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

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

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

$$= -(1+e^{-x})^{-2}\cdot\left(\frac{d}{dx}\cdot 1 + \frac{d}{dx}\cdot e^{-x}\right) = -(1+e^{-x})^{-2}\cdot\left(0+\frac{d}{dx}\cdot e^{-x}\right)$$

$$= -(1+e^{-x})^{-2}\cdot\left(\frac{d}{dx}e^{-x}\right) = -(1+e^{-x})^{-2}\cdot\left(e^{-x}\cdot\frac{d}{dx}-x\right)$$

$$= -(1+e^{-x})^{-2}\cdot\left(e^{-x}\cdot -\frac{d}{dx}x\right) = -(1+e^{-x})^{-2}\cdot(e^{-x}\cdot -1) = (1+e^{-x})^{-2}\cdot e^{-x}$$

미분끝

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

정리

$$= \frac{1}{1+e^{-x}}\left(1-\frac{1}{1+e^{-x}}\right) = \boxed{f(x)-(1-f(x))}$$

2. Compute the df/dt of the f(x1,x2) = x12 + 2x2, where x1=sin t and x2 = cos t

$2\sin t(\cos t - 1)$

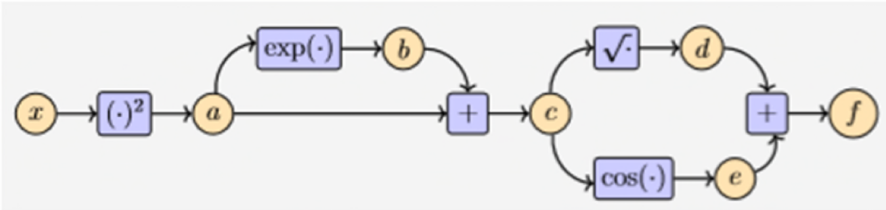
$$\frac{d}{dt} f(x1, x2) = \frac{d}{dt}(x_1^2 + 2x_2) =$$

$$\frac{dx_1^2}{dx_1} \cdot \frac{dx_1}{dt} + \frac{d2x_2}{dx_2} \cdot \frac{dx_2}{dt} =$$

$$2 \cdot \sin t \cdot \frac{d\sin t}{dt} + 2 \cdot \frac{d\cos t}{dt} = 2 \cdot \sin t \cdot \cos t + 2(-\sin t)$$

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

3. Fill the blank



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

- $\frac{\partial a}{\partial x} = 2x$
- $\frac{\partial b}{\partial a} = e^a$
- $\frac{\partial c}{\partial a} = 2^{a}+1$
- $\frac{\partial d}{\partial c} = \frac{1}{2\sqrt{c}}$
- $\frac{\partial e}{\partial c} = -\sin(c)$
- $\frac{\partial f}{\partial d} = 1 - 2d \cdot \sin(d^2)$

- $\frac{\partial f}{\partial c} = \frac{1}{2\sqrt{c}} - \sin(c)$
- $\frac{\partial f}{\partial b} = -\frac{(b+1) \cdot \sin(\log_e b + b) - b - 1}{b}$
- $\frac{\partial f}{\partial a} = -\frac{(2e^a + 2) \cdot \sin(e^a + a) - e^a - 1}{\sqrt{e^a + a}}$
- $\frac{\partial f}{\partial x} = x(1 + e^{(x^2)})\left(\frac{1}{\sqrt{x^2 + e^{(x^2)}}} - 2\sin(x^2 + e^{(x^2)})\right)$

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

$e = \cos(c) = \cos(x^2 + e^{(x^2)})$ / $f = d + e = \boxed{\sqrt{x^2 + e^{(x^2)}} + \cos(x^2 + e^{(x^2)})}$

$\frac{d}{dx} a = \frac{d}{dx} x^2 = 2x$ / $\frac{d}{da} b = \frac{d}{da} e^a = e^a$ / $\frac{d}{da} c = \frac{d}{da}(a + e^a) = 2^a + 1$

$\frac{d}{dc} d = \frac{d}{dc}\sqrt{c} = \frac{1}{2\sqrt{c}}$ / $\frac{d}{dc} e = \frac{d}{dc}\cos(c) = -\sin(c)$

$\frac{d}{dd} f = \frac{d}{dd}\, d + \cos(d^2) = 1 - 2d\sin(d^2)$

$$\frac{d}{dc}f = \frac{d}{dc}\sqrt{c} + \cos(c) = \boxed{\frac{1}{2\sqrt{c}} - \sin(c)}$$

$$\frac{d}{db}f = \sqrt{\log_e b + b} + \cos(\log_e b + b) = \boxed{-\frac{(b+1)\cdot\sin(\log_e b + b) - b - 1}{b}}$$

$$\frac{d}{da}f = \frac{d}{da}\sqrt{a+e^a} + \cos(a+e^a) = \boxed{-\frac{(2e^a+2)\cdot\sin(e^a+a) - e^a - 1}{\sqrt{e^a+a}}}$$

$$\frac{d}{dx}f = \frac{d}{dx}\sqrt{x^2+e^{x^2}} + \cos(x^2+e^{x^2})$$

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