Matrices

In [1]:
```
A=matrix(QQ,[[1,2,3],[-1,2,2/3]])
A
```

Out[1]:
```
[  1   2   3]
[ -1   2 2/3]
```

In [2]:
```
show(A)
```

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

In [3]:
```
A=matrix(QQ,3,4,[1,2,3,4,5,6,7,8,9,10,11,12]) # parte la lista de los doce n
úmeros en 3 filas y 3 columnas
show(A)
```

$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{pmatrix}$$

In [9]:
```
A[0,2] # nos dice el valor de la posicion (1,3) de la matriz A
```

Out[9]:
```
3
```

In [5]:
```
A[0,2]=-1 # modifica la posicion (1,3) de A, siendo la nueva entrada de -1
show(A)
```

$$\begin{pmatrix} 1 & 2 & -1 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{pmatrix}$$

In [6]:
```
A=random_matrix(QQ,2,3) # genera una matriz aleatoria sobre el cuerpo Q de 2
filas y 3 columnas
show(A)
```

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

In [78]:
```
show(A.nrows())
show(A.ncols())
```

2

3

Operaciones con matrices

In [10]:
```
show(A)
A.T # matriz traspuesta de A
A.transpose() # matriz traspuesta de A
show(A.T)
show(A.transpose())
```

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

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

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

In [11]:
```
A=matrix(QQ,[[1,2,3],[-1,2,2/3]])
B=matrix(QQ,[[1,3,4],[-1,3,1/3]])
show(A+B)
show(3*A)
```

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

$$\begin{pmatrix} 3 & 6 & 9 \\ -3 & 6 & 2 \end{pmatrix}$$

In [12]:
```
show(A+B)
show(B+A)
```

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

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

In [13]:
```
show(2*A+5*B)
```

$$\begin{pmatrix} 7 & 19 & 26 \\ -7 & 19 & 3 \end{pmatrix}$$

In [84]:
```
A=matrix(QQ,[[1,2,3],[-1,2,2/3]])
B=column_matrix(QQ,[[1,3,4],[-1,3,1/3]])
show(A*B)
```

$$\begin{pmatrix} 19 & 6 \\ \frac{23}{3} & \frac{65}{9} \end{pmatrix}$$

In [86]:
```
show((A*B)^2) # el cuadrado de una matriz
```

$$\begin{pmatrix} 407 & \frac{472}{3} \\ \frac{5428}{27} & \frac{7951}{81} \end{pmatrix}$$

In [87]:
```
show((A*B)**2) # el cuadrado de una matriz
```

$$\left(\begin{array}{rr} 407 & \frac{472}{3} \\ \frac{5428}{27} & \frac{7951}{81} \end{array}\right)$$

In [132]:
```
A=matrix(QQ,[[1,-1,1],[0,2,3],[0,0,4]])
show(A.inverse()) # inversa de A
show(A^-1) # inversa de A
show(~A) # inversas de A
```

$$\left(\begin{array}{rrr} 1 & \frac{1}{2} & -\frac{5}{8} \\ 0 & \frac{1}{2} & -\frac{3}{8} \\ 0 & 0 & \frac{1}{4} \end{array}\right)$$

$$\left(\begin{array}{rrr} 1 & \frac{1}{2} & -\frac{5}{8} \\ 0 & \frac{1}{2} & -\frac{3}{8} \\ 0 & 0 & \frac{1}{4} \end{array}\right)$$

$$\left(\begin{array}{rrr} 1 & \frac{1}{2} & -\frac{5}{8} \\ 0 & \frac{1}{2} & -\frac{3}{8} \\ 0 & 0 & \frac{1}{4} \end{array}\right)$$

