$c.grad = ?$ $\frac{dL}{dc} = ?$ $L = d * f$

$L = (c+e) * f$.

(introducing chain rule in calculus)

$A = 2B$
$B = 4C$
$A = 8C$

Basic understanding

$$\boxed{\frac{dz}{dx} = \left(\frac{dz}{dy}\right) * \left(\frac{dy}{dx}\right) \Rightarrow \frac{dc}{da} = \left(\frac{dc}{db}\right) * \left(\frac{db}{da}\right)}$$

Chain rule in calculus

(Heart of the BackProp)

(Heart of the NN)

$c.grad = \frac{dL}{dc}$, $c.grad = ?$

we know,
$d.grad = dL/dd$

$$\boxed{\frac{dL}{dc} = \frac{dL}{dd} * \frac{dd}{dc}} \Rightarrow \boxed{c.grad = d.grad * \frac{dd}{dc}}$$

$c.grad = \underline{d.grad} * \frac{dd}{dc}$

A) $\frac{dd}{dc} = ?$, $d = (c+e)$, $slope = \frac{f(x+h) - f(x)}{h}$

$\frac{dd}{dc} = ?$, $d = (c+e)$, slope $= \frac{f(x+h) - f(x)}{h}$

slope $= \frac{\cancel{(c+h+e)} - \cancel{(c+e)}}{\cancel{h}} = 1$,

$$\boxed{\frac{dd}{dc} = 1}$$

c.grad = d.grad $\times \cancel{\frac{dd}{dc}}$ ' $=$ $\boxed{\begin{array}{l} \text{c.grad} = \text{d.grad} \\ \frac{dL}{dc} = \frac{dL}{dd} \end{array}}$

Analytically

B) $\frac{dd}{dc} = ?$ $d = (c+e)$

$(e = k)$

$$\frac{dd}{dc} = \frac{d}{dc}(c+e) = \frac{dc}{dc} + \frac{de}{dc}$$

$\frac{dc}{dc} \to 1$, $\frac{de}{dc} \to 0$

$\boxed{dd/dc = 1}$ → calculus

c.grad = d.grad $\times \cancel{\left(\frac{dd}{dc}\right)}$ → 1

$\boxed{\begin{array}{l} \text{c.grad} = \text{d.grad} \\ dL/dc = dL/dd \end{array}}$ → calculus

Note:- when there is addⁿ, the gradients flows without changing

e.grad = ?, dL/de = ? $(d = c+e)$

we know that, dL/dd

with chain rule in calculus,

$$\boxed{\frac{dL}{de} = \frac{dL}{dd} \times \frac{dd}{de}} \Rightarrow e.grad = d.grad \times \frac{dd}{de}$$

$dd/de = ?$, $d = (c+e)$

A) $$\frac{dd}{de} = \text{slope} = \frac{f(x+h) - f(x)}{h} = \frac{(\cancel{c}+\cancel{e}+\cancel{h}) - (\cancel{c}+\cancel{e})}{\cancel{h}}$$

$$\boxed{\frac{dd}{de} = 1}$$

$$e.grad = d.grad \times \cancel{\frac{dd}{de}} \rightarrow 1$$

$\boxed{e.grad = d.grad}$ → Analytical

B) $\frac{dd}{de} = ?$, $d = (c+e)$

$$\frac{dd}{de} = \frac{d}{de}(c+e) = \cancel{\frac{dc}{de}}^{\,0} + \cancel{\frac{de}{de}}^{\,1} \quad (C = K)$$

$\boxed{dd/de = 1}$ → calculus

$\boxed{e.grad = d.grad}$

a.grad = ? dL/da = ? dL/de = ✓, $e = a*b$

by chain rule,

$$\boxed{\frac{dL}{da} = \left(\frac{dL}{de}\right) * \left(\frac{de}{da}\right)} \rightarrow \text{chain rule.}$$

$$\frac{de}{da} = ?$$

A) de/da = ?, $e = a*b$, slope = $\frac{f(x+h) - f(x)}{h}$

$$\text{slope} = \frac{(a+h)*b - (a*b)}{h} = \frac{\cancel{ab} + \cancel{h}b - \cancel{ab}}{\cancel{h}} = b$$

$$\boxed{\frac{de}{da} = b}$$

$$\frac{dL}{da} = \frac{dL}{de} * \frac{de}{da}$$

$$\text{a.grad} = \text{e.grad} * \frac{de}{da}$$

$$\boxed{\text{a.grad} = b * (\text{e.grad})}$$

→ Analytically.

B) $\frac{de}{da}$ = ?, $e = a*b$ $(b = k)$

$$\frac{d}{da}(a*b) = a\frac{db}{da} + b\frac{da}{da} = b$$

$$\boxed{de/da = b}$$

$$\boxed{\text{a.grad} = b * \text{e.grad}}$$

→ calculus

$\frac{dL}{db} = ?$, $\frac{dL}{de}$, $e = a * b$

Chain rule,

$$\boxed{\frac{dL}{db} = \frac{dL}{de} * \frac{de}{db}}$$

A) $de/db = ?$, $e = a * b$, $slope = \frac{f(x+h) - f(x)}{h}$

$$slope = \frac{(a * (b+h)) - (a * b)}{h} = \frac{\cancel{ab} + \cancel{h}a - \cancel{ab}}{\cancel{h}} = a$$

$$\boxed{de/db = a}$$

$$b.grad = e.grad * \frac{de}{db}$$

Analytical $\rightarrow$ $\boxed{b.grad = e.grad * a}$

B) $\frac{de}{db} = ?$ $e = a * b$

$(a = k)$

$$\frac{d(a * b)}{db} = a\cancel{\frac{db}{db}}^{1} + b\cancel{\frac{da}{db}}^{0} = a, \quad \boxed{\frac{de}{db} = a}$$

$\boxed{b.grad = e.grad * a}$ $\rightarrow$ calculus