$$\frac{\partial(\mathbf{b}^T\mathbf{a})}{\partial\mathbf{a}} = \mathbf{b}$$

$$\frac{\partial(\mathbf{a}^T\mathbf{A}\mathbf{a})}{\partial\mathbf{a}} = (\mathbf{A}+\mathbf{A}^T)\mathbf{a}$$

$$\frac{\partial}{\partial\mathbf{A}}\mathrm{tr}(\mathbf{B}\mathbf{A}) = \mathbf{B}^T$$

$$\frac{\partial}{\partial\mathbf{A}}\log|\mathbf{A}| = \mathbf{A}^{-T} \triangleq (\mathbf{A}^{-1})^T$$

$$\mathrm{tr}(\mathbf{ABC}) = \mathrm{tr}(\mathbf{CAB}) = \mathrm{tr}(\mathbf{BCA})$$

Figure 1: important formulas

Mahalanobis distance

Eigendecomposition:

Equation of Ellipse: $(\mathbf{x}-\mathbf{c})^T A(\mathbf{x}-\mathbf{c})$

Orthonormal Matrices: $\mathbf{U}^T = \mathbf{U}^{-1} \Rightarrow \mathbf{U}^{-T} = \mathbf{U}$

Trace of a Matrix A: $\mathrm{tr}(A) = \sum_{i=1}^{n} a_{ii} = a_{11} + a_{22} + \ldots + a_{nn}$

Discriminant Analysi $p(y=c|\mathbf{x},\theta) = p(\mathbf{x}|y=c,\theta) \times p(y=c|\theta)$