$L_X(f)_p =$ (en funciones)

$$= X_p(f) = df_p(X_p)$$
$$= df_p\left(\frac{d}{dt}\Big|_{t=0} \varphi_t(p)\right)$$
$$= \frac{d}{dt}\Big|_{t=0} f(\varphi_t(p))$$
$$= \frac{d}{dt}\Big|_{t=0} f(\gamma_p(t))$$

$\omega \in \Omega^k(M)$ se dice cerrada $\iff d\omega = 0$

$\omega \in \Omega^k(M)$ se dice exacta $\iff \exists\, \alpha \in \Omega^{k-1}(M) \ni \omega = d\alpha$

$d^2 = 0$:

exacta $\implies$ cerrada

$\not\Longleftarrow$

Producto $\wedge$:

$\alpha_1, \dots, \alpha_k$ 1-formas:

$$\alpha_1 \wedge \dots \wedge \alpha_k (v_1, \dots, v_k) =$$

$$\left(\neq \alpha_1(v_1) \cdot \ldots \cdot \alpha_k(v_k) \right)$$

$$(\alpha_i(v_j))_{i,j=1}^{k}$$

$$= \det\left((\alpha_i(v_j))_{i,j=1}^{k} \right)$$

$$= \sum_{\sigma \in S_k} \operatorname{sgn}(\sigma)\, \alpha_1(v_{\sigma(1)}) \cdot \ldots \cdot \alpha_k(v_{\sigma(k)})$$

$f: M \longrightarrow \mathbb{R}$ es 0-forma y:

$$L_X(f) = X(f) = df(X)$$

$$= \iota(X)\, df$$

$$= \iota(X)\, df + d \underbrace{\overset{=0}{\iota(X) f}}_{(-1)\text{-forma}}$$