**Partial Derivatives**

Partial Derivatives for $f(x,y)$:

- Partial derivative for $x$: $\frac{\partial}{\partial x} f(x,y)$ measures variation in direction of $x$-axis.
- Partial derivative for $y$: $\frac{\partial}{\partial y} f(x,y)$ measures variation in direction of $y$-axis.

How to compute $\frac{\partial}{\partial x} f(x,y)$:

1. Think of $y$ as being "constant".
2. Derive as usual with respect to $x$.

Same for $\frac{\partial}{\partial y} f(x,y)$ just now thinking of $x$ as constant.

One variable derivative:

- $f(x,y) = x^2 + y^2$: $\frac{\partial f}{\partial x} = 2x$, $\frac{\partial f}{\partial y} = 2y$.
- $f(x,y) = xy$: $\frac{\partial f}{\partial x} = y$, $\frac{\partial f}{\partial y} = x$.
- $f(x,y) = e^{xy} + xy \cos(x)$: $\frac{\partial f}{\partial x} = ye^{xy} + y \cos(x)$, $\frac{\partial f}{\partial y} = xe^{xy} + x \cos(x)$.

Application: Computing critical points.

1. Compute $\frac{\partial f}{\partial x}$ & $\frac{\partial f}{\partial y}$.
2. Solve $\frac{\partial f}{\partial x} = 0$ & $\frac{\partial f}{\partial y} = 0$.

Similar to using $f'(x) = 0$ to solve for max or min.

Example 1:

- $f(x,y) = x^2 - y^2$: $\frac{\partial f}{\partial x} = 2x$, $\frac{\partial f}{\partial y} = -2y$.
- $\frac{\partial f}{\partial x} = 0 \Rightarrow x = 0$.
- $\frac{\partial f}{\partial y} = 0 \Rightarrow y = 0$.

$(x, y) = (0, 0)$ is a critical point.