* $f(u) = f(-2, -1, 1, 0) = (\underbrace{-2-(-1)+1}_{0}, \underbrace{-1+1+0}_{0}, 0, \underbrace{-2+1+1+0+3}_{0})$

$f(u) = (0, 0, 0, 0) \Rightarrow u \in \ker f$.

$f(v) = f(-1, -1, 0, 1) = (0, 0, 0, 0). \Rightarrow v \in \ker f$..

$\{u, v\}$ st famille de $\ker f$.

$\alpha u + \beta v = \alpha(-2, -1, 1, 0) + \beta(-1, -1, 0, 1)$

$= (-2\alpha - \beta, -\alpha - \beta, \alpha, \beta)$. $\Rightarrow \alpha = \beta = 0$

$= (0, 0, 0, 0)$

U et V sont L.I. $\{u, v\}$ est famille libre de $\ker f$

le nbr de vect st = la dim $(\ker f) \Rightarrow$

$\{u, v\}$ st base de $\ker f$

$\Rightarrow \ker f = \langle u, v \rangle$..

Ex4

$f : E \longrightarrow F$

$f : \mathbb{R}^3 \longrightarrow \mathbb{R}^4$

$u = (x, y, z) \longrightarrow V = (X, Y, Z, T)$

$V = f(x, y, z)$.

1). $B_{\mathbb{R}^3} = \{e_1, e_2, e_3\}$ $e_1 = (1, 0, 0)$ $e_2 = (0, 1, 0)$ $e_3 = (0, 0, 1)$

$B_{\mathbb{R}^4} = \{f_1, f_2, f_3, f_4\}$ $f_1 = (1, 0, 0, 0)$, $f_2 = (0, 1, 0, 0)$, $f_3 = (0, 0, 1, 0)$ $f_4 = (0, 0, 0, 1)$

$f(x, y, z) = (x + z, y - x, z + y, x + y + 2z)$

$f(e_1) = f(1, 0, 0) = (1, -1, 0, 1)$

$f(e_2) = f(0, 1, 0) = (0, 1, 1, 1)$.

$f(e_3) = f(0, 0, 1) = (1, 0, 1, 2)$

$$\begin{array}{c|ccc} & f(e_1) & f(e_2) & f(e_3) \\ \hline f_1 & 1 & 0 & 1 \\ f_2 & -1 & 1 & 0 \\ f_3 & 0 & 1 & 1 \\ f_4 & 1 & 1 & 2 \end{array}$$

D. ABID

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