```
> restart : with(linalg) :
> f := (x, y, z, t) → [-y + z, -7·x + 2·y + 5·z - 4·t, -x + z - t, -2·x + y + z - 2·t];
```

$$f := (x, y, z, t) \to [-y + z, -7x + 2y + 5z - 4t, -x + z - t, -2x + y + z - 2t] \quad (1)$$

```
> f(1, 0, 0, 0);
  f(0, 1, 0, 0);
  f(0, 0, 1, 0);
  f(0, 0, 0, 1);
```

$$[0, -7, -1, -2]$$
$$[-1, 2, 0, 1]$$
$$[1, 5, 1, 1]$$
$$[0, -4, -1, -2] \quad (2)$$

```
> A := concat(f(1, 0, 0, 0), f(0, 1, 0, 0), f(0, 0, 1, 0), f(0, 0, 0, 1));
```

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

```
> eigenvectors(A);
```

$$\left[3, 1, \left\{\left[\begin{matrix} -1 & 3 & 0 & 1 \end{matrix}\right]\right\}\right], \left[0, 1, \left\{\left[\begin{matrix} 1 & 1 & 1 & 0 \end{matrix}\right]\right\}\right], \left[-1, 2, \left\{\left[\begin{matrix} -1 & -1 & 0 & 1 \end{matrix}\right], \left[\begin{matrix} 2 & 3 & 1 & 0 \end{matrix}\right]\right\}\right] \quad (4)$$

```
> MD := diag(3, 0, -1, -1);
```

$$MD := \begin{bmatrix} 3 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{bmatrix} \quad (5)$$

```
> P := concat([ -1  3  0  1 ], [ 1  1  1  0 ], [ -1  -1  0  1 ], [ 2  3  1  0 ]);
```

$$P := \begin{bmatrix} -1 & 1 & -1 & 2 \\ 3 & 1 & -1 & 3 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix} \quad (6)$$

```
> evalm(A-P&*MD&*inverse(P));
```

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \quad (7)$$

```
> rank(A);
```

$$3 \quad (8)$$

```
> "Ecuaciones del subespacio Imagen de f"
```

"Ecuaciones del subespacio Imagen de f" (9)

```
> rank(submatrix(A, [1, 2, 3, 4], [2, 3, 4]));
```

$$3 \tag{10}$$

```
> concat([x, y, z, t], submatrix(A, [1, 2, 3, 4], [2, 3, 4]));
```

$$\begin{bmatrix} x & -1 & 1 & 0 \\ y & 2 & 5 & -4 \\ z & 0 & 1 & -1 \\ t & 1 & 1 & -2 \end{bmatrix} \tag{11}$$

```
> det(concat([x, y, z, t], submatrix(A, [1, 2, 3, 4], [2, 3, 4]))) = 0;
```

$$-3x + 6z - 3t = 0 \tag{12}$$

```
> "Matriz asociada a f respecto de la base B'"
```

"Matriz asociada a f respecto de la base B'" **(13)**

```
> f(2, 2, 2, 0);
  f(-1, -1, 0, 1);
  f(1, 2, 1, 1);
  f(-1, 3, 0, 1);
```

$$[0, 0, 0, 0]$$
$$[1, 1, 0, -1]$$
$$[-1, -2, -1, -1]$$
$$[-3, 9, 0, 3] \tag{14}$$

```
> Ap := diag(0, -1, -1, 3);
```

$$Ap := \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 3 \end{bmatrix} \tag{15}$$

```
>
```