

Course: ML

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### Assignment 1

Given,  $f(z) = \ln(1+z)$ ; where  $z = x^T x$

Solve using chain rule:

~~where~~ we know that,

$$\frac{df}{dx} = \frac{df}{dz} \cdot \frac{dz}{dx}$$

$$\text{here, } \frac{df}{dz} = \frac{1}{1+z}$$

$$\text{and, } \frac{dz}{dx} = 2x$$

$$\therefore \frac{df}{dx} = \frac{1}{1+z} \cdot 2x = \frac{2x}{1+x^T x}$$

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## Assignment 2

Given:  $f(z) = e^{-z/2}$

where,  $z = g(y) = y^T S^{-1} y$

$$y = h(x) = x - \mu$$

Solve using chain rule,

As we know,

$$\frac{dz}{dx} = \frac{df}{dz} \cdot \frac{dz}{dy} \cdot \frac{dy}{dx}$$

here,  $\frac{df}{dz} = -\frac{1}{2} z^{-\frac{3}{2}} \quad (1)$

$$\frac{dz}{dy} = I$$

$$\begin{aligned} \frac{df}{dz} &= -\frac{1}{2} e^{-\frac{z}{2}} \cdot \{S^{-1} y\} \\ &= -\frac{1}{2} e^{-\frac{z}{2}} \cdot \{(x - \mu)^T \cdot S^{-1} (x - \mu)\} \cdot S^{-1} (x - \mu) \\ &= -e^{-\frac{z}{2}} \cdot S^{-1} (x - \mu) \end{aligned}$$

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