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9. Notation and properties of directional derivatives

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Notation

We having been using the notation $D_{\vec{v}} f(x,y)$ to denote the directional derivative in the direction of $\vec{v}$. There is a lot of different notation that one may encounter for the directional derivative out in the wild, so we wanted to bring it to your attention here. We have boxed the notation that we will use in this course for clarity.

- $\boxed{D_{\vec{v}} f(x,y)}$
- $\nabla_{\vec{v}} f(x,y)$
- $f'_{\vec{v}}(x,y)$
- $Df(x,y)(\vec{v})$
- $\boxed{\vec{v} \cdot \nabla f(x,y)}$

When in doubt, try to figure out from context what type of quantity is being expressed: vector or scalar, and then determine from there if perhaps a directional derivative is intended!

Properties of the directional derivative

The directional derivative behaves in nearly identical ways as partial derivatives, and satisfies the same general properties.

1. For a function f and a real number c, we have $D_{\vec{v}}(cf) = cD_{\vec{v}} f$.
2. For functions f and g, we have $D_{\vec{v}}(f+g) = D_{\vec{v}} f + D_{\vec{v}} g$.
3. For functions f and g, we have $D_{\vec{v}}(fg) = gD_{\vec{v}} f + fD_{\vec{v}} g$.

Try verifying these properties using what you know about the gradient and dot products.

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