```
> restart;
> with(LinearAlgebra):
> M := <<5,0,0,0>|<0,1,0,0>|<0,0,2,0>|<0,0,0,1>>;
```

$$M := \begin{bmatrix} 5 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (1)$$

```
> v := <x,y,z,1>;
```

$$v := \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} \quad (2)$$

```
> MatrixVectorMultiply(M,v);
```

$$\begin{bmatrix} 5\,x \\ y \\ 2\,z \\ 1 \end{bmatrix} \quad (3)$$

```
> N:=<<1 | -1 | 0 | 0>, <0 | 2 | 5 | -3>, <2 | -4 | 6 | 7>, <-5 |
  -1 | 0 |0>>;
```

$$N := \begin{bmatrix} 1 & -1 & 0 & 0 \\ 0 & 2 & 5 & -3 \\ 2 & -4 & 6 & 7 \\ -5 & -1 & 0 & 0 \end{bmatrix} \quad (4)$$

```
> P:=MatrixMatrixMultiply(M,N);
```

$$P := \begin{bmatrix} 5 & -5 & 0 & 0 \\ 0 & 2 & 5 & -3 \\ 4 & -8 & 12 & 14 \\ -5 & -1 & 0 & 0 \end{bmatrix} \quad (5)$$

```
> Determinant(M);
```

$$10 \quad (6)$$

```
> Determinant(N);
```

$$-318 \quad (7)$$

```
> MatrixInverse(M);
```

$$\begin{bmatrix} \frac{1}{5} & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (8)$$

```
> MatrixInverse(N);
```

$$\begin{bmatrix} \frac{1}{6} & 0 & 0 & \frac{-1}{6} \\ \frac{-5}{6} & 0 & 0 & \frac{-1}{6} \\ \frac{2}{159} & \frac{7}{53} & \frac{3}{53} & \frac{4}{159} \\ \frac{-85}{159} & \frac{-6}{53} & \frac{5}{53} & \frac{-11}{159} \end{bmatrix} \quad (9)$$

```
> Eigenvalues(M);
```

$$\begin{bmatrix} 5 \\ 2 \\ 1 \\ 1 \end{bmatrix} \quad (10)$$

```
> Eigenvectors(M);
```

$$\begin{bmatrix} 2 \\ 5 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \quad (11)$$

```
> with(linalg):
Warning, the previous binding of the name GramSchmidt has been
removed and it now has an assigned value
```

```
> multiply(M, v);
```

(12)

$$\left[\begin{array}{cccc} 5x & y & 2z & 1 \end{array}\right] \quad (12)$$

```
> multiply(M,N);
```

$$\left[\begin{array}{cccc} 5 & -5 & 0 & 0 \\ 0 & 2 & 5 & -3 \\ 4 & -8 & 12 & 14 \\ -5 & -1 & 0 & 0 \end{array}\right] \quad (13)$$

```
> inverse(N);
```

$$\left[\begin{array}{cccc} \frac{1}{6} & 0 & 0 & \frac{-1}{6} \\ \frac{-5}{6} & 0 & 0 & \frac{-1}{6} \\ \frac{2}{159} & \frac{7}{53} & \frac{3}{53} & \frac{4}{159} \\ \frac{-85}{159} & \frac{-6}{53} & \frac{5}{53} & \frac{-11}{159} \end{array}\right] \quad (14)$$

```
> inverse(M);
```

$$\left[\begin{array}{cccc} \frac{1}{5} & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & 1 \end{array}\right] \quad (15)$$

```
> f:=t->[cos(t),sin(t),t];
```

$$f := t \rightarrow [\cos(t), \sin(t), t] \quad (16)$$

```
> map(limit,f(t),t=0);
```

$$[1, 0, 0] \quad (17)$$

```
> fprime:=map(diff,f(t),t);
```

$$fprime := [-\sin(t), \cos(t), 1] \quad (18)$$

```
> g:=t->[-sin(t), cos(t), 1];
```

