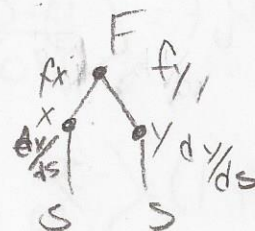


Exercise 1. Find $\frac{dy}{dx}$ when $F(x, y) = \sin xy + \pi y^2 - x = 0$.

$$\frac{F_x = y \cos(xy) + 0 - 1}{F_y = x \cos(xy) + 2\pi y - 0} = \frac{dy}{dx} = \frac{-y \cos(xy) + 1}{x \cos(xy) + 2\pi y}$$

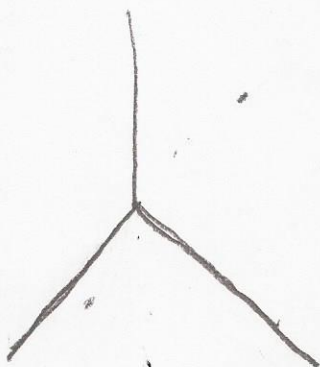
Exercise 2. Given function $f(x, y)$, write a formula for $\frac{df}{ds}$ when $x = a + su_1$ and $y = b + su_2$.

$$\frac{df}{ds} = \frac{dx}{ds} \cdot \frac{df}{dx} + \frac{dy}{ds} \cdot \frac{df}{dy}$$



$$\frac{df}{ds} = u_1 \frac{df}{dx} + u_2 \frac{df}{dy}$$

$$f' = f'(u_1, u_2)$$



Example 3. Let $f(x, y) = 3 - \frac{x^2}{10} + \frac{xy^2}{10}$.

a. Compute $\nabla f(3, -1)$.

$$f_x(x, y) \quad f_y(x, y)$$

↓

$$\nabla f = -\frac{x}{5} + \frac{y^2}{10}, \quad \frac{xy}{5}$$

$$-\frac{3}{5} + \frac{(-1)^2}{10}, \quad \frac{3(-1)}{5}$$

$$\nabla f = \left(-\frac{3}{10}, -\frac{3}{5}\right)$$

b. Compute $D_{\vec{u}}f(3, -1)$ in the direction of the vector $\langle 1, -1 \rangle = \vec{u}$

\vec{u} Has to be unit vector

$$D_{\vec{u}}f = \left\langle \frac{y^2 - 2x}{10}, \frac{xy}{5} \right\rangle \cdot \left\langle \frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}} \right\rangle$$

$$|\vec{u}| = \sqrt{1^2 + (-1)^2} = \sqrt{2}$$

$$(3, -1) = \left\langle -\frac{5}{10}, -\frac{3}{5} \right\rangle \cdot \left\langle \frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}} \right\rangle$$

$$\frac{-5}{10\sqrt{2}} + \frac{6}{\sqrt{2} \cdot 10}$$

$$D_{\vec{u}}f(3, -1) = \frac{1}{10\sqrt{2}}$$