In [26]:
```
AB = matrix(QQ,6,7,[[-5,9/2,2,-2,-2,2,0],[1,0,0,1/2,0,-1,0],[1,-1,-2,-5/2,-
3,3,0],[2,5,-1,-9/2,-7,1,2],
[2,-3,-2,1,-2,0,-2],[-13/2,-1,3/2,4,6,-2,0]])
show(AB)
show(AB.echelon_form()) # determina la matriz reducida de AB
```

$$\left(\begin{array}{rrrrrrr} -5 & \frac{9}{2} & 2 & -2 & -2 & 2 & 0 \\ 1 & 0 & 0 & \frac{1}{2} & 0 & -1 & 0 \\ 1 & -1 & -2 & -\frac{5}{2} & -3 & 3 & 0 \\ 2 & 5 & -1 & -\frac{9}{2} & -7 & 1 & 2 \\ 2 & -3 & -2 & 1 & -2 & 0 & -2 \\ -\frac{13}{2} & -1 & \frac{3}{2} & 4 & 6 & -2 & 0 \end{array}\right)$$

$$\left(\begin{array}{rrrrrrr} 1 & 0 & 0 & 0 & 0 & -\frac{19}{50} & \frac{7}{50} \\ 0 & 1 & 0 & 0 & 0 & -1 & 1 \\ 0 & 0 & 1 & 0 & 0 & \frac{39}{50} & -\frac{67}{50} \\ 0 & 0 & 0 & 1 & 0 & -\frac{31}{25} & -\frac{7}{25} \\ 0 & 0 & 0 & 0 & 1 & -\frac{7}{25} & \frac{21}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{array}\right)$$

Matrices por bloques

In [89]:
```
A=matrix(QQ,[[1,2,3,4,5],[-1,2,5,-3,2],[1,1,1,2,1]])
B=matrix(QQ,[[1,2,0,4,-2],[-1,1,2,-3,4],[2,-1,0,2,1]])
show(A)
show(B)
```

$$\left(\begin{array}{rrrrr} 1 & 2 & 3 & 4 & 5 \\ -1 & 2 & 5 & -3 & 2 \\ 1 & 1 & 1 & 2 & 1 \end{array}\right)$$

$$\left(\begin{array}{rrrrr} 1 & 2 & 0 & 4 & -2 \\ -1 & 1 & 2 & -3 & 4 \\ 2 & -1 & 0 & 2 & 1 \end{array}\right)$$

In [91]:
```
U=block_matrix([[A,B]])
V=block_matrix([[A],[B]])
show(U)
show(V)
```

$$\left(\begin{array}{rrrrr|rrrrr} 1 & 2 & 3 & 4 & 5 & 1 & 2 & 0 & 4 & -2 \\ -1 & 2 & 5 & -3 & 2 & -1 & 1 & 2 & -3 & 4 \\ 1 & 1 & 1 & 2 & 1 & 2 & -1 & 0 & 2 & 1 \end{array}\right)$$

$$\left(\begin{array}{rrrrr} 1 & 2 & 3 & 4 & 5 \\ -1 & 2 & 5 & -3 & 2 \\ 1 & 1 & 1 & 2 & 1 \\ \hline 1 & 2 & 0 & 4 & -2 \\ -1 & 1 & 2 & -3 & 4 \\ 2 & -1 & 0 & 2 & 1 \end{array}\right)$$

In [93]:
```
show(block_matrix(1,2,[A,B]))
show(block_matrix(2,1,[A,B]))
```

$$\left(\begin{array}{rrrrr|rrrrr} 1 & 2 & 3 & 4 & 5 & 1 & 2 & 0 & 4 & -2 \\ -1 & 2 & 5 & -3 & 2 & -1 & 1 & 2 & -3 & 4 \\ 1 & 1 & 1 & 2 & 1 & 2 & -1 & 0 & 2 & 1 \end{array}\right)$$

$$\left(\begin{array}{rrrrr} 1 & 2 & 3 & 4 & 5 \\ -1 & 2 & 5 & -3 & 2 \\ 1 & 1 & 1 & 2 & 1 \\ \hline 1 & 2 & 0 & 4 & -2 \\ -1 & 1 & 2 & -3 & 4 \\ 2 & -1 & 0 & 2 & 1 \end{array}\right)$$

In [95]:
```
show(block_matrix([[A.T,1]])) # si en vez de 1 se pone numero k la matriz qu
e adjunta es todo k en la diagonal
```

$$\left(\begin{array}{rrr|rrrrr} 1 & -1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 2 & 2 & 1 & 0 & 1 & 0 & 0 & 0 \\ 3 & 5 & 1 & 0 & 0 & 1 & 0 & 0 \\ 4 & -3 & 2 & 0 & 0 & 0 & 1 & 0 \\ 5 & 2 & 1 & 0 & 0 & 0 & 0 & 1 \end{array}\right)$$

