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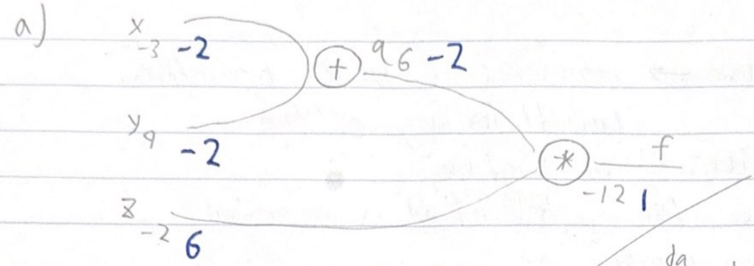
$f(x,y,z) = (x+y)z$ eval at $x = -3$, $y = 9$, $z = -2$

a)



blue = gradient

$\frac{\partial q}{\partial x} = 1$ $\frac{\partial q}{\partial y} = 1$

$\frac{\partial f}{\partial q} = z$ $\frac{\partial f}{\partial z} = q$

$\frac{\partial f}{\partial y} = \frac{\partial f}{\partial q}\frac{\partial q}{\partial y}$ $\frac{\partial f}{\partial x} = \frac{\partial f}{\partial q}\frac{\partial q}{\partial x}$

upstream   local

b) standard: $h'(x) = f'(g(x))g'(x)$
modified: $h'(x) = g'(f(x))f'(x)$

standard: $\frac{dh}{dx} = \frac{df}{dg} \cdot \frac{dg}{dx}$

modified: $\frac{dh}{dx} = \frac{dg}{df} \cdot \frac{df}{dx}$ $\frac{dg}{df} = z$ $\frac{df}{dx} = 1$

$\frac{dh}{dx} = \frac{dg}{df} \cdot \frac{df}{dx} = (-2)(1) = -2$ $\frac{dg}{dz} = q$ $\frac{df}{dy} = 1$

$\frac{dh}{dy} = \frac{dg}{df} \cdot \frac{df}{dy} = (-2)(1) = -2$

$\frac{dh}{dz} = \frac{dg}{dz} = 6$ answers: $-2, -2, 6$

Note: $g'(f(x))$ doesn't make sense because $(x+y)z \rightarrow z$ is independent from x and y. f(x) is a linear function so it's the same, but for something like log(x), it fails.