Let $\forall((a,b), (d, e)) \in (\mathbb{N}^2)^2, let w = \frac{(max(a,b)-min(a,b))}{2}, w' = \frac{max(e,d)-min(e,d)}{2}$
$\implies \frac{(max(a,b)+max(e,d))-(min(a,b)+min(e,d))}{2} = w + w' \blacksquare$

In the case of $I_1 = (a,b), I_2 = (d,e), w_{I_1 * I_2} = \frac{max((ae,ad,be,bd))-min((ae,ad,be,bd))}{2}$,
let $b = 0, d = 0 \implies w_{I_1 * I_2} = ae \neq f(w_{I_1}, w_{I_2})$