In [97]:
```
show(block_matrix([[B],[2]]))
```

$$\left(\begin{array}{rrrrr} 1 & 2 & 0 & 4 & -2 \\ -1 & 1 & 2 & -3 & 4 \\ 2 & -1 & 0 & 2 & 1 \\ \hline 2 & 0 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 & 0 \\ 0 & 0 & 2 & 0 & 0 \\ 0 & 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 & 2 \end{array}\right)$$

In [98]:
```
show(block_matrix([[A,identity_matrix(3)]]))
```

$$\left(\begin{array}{rrrrr|rrr} 1 & 2 & 3 & 4 & 5 & 1 & 0 & 0 \\ -1 & 2 & 5 & -3 & 2 & 0 & 1 & 0 \\ 1 & 1 & 1 & 2 & 1 & 0 & 0 & 1 \end{array}\right)$$

In [101]:
```
show(block_matrix([[A,B],[B,A]]))
```

$$\left(\begin{array}{rrrrr|rrrrr} 1 & 2 & 3 & 4 & 5 & 1 & 2 & 0 & 4 & -2 \\ -1 & 2 & 5 & -3 & 2 & -1 & 1 & 2 & -3 & 4 \\ 1 & 1 & 1 & 2 & 1 & 2 & -1 & 0 & 2 & 1 \\ \hline 1 & 2 & 0 & 4 & -2 & 1 & 2 & 3 & 4 & 5 \\ -1 & 1 & 2 & -3 & 4 & -1 & 2 & 5 & -3 & 2 \\ 2 & -1 & 0 & 2 & 1 & 1 & 1 & 1 & 2 & 1 \end{array}\right)$$

In [103]:
```
A.augment(B,subdivide=true)
show(A.augment(B,subdivide=true))
```

$$\left(\begin{array}{rrrrr|rrrrr} 1 & 2 & 3 & 4 & 5 & 1 & 2 & 0 & 4 & -2 \\ -1 & 2 & 5 & -3 & 2 & -1 & 1 & 2 & -3 & 4 \\ 1 & 1 & 1 & 2 & 1 & 2 & -1 & 0 & 2 & 1 \end{array}\right)$$

In [104]:
```
show(A)
```

$$\left(\begin{array}{rrrrr} 1 & 2 & 3 & 4 & 5 \\ -1 & 2 & 5 & -3 & 2 \\ 1 & 1 & 1 & 2 & 1 \end{array}\right)$$

A.subdivide(None,[4]) show(A)

In [110]:
```
B.subdivide(None,[3,4])
show(B)
```

$$\left(\begin{array}{rrr|r|r} 1 & 2 & 0 & 4 & -2 \\ -1 & 1 & 2 & -3 & 4 \\ 2 & -1 & 0 & 2 & 1 \end{array}\right)$$

Particionando matrices

In [119]:
```
C=matrix(QQ,[[1,2,3,4,5],[6,7,8,9,10],[11,12,13,14,15]])
show(C)
```

$$\begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 6 & 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 & 15 \end{pmatrix}$$

In [120]:
```
C[1,[0,2]] # fila 1 columna 0 y 2
```

Out[120]:
```
[6 8]
```

In [121]:
```
C[2,:] # fila 1 y todas las columnas
```

Out[121]:
```
[11 12 13 14 15]
```

In [122]:
```
C[1,1:3] # fila 1. columnas j con 1<= j < 3
```

Out[122]:
```
[7 8]
```

In [123]:
```
C[1,3:] # fila 1. columnas j con 3 <= j
```

Out[123]:
```
[ 9 10]
```

In [124]:
```
C[1,:3] # fila 1. columnas j con j < 3
```

Out[124]:
```
[6 7 8]
```

In [125]:
```
C[:,2:] # todas las filas. columnas de la 2 hasta la final
```

Out[125]:
```
[ 3  4  5]
[ 8  9 10]
[13 14 15]
```

In [127]:
```
C[[0,2],[1,3,4]] # filas 0 y 2. Columnas  1, 3 y 4
```

Out[127]:
```
[ 2  4  5]
[12 14 15]
```