In [1]:
```
# define the said matrix and name it B
#
B=matrix(QQ,[[1,1,0,0],[0,0,1,1],[2,3,0,0],[0,0,2,3]])
show(B)
```

Out[1]:

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

In [2]:
```
# check to see if B is invertible
#
det(B)
```

Out[2]: -1

In [3]:
```
# define the images v1 and v2
# stack them, and name it bb
#
bb=vector([1,2,3,4]).column()
show(bb)
```

Out[3]:

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

In [4]:
```
# linear solve for a,b,c,d
# name it longA
#
longA=B.solve_right(bb)
show(longA)
```

Out[4]:

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

In [5]:
```
# capture the first two elements into first column and
# capture the last two elements into second column
# name this matrix AT
#
AT=longA.matrix_from_rows([0,1]).augment(longA.matrix_from_rows([2,3]))
show(AT)
```

Out[5]:

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

In [6]:
```
# A is given by the transpose of AT
#
A=AT.transpose()
show(A)
```

Out[6]:

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

In [7]:
```
# double check to see if image of u1 is v1
#
show(A*vector([1,1]).column())
```

Out[7]:

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

In [8]:
```
# double check to see if image of u2 is v2
#
show(A*vector([2,3]).column())
```

Out[8]:

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

In [0]: