



$E(\underline{w}), \frac{\partial E}{\partial \underline{w}}$

- REGRESSION $y = \underline{w}^T \cdot \phi(\underline{x}) = a$
LINEAR (ARBITRARY TARGET t)
- CLASSIFICATION $y = \sigma(\underline{w}^T \phi(\underline{x})) = \sigma(a)$
NONLINEAR SIGMOID (TARGET 1/0)
 (SATURATION)

(LIN) $E(\underline{w}) = \frac{1}{2} \sum_{n=1}^N \{ y(x_n, \underline{w}) - t_n \}^2$
 $\{ \underline{w}^T \phi(x_n) - t_n \}^2$

$\frac{\partial E}{\partial \underline{w}} \xrightarrow{\left(\frac{\partial E}{\partial a_n} \right)} (y_n - t_n) \quad y_n = y(x_n, \underline{w})$

(NL) $\sigma(a) = \frac{1}{1 + \exp(-a)} = y = y(\underline{x}, \underline{w}) = p(c_1 | \underline{x})$
 $p(c_2 | \underline{x}) = 1 - y$

DISTRIBUTION OF t

$p(t | \underline{x}, \underline{w}) = y(\underline{x}, \underline{w})^t \{ 1 - y(\underline{x}, \underline{w}) \}^{1-t}$

\downarrow

MORE DATA
NEG. LIKELIHOOD

$E(\underline{w}) = - \sum_{n=1}^N \{ t_n \ln y_n + (1 - t_n) \ln (1 - y_n) \}$

CROSS-ENTROPY ERROR FUNCTION

$\frac{\partial E}{\partial \underline{w}} \xrightarrow{\left(\frac{\partial E}{\partial a_n} \right)} (y_n - t_n)$

MORE CLASSES & DATA:
(OUTPUTS)

$p(\underline{t} | \underline{x}, \underline{w}) = \prod_{k=1}^K y_k(\underline{x}, \underline{w})^{t_k} [1 - y_k(\underline{x}, \underline{w})]^{1-t_k}$

$E(\underline{w}) = - \sum_{n=1}^N \sum_{k=1}^K \{ t_{nk} \ln y_{nk} + (1 - t_{nk}) \ln (1 - y_{nk}) \}$

1-OF-K CODING

$E(\underline{w}) = - \sum_n \sum_k t_{nk} \ln y_{nk} \quad y_k = \frac{\exp(a_k(\underline{x}, \underline{w}))}{\sum_j \exp(a_j)}$
 SOFTMAX F.