Algebra Everything is Handwavy!

A, a, b, c are constants

Think:

$x^T A x \sim Ax^2$

$x^T x \sim x^2$

$\underbrace{Ax}_{\text{vector}} \cdot \underbrace{(b - Ax)}_{\text{vector}} = x^T A^T (b - Ax)$

Derivatives

$\partial A = 0$

$\partial(aX) = a\,\partial X$

$\partial(X + Y) = \partial X + \partial Y$

$\sim \frac{da x}{dx}$

$\frac{\partial x^T a}{\partial x} = \frac{\partial a^T x}{\partial x} = a \sim \frac{\partial (ax)}{\partial x}$

$\frac{\partial a^T x b}{\partial x} = ab^T \sim \frac{\partial ((ab)x)}{dx}$

$\frac{\partial a^T x^T b}{\partial x} = ba^T$

Think:

$\frac{\partial \|x\|_2}{\partial x} = \frac{\partial \|x^T x\|_2}{\partial x} = 2x$

with Symmetric Matrix S

$$\frac{\partial}{\partial x}(b - Ax)^T S (b - Ax) = -2A^T S(b - Ax)$$

Think ~

$$\frac{\partial}{\partial x} S\, y(x)^2 = 2S\, y(x) \cdot y'(x)$$

Try: $\frac{\partial}{\partial x}(b - x)^T W (b - x)$:

if not symmetric more weird but don't think you'll need