}$$

now

$$\begin{bmatrix} 1 & 4 \\ 5 & 1 \end{bmatrix}$$

$*$

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

$=$

$$\begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$-->$

$(x_1,\ 4x_1)$

$+$

$(5x_2,\ x_2)$

$=$

$(0,\ 0)$

arranged matrix

$$\begin{bmatrix} 1 & 5 \\ 4 & 1 \end{bmatrix}$$

$x_1 + 5x_2 = 0$

$4x_1 + x_2 = 0$

augmented form

$$\begin{bmatrix} 1 & 5 & 0 \\ 4 & 1 & 0 \end{bmatrix}$$

```
The two vectors are
linearly independant
```

$\{x_1 : 0, \ x_2 : 0\}$

```
The given vectors does form a basis of R^2
Number of vectors : 3
Enter 1st row : 1 2 3
Enter 2nd row : 3 -2 1
Enter 3rd row : 1 -6 -5
```

x_1

$*$

$[1, \ 2, \ 3]$

$+$

x_2

$*$

$[3, \ -2, \ 1]$

$+$

x_3

$*$

$[1, \ -6, \ -5]$

$=$

$(0, \ 0, \ 0)$

```
Given Matrix
```

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

```
now
```

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

$$*$$

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

$$=$$

$$\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$-->$$

$$(x_1,\ 2x_1,\ 3x_1)$$

$$+$$

$$(3x_2,\ -2x_2,\ x_2)$$

$$+$$

$$(x_3,\ -6x_3,\ -5x_3)$$

$$=$$

$$(0,\ 0,\ 0)$$

$$-->$$

$$x_1 + 3x_2 + x_3 = 0$$

$$2x_1 - 2x_2 - 6x_3 = 0$$

$$3x_1 + x_2 - 5x_3 = 0$$

```
arranged matrix
```

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

```
augmented form
```

$$\begin{bmatrix} 1 & 3 & 1 & 0 \\ 2 & -2 & -6 & 0 \\ 3 & 1 & -5 & 0 \end{bmatrix}$$

```
The two vectors are
linearly dependant
```

$$\{x_1 : 2x_3,\ x_2 : -x_3\}$$

```
dim R3 != 3, The given vectors NOT form a basis of R^3
Number of vectors : 4
Enter 1st row : 1 1 1 1
Enter 2nd row : 1 2 3 2
Enter 3rd row : 2 5 6 4
Enter 4th row : 2 6 8 5
```

$$x_1$$

$$*$$

$$[1,\ 1,\ 1,\ 1]$$

$$+$$

$$x_2$$

$$*$$

$$[1,\ 2,\ 3,\ 2]$$

$$+$$

$$x_3$$

$$*$$

$$[2,\ 5,\ 6,\ 4]$$

$$+$$

$$x_4$$

$$*$$

$$[2,\ 6,\ 8,\ 5]$$

Given Matrix

$$\begin{bmatrix}1 & 1 & 1 & 1\\1 & 2 & 3 & 2\\2 & 5 & 6 & 4\\2 & 6 & 8 & 5\end{bmatrix}$$

now

$$\begin{bmatrix}1 & 1 & 1 & 1\\1 & 2 & 3 & 2\\2 & 5 & 6 & 4\\2 & 6 & 8 & 5\end{bmatrix}$$

*

$$\begin{bmatrix}x_1\\x_2\\x_3\\x_4\end{bmatrix}$$

$$=$$

$$\begin{bmatrix}0\\0\\0\\0\end{bmatrix}$$

$$-->$$

$$(x_1,\ x_1,\ x_1,\ x_1)$$

$$+$$

$$(x_2,\ 2x_2,\ 3x_2,\ 2x_2)$$

$$+$$

$$(2x_3,\ 5x_3,\ 6x_3,\ 4x_3)$$

$$+$$

$$(2x_3,\ 6x_3,\ 8x_3,\ 5x_3)$$

$$=$$

$$(0,\ 0,\ 0,\ 0)$$

$$-->$$

$$x_1 + x_2 + 2x_3 + 2x_4 = 0$$

$$x_1 + 2x_2 + 5x_3 + 6x_4 = 0$$

$$x_1 + 3x_2 + 6x_3 + 8x_4 = 0$$

$$x_1 + 2x_2 + 4x_3 + 5x_4 = 0$$

```
rearranged matrix
```

$$\begin{bmatrix} 1 & 1 & 2 & 2 \\ 1 & 2 & 5 & 6 \\ 1 & 3 & 6 & 8 \\ 1 & 2 & 4 & 5 \end{bmatrix}$$

```
augmented form
```

$$\begin{bmatrix} 1 & 1 & 2 & 2 & 0 \\ 1 & 2 & 5 & 6 & 0 \\ 1 & 3 & 6 & 8 & 0 \\ 1 & 2 & 4 & 5 & 0 \end{bmatrix}$$

```
The two vectors are
linearly dependant
```

$$\{x_1 : x_4,\ x_2 : -x_4,\ x_3 : -x_4\}$$

```
dim R4 != 4, The given vectors NOT form a basis of R^4
```

In [ ]: