1. Compute the derivative $f'(x)$ of the logistic sigmoid

$$f(x) = \frac{1}{1+\exp(-x)}$$

sol) $f(x) = \dfrac{1}{1+e^{-x}}$

$$f'(x) = \frac{+e^{-x}}{(1+e^{-x})^2} = \frac{+e^{-x}}{1+2e^{-x}+e^{-2x}} = \frac{+1}{e^{x}+2+e^{-x}} = + \frac{1}{e^{x}+e^{-x}+2}$$

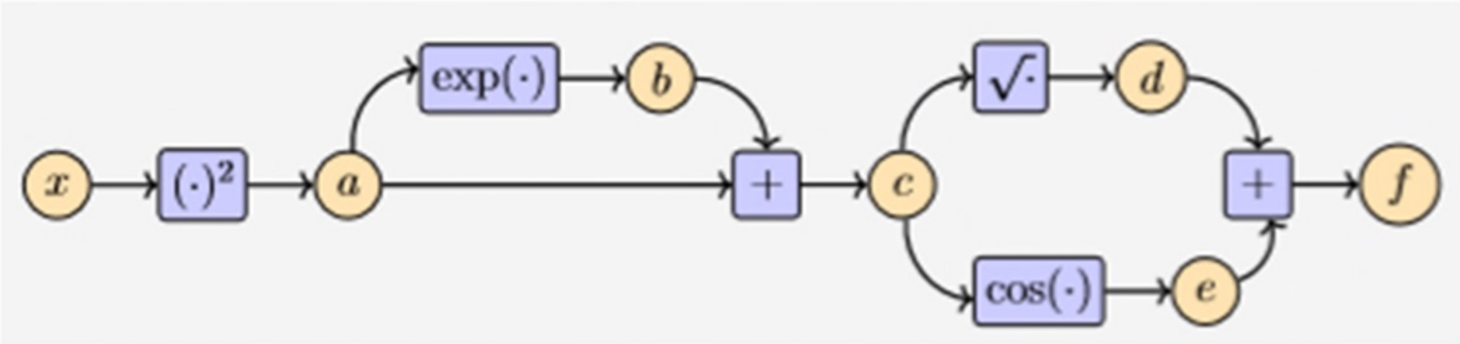
2. Compute the $\frac{df}{dt}$ of the $f(x_1, x_2) = x_1^2 + 2x_2$, where $x_1 = \sin t$ and $x_2 = \cos t$

$$f(x_1, x_2) = x_1^2 + 2x_2$$

$$\frac{f(x_1, x_2)}{dt} = 2x_1\left(\frac{dx_1}{dt}\right) + 2\left(\frac{dx_2}{dt}\right) = 2(\sin t)(\cos t) + 2(-\sin t)$$

$$= 2\sin t\,\{(\cos t) - 1\}$$

3. Fill the blank



- $a = x^2$
- $b = e^{x^2}$
- $c = x^2 + e^{x^2}$
- $d = \sqrt{x^2 + e^{x^2}}$
- $e = \cos(x^2 + e^{x^2})$
- $f = \sqrt{x^2 + e^{x^2}} + \cos(x^2 + e^{x^2})$

- $\frac{\partial a}{\partial x} = 2x$
- $\frac{\partial b}{\partial a} =$
- $\frac{\partial c}{\partial a} =$
- $\frac{\partial d}{\partial c} =$
- $\frac{\partial e}{\partial c} =$
- $\frac{\partial f}{\partial d} =$

↓ 아래에서 따로 계산

- $\frac{\partial f}{\partial c} =$
- $\frac{\partial f}{\partial b} =$
- $\frac{\partial f}{\partial a} =$
- $\frac{\partial f}{\partial x} =$

$$\frac{\partial b}{\partial a} = \frac{\partial b}{\partial x} \cdot \frac{\partial x}{\partial a} = (\cancel{2x} e^{x^2}) \cdot \left(\frac{1}{\cancel{2x}}\right) = e^{x^2}$$

$$\frac{\partial c}{\partial a} = \frac{\partial c}{\partial x} \cdot \frac{\partial x}{\partial a} = (2x + 2xe^{x^2}) \cdot \left(\frac{1}{2x}\right) = 1 + e^{x^2}$$

$$\frac{\partial d}{\partial c} = \frac{\partial d}{\partial x} \cdot \frac{\partial x}{\partial c} = \left(\frac{\cancel{2x + 2xe^{x^2}}}{2\sqrt{x^2 + e^{x^2}}}\right) \cdot \left(\frac{1}{\cancel{2x + 2xe^{x^2}}}\right) = \frac{1}{2\sqrt{x^2 + e^{x^2}}}$$

$$\frac{\partial e}{\partial c} = \frac{\partial e}{\partial x} \cdot \frac{\partial x}{\partial c} = \left(-\sin(x^2 + e^{x^2})\right) \cdot (\cancel{2x + 2xe^{x^2}}) \cdot \left(\frac{1}{\cancel{2x + 2xe^{x^2}}}\right) = -\sin(x^2 + e^{x^2})$$

$$\frac{\partial f}{\partial d} = \frac{\partial f}{\partial x} \cdot \frac{\partial x}{\partial d} = \left[\frac{2x + 2xe^{x^2}}{2\sqrt{x^2 + e^{x^2}}} + \left(-\sin(x^2 + e^{x^2})\right)(2x + 2xe^{x^2})\right] \cdot \left(\frac{2\sqrt{x^2 + e^{x^2}}}{2x + 2xe^{x^2}}\right)$$

$$= 1 - 2\sqrt{x^2 + e^{x^2}}\left(\sin(x^2 + e^{x^2})\right)$$

$$\frac{\partial f}{\partial c} = \frac{\partial f}{\partial x} \cdot \frac{\partial x}{\partial c} = \left[(2x + 2xe^{x^2})\left(\frac{1}{2\sqrt{x^2 + e^{x^2}}} - \sin(x^2 + e^{x^2})\right)\right] \cdot \left(\frac{1}{2x + 2xe^{x^2}}\right)$$

$$= \frac{1}{2\sqrt{x^2 + e^{x^2}}} - \sin(x^2 + e^{x^2})$$

$$\frac{\partial f}{\partial b} = \frac{\partial f}{\partial x} \cdot \frac{\partial x}{\partial b} = \left[(2x + 2xe^{x^2}) \left(\frac{1}{2\sqrt{x^2+e^{x^2}}} - \sin(x^2+e^{x^2}) \right) \right] \left(\frac{1}{2xe^{x^2}} \right)$$

$$= \left(\frac{1}{e^{x^2}} + 1 \right) \left(\frac{1}{2\sqrt{x^2+e^{x^2}}} - \sin(x^2+e^{x^2}) \right)$$

$$\frac{\partial f}{\partial a} = \frac{\partial f}{\partial x} \cdot \frac{\partial x}{\partial a} = \left[(2x + 2xe^{x^2}) \left(\frac{1}{2\sqrt{x^2+e^{x^2}}} - \sin(x^2+e^{x^2}) \right) \right] \left(\frac{1}{2x} \right)$$

$$= (1+e^{x^2}) \left(\frac{1}{2\sqrt{x^2+e^{x^2}}} - \sin(x^2+e^{x^2}) \right)$$

$$\frac{\partial f}{\partial x} = (2x + 2xe^{x^2}) \left(\frac{1}{2\sqrt{x^2+e^{x^2}}} - \sin(x^2+e^{x^2}) \right)$$