Kernel: SageMath 10.3

NAME : SUMIT HELONDE

ROLL NO : 58

EXPERIMENT NO : 05

AIM : To find range space and null space of a linear transformation .

QUESTION . 01

In [1]:
```
V = W = QQ^3
var('x1, x2, x3')
```

Out[1]:
```
(x1, x2, x3)
```

In [2]:
```
f(x1, x2, x3) = [x1-x2-x3, x1+3*x2+x3, -3*x1+x2-x3]
T = linear_transformation(V, W, f)
T
```

Out[2]:
```
Vector space morphism represented by the matrix:
[ 1  1 -3]
[-1  3  1]
[-1  1 -1]
Domain: Vector space of dimension 3 over Rational Field
Codomain: Vector space of dimension 3 over Rational Field
```

In [3]:
```
u = vector(QQ, [1, 2, -1])
T(u)
```

Out[3]:
```
(0, 6, 0)
```

In [4]:
```
T.image()
```

Out[4]:
```
Vector space of degree 3 and dimension 3 over Rational Field
Basis matrix:
[1 0 0]
[0 1 0]
[0 0 1]
```

In [5]:
```
T.kernel()
```

Out[5]:
```
Vector space of degree 3 and dimension 0 over Rational Field
Basis matrix:
[]
```

QUESTION . 02 (SELF)

In [6]:
```
V = W = QQ^3
var('x1, x2, x3')
```

Out[6]:
```
(x1, x2, x3)
```

In [8]:
```
f(x1, x2, x3) = [x1+x2+x3, x1+5*x2-x3, 6*x1-x2+3*x3]
T = linear_transformation(V, W, f)
T
```

Out[8]:
```
Vector space morphism represented by the matrix:
[ 1  1  6]
[ 1  5 -1]
[ 1 -1  3]
Domain: Vector space of dimension 3 over Rational Field
Codomain: Vector space of dimension 3 over Rational Field
```

In [10]:
```
u = vector(QQ, [3, 2, 1])
T(u)
```

Out[10]:
```
(6, 12, 19)
```

In [11]:
```
T.image()
```

Out[11]:
```
Vector space of degree 3 and dimension 3 over Rational Field
Basis matrix:
[1 0 0]
[0 1 0]
[0 0 1]
```

In [12]:
```
T.kernel()
```

Out[12]:
```
Vector space of degree 3 and dimension 0 over Rational Field
Basis matrix:
[]
```

Conclusion: Problems on linear transformation, range space and null space are successfully executed.