Some Vector Derivatives

Let $\mathbf{x}$, $\mathbf{u}$ be vectors of length N and let $\mathbf{A}$ be a matrix of size $N \times N$

$$\frac{\partial}{\partial \mathbf{x}}(\mathbf{u}^T\mathbf{x}) = \frac{\partial}{\partial \mathbf{x}}(\mathbf{x}^T\mathbf{u}) = \mathbf{u}^T \tag{1}$$

$$\frac{\partial}{\partial \mathbf{x}}(\mathbf{A}\mathbf{x}) = \mathbf{A} \tag{2}$$

$$\frac{\partial}{\partial \mathbf{x}}(\mathbf{x}^T\mathbf{A}\mathbf{x}) = \mathbf{x}^T(\mathbf{A} + \mathbf{A}^T) \tag{3}$$

$$\frac{\partial^2}{\partial \mathbf{x}^2}(\mathbf{x}^T\mathbf{A}\mathbf{x}) = \mathbf{A} + \mathbf{A}^T \tag{4}$$

Note that if $\mathbf{A}$ is a symmetric matrix $\mathbf{A} + \mathbf{A}^T = 2\mathbf{A}$.