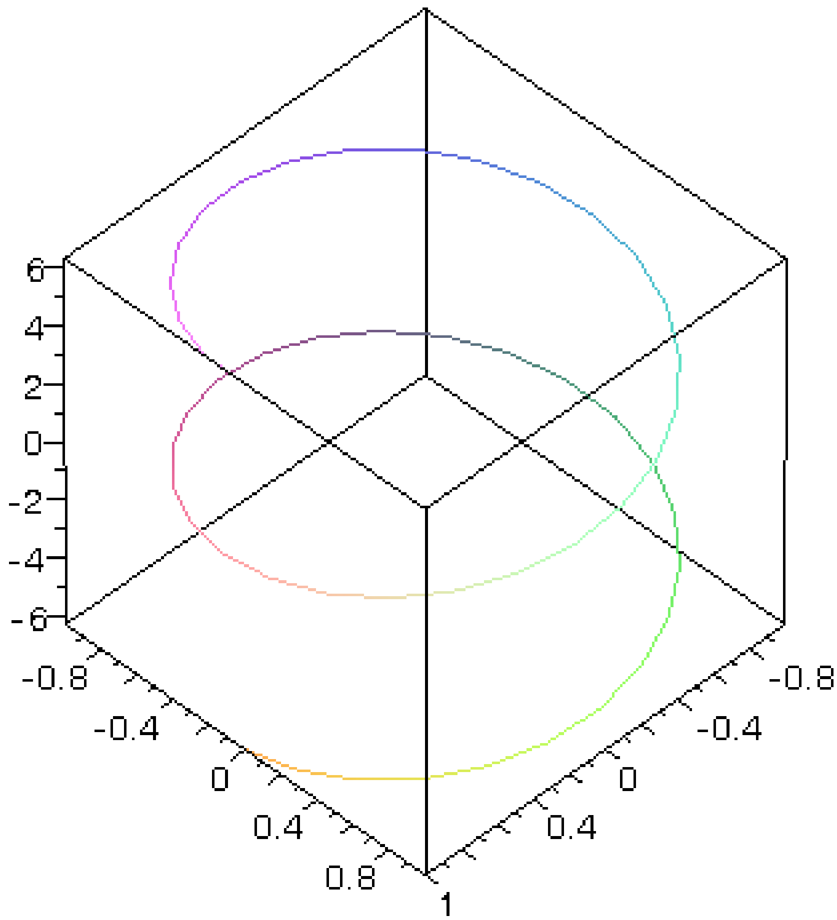
$$g := t \rightarrow [-\sin(t), \cos(t), 1] \quad (19)$$

```
> g(0);
```

$$[0, 1, 1] \quad (20)$$

```
> with(plots):
Warning, the name changecoords has been redefined
```

```
> spacecurve([cos(t),sin(t),t],t=-2*Pi..2*Pi);
```




```
> v:=[-sin(t), cos(t), 1];
```

$$v := [-\sin(t), \cos(t), 1] \quad (21)$$

```
> norm(v,2);
```

$$\sqrt{1 + |\sin(t)|^2 + |\cos(t)|^2} \quad (22)$$

```
> Int(norm(v,2),t=0..2*Pi)=int(norm(v,2),t=0..2*Pi);
```

$$\int_0^{2\pi} \sqrt{1 + |\sin(t)|^2 + |\cos(t)|^2}\, dt = 2\sqrt{2}\,\pi \quad (23)$$

```
> normalize(v);
```

$$\left[-\frac{\sin(t)}{\sqrt{1 + |\sin(t)|^2 + |\cos(t)|^2}}, \frac{\cos(t)}{\sqrt{1 + |\sin(t)|^2 + |\cos(t)|^2}}, \frac{1}{\sqrt{1 + |\sin(t)|^2 + |\cos(t)|^2}} \right] \quad (24)$$

```
> T:=t->vector([-sin(t)/(1+abs(sin(t))^2+abs(cos(t))^2)^(1/2), cos
(t)/(1+abs(sin(t))^2+abs(cos(t))^2)^(1/2), 1/(1+abs(sin(t))^2+
abs(cos(t))^2)^(1/2)]);
```

$$T := t \rightarrow \left[-\frac{\sin(t)}{\sqrt{1 + |\sin(t)|^2 + |\cos(t)|^2}} \quad \frac{\cos(t)}{\sqrt{1 + |\sin(t)|^2 + |\cos(t)|^2}} \quad \frac{1}{\sqrt{1 + |\sin(t)|^2 + |\cos(t)|^2}} \right] \quad (25)$$

```
> T(0);
```

$$\left[0 \quad \frac{1}{2}\sqrt{2} \quad \frac{1}{2}\sqrt{2} \right] \quad (26)$$

> *restart*;

> *with*(*plots*) :

```
Warning, the name changecoords has been redefined
```

```
> spacecurve([1/4*3*cos(t)+1/4*cos(3*t),1/4*3*sin(t)-1/4*sin(3*t),
  0],t=0..2*Pi);
```