

Section 2

$$\begin{aligned} 1. \nabla_x f(x) &= \frac{d}{dx} (Ax)^T \in \mathbb{R}^{1 \times n} \\ &= \frac{d}{dx} x^T A^T \\ &= (A^T)^T \\ &= A \end{aligned}$$

$$\begin{aligned} 2. (x^T A y) (x^T A y)^{-1} &= (x^T A y) (x^T y)^{-1} \\ &= x^T A y y^{-1} (x^T)^{-1} \\ &= x^T A \cdot I (x^T)^{-1} = x^T A (x^T)^{-1} \end{aligned}$$

We know that $x^T A (x^T)^{-1} = I$

$$\begin{aligned} \text{then } (x^T)^{-1} x^T A (x^T)^{-1} (x^T) &= (x^T)^{-1} I (x^T) \\ I \cdot A \cdot I &= (x^T)^{-1} (x^T) \\ A &= I \end{aligned}$$