```
> restart: with(linalg):
Warning, the protected names norm and trace have been redefined and
unprotected
```

Ejercicio 1

```
> u1:=[1,1,1,1];u2:=[1,1,-1,-1];u3:=[1,-1,1,-1];u4:=[1,-1,-1,1]
  ;
```

$$u1 := [1, 1, 1, 1]$$
$$u2 := [1, 1, -1, -1]$$
$$u3 := [1, -1, 1, -1]$$
$$u4 := [1, -1, -1, 1]$$

```
> s1:=evalm(a*u1+b*u2+c*u3+d*u4);
```

$$s1 := [a + b + c + d, a + b - c - d, a - b + c - d, a - b - c + d]$$

```
> solve({s1[1],s1[2],s1[3],s1[4]}, {a,b,c,d});
```

$$\{d = 0, b = 0, c = 0, a = 0\}$$

También podemos estudiar el rango de la matriz formada por los vectores u1, u2, u3 y u4.

```
> A:=concat(u1,u2,u3,u4);
```

$$A := \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & 1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix}$$

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

$$4$$

B es una base de R^4

```
> s2:=evalm([1,-3,5,6]-(a*u1+b*u2+c*u3+d*u4));
```

$$s2 := [1 - a - b - c - d, -3 - a - b + c + d, 5 - a + b - c + d, 6 - a + b + c - d]$$

```
> solve({s2[1],s2[2],s2[3],s2[4]}, {a,b,c,d});
```

$$\{c = \frac{3}{4}, a = \frac{9}{4}, b = \frac{-13}{4}, d = \frac{5}{4}\}$$

```
> s3:=evalm(u1-(a*u1+b*u2+c*u3+d*u4));
```

$$s3 := [1 - a - b - c - d, 1 - a - b + c + d, 1 - a + b - c + d, 1 - a + b + c - d]$$

```
> solve({s3[1],s3[2],s3[3],s3[4]}, {a,b,c,d});
```

$$\{d = 0, b = 0, c = 0, a = 1\}$$

Ejercicio 2

```
> u1:=[1,2,0];
  u2:=[2,3,4];
  u3:=[1,0,1];
```

$$u1 := [1, 2, 0]$$
$$u2 := [2, 3, 4]$$
$$u3 := [1, 0, 1]$$

```
> rank(concat(u1,u2,u3));
```

3

```
> v1:=[1,3,0]:
  v2:=[1,4,1]:
  v3:=[1,1,1]:
> rank(concat(v1,v2,v3));
```

3

```
>
> S:=evalm([1,3,0]-a*u1-b*u2-c*u3);
```

$$S := [1 - a - 2\,b - c,\ 3 - 2\,a - 3\,b,\ -4\,b - c]$$

```
> solve({S[1],S[2],S[3]},{a,b,c});
```

$$\{b = \frac{1}{7},\ a = \frac{9}{7},\ c = \frac{-4}{7}\}$$

```
> T:=evalm([1,3,0]-a*v1-b*v2-c*v3);
```

$$T := [1 - a - b - c,\ 3 - 3\,a - 4\,b - c,\ -c - b]$$

```
> solve({T[1],T[2],T[3]},{a,b,c});
```

$$\{b = 0,\ c = 0,\ a = 1\}$$

Coordenadas de los vectores de la base B respecto de la base B'

```
> c1:=evalm(u1-a*v1-b*v2-c*v3):
  solve({c1[1],c1[2],c1[3]},{a,b,c});
```

$$\{c = \frac{1}{3},\ b = \frac{-1}{3},\ a = 1\}$$

```
> c2:=evalm(u2-a*v1-b*v2-c*v3):
  solve({c2[1],c2[2],c2[3]},{a,b,c});
```

$$\{a = -2,\ c = \frac{7}{3},\ b = \frac{5}{3}\}$$

```
> c3:=evalm(u3-a*v1-b*v2-c*v3):
  solve({c3[1],c3[2],c3[3]},{a,b,c});
```

$$\{a = 0,\ b = \frac{-1}{3},\ c = \frac{4}{3}\}$$

Coordenadas de los vectores de la base B' respecto de la base B'

```
> cc1:=evalm(v1-a*v1-b*v2-c*v3):
  solve({cc1[1],cc1[2],cc1[3]},{a,b,c});
```

$$\{b = 0,\ c = 0,\ a = 1\}$$

```
> cc2:=evalm(v2-a*v1-b*v2-c*v3):
  solve({cc2[1],cc2[2],cc2[3]},{a,b,c});
```

$$\{c = 0,\ a = 0,\ b = 1\}$$

```
> cc3:=evalm(v3-a*v1-b*v2-c*v3):
  solve({cc3[1],cc3[2],cc3[3]},{a,b,c});
```

$$\{b = 0,\ a = 0,\ c = 1\}$$

Ejercicio 3

```
> v1:=[1,2,3,4,5]:
  v2:=[1,alpha,1,0,1]:
  v3:=[1,1,1,1,1]:
  v4:=[1,2,1,0,1]:
  v5:=[1,0,1,0,3]:
```

```
> det(concat(v1,v2,v3,v4,v5));
```

$$4\,\alpha - 8$$

```
> alpha:='0';
```

$$\alpha := 0$$

```
> S:=evalm([2,3,5,8,0]-a*v1-b*v2-c*v3-d*v4-e*v5);
```

$$S := [2 - a - b - c - d - e,\ 3 - 2\,a - c - 2\,d,\ 5 - 3\,a - b - c - d - e,\ 8 - 4\,a - c,$$
$$-5\,a - b - c - d - 3\,e]$$

```
> solve({S[1],S[2],S[3],S[4],S[5]},{a,b,c,d,e});
```

$$\{b = \frac{7}{2},\ c = 2,\ d = -1,\ e = -4,\ a = \frac{3}{2}\}$$

```
>
```