$+$ $\times$

$-$ $\div$

DIFFERENTIABILITY OF THE COMPOSITION

THEOREM

- $f : A \subseteq \mathbb{R}^N \longrightarrow \mathbb{R}^M$ $\quad$ A OPEN
- $g : B \subseteq \mathbb{R}^M \longrightarrow \mathbb{R}^L$ $\quad$ B OPEN
- $f(A) \subseteq B$
- $x^0 \in A$, $y^0 = f(x^0) \in B$

- ASSUME f IS DIFFERENTIABLE IN x^0 WITH JACOBIAN MATRIX $Jf(x^0)$
- ASSUME g IS DIFFERENTIABLE IN $y^0 = f(x^0)$ WITH JACOBIAN $Jg(y^0)$

THEN

$(g \circ f) : A \subseteq \mathbb{R}^N \longrightarrow \mathbb{R}^L$ IS DIFFERENTIABLE IN x^0

AND

$$\boxed{J(g \circ f)(x^0) = Jg(f(x^0)) \cdot Jf(x^0)}$$ CHAIN RULE

PRODUCT ROWS BY COLUMNS