Calculus rules $\frac{d}{dx}x^a = ax^{a-1}$ $\frac{d}{dx}kf(x) = kf'(x)$

$\frac{d}{dx}[f(x) + g(x)] = f'(x) + g'(x)$

$\frac{d}{dx}\big(f(g(x))\big) = g'(x) \cdot f'(g(x))$

$\frac{d}{dx}\log x = \frac{1}{x}$ $\frac{d}{dx}e^x = e^x$ $\frac{d}{dx}f(w) = 0$

Log rules $\log ab = \log a + \log b$

$\log a^n = n \log a$ $\log e^a = \log(\exp(a)) = a$

Update rules

Basic logistic update:

$$w_j \leftarrow w_j + \varepsilon x_j^i \left(y^i - g(\boldsymbol{w}^T \boldsymbol{x})\right)$$

SVM optimization with slack: $\underset{w}{\text{argmin}}\ \boldsymbol{w}^T\boldsymbol{w} + C\sum_i \xi^i$ such that $\boldsymbol{w}^T\boldsymbol{x}^+ + b \geq +1 - \xi^i$ $\boldsymbol{w}^T\boldsymbol{x}^- + b \leq -1 + \xi^i$	$\boldsymbol{w} = \sum_i \alpha^i y^i \boldsymbol{x}^i$

For PCA: $z_q^i = (\boldsymbol{u}^q)^T \boldsymbol{x}^i$

For Neural Network:

$\delta_k^{top,i} = \left(1 - r_k^{top,i}\right)\left(y^i - r_k^{top,i}\right) r_k^{top,i}$

HMM *Beta equation corrected 11:50pm Dec 11*

$$\beta_t(i) = \sum_j A_{j,i}\phi_{o_{t+1},j}\beta_{t+1}(j)$$

$$S_t(i,j) = \frac{\alpha_t(j)A_{i,j}\phi_{o_{t+1},i}\beta_{t+1}(i)}{\sum_{f,g}\alpha_t(g)A_{f,g}\phi_{o_{t+1},f}\beta_{t+1}(f)}$$