Practice Gradients/Derivatives

Matrix and Vector Calculus

For vectors $\mathbf{x}, \mathbf{y} \in \mathbb{R}^d$ and matrices $\mathbf{M} \in \mathbb{R}^{k \times d}$ and $\mathbf{A} \in \mathbb{R}^{d \times d}$

- $\nabla_{\mathbf{x}}(\mathbf{y}^T\mathbf{x}) = \nabla_{\mathbf{x}}(\mathbf{x}^T\mathbf{y}) = \mathbf{y}^T$
- $\nabla_{\mathbf{x}}(\mathbf{M}\mathbf{x}) = \mathbf{M}$
- $\nabla_{\mathbf{x}}(\mathbf{x}^T\mathbf{A}\mathbf{x}) = \mathbf{x}^T(\mathbf{A}^T + \mathbf{A})$
- For symmetric $\mathbf{A}$, $\nabla_{\mathbf{x}}(\mathbf{x}^T\mathbf{A}\mathbf{x}) = 2(\mathbf{A}\mathbf{x})^T$

Prove all of the derivatives given above.