

## Assignment 2 (Sindipam Haldar 18ME10050)

1)  $l(y_i, \hat{y}_i) = \log(1 + \exp(-y_i \hat{y}_i))$

Loss function

$$\sum_{i=1}^n \log(1 + \exp(-y_i \hat{y}_i)) + \lambda \|\omega\|^2$$

$$= \sum_{i=1}^n \log(1 + \exp(-y_i \hat{y}_i)) + \lambda \sum_{i=1}^d \omega_i^2$$

We know  $\omega_{t+1} = \omega_t + \eta \frac{\partial \text{loss}}{\partial \omega}$

let us take a single component of  $\omega$ .

$$\omega_{t+1,i} = \omega_{t,i} - \eta \frac{\partial \text{loss}}{\partial \omega_{t,i}}$$

$$\text{loss} = \sum_{j=1}^n \log(1 + \exp(y_j \hat{y}_j)) + \lambda \sum_{j=1}^d \omega_j^2$$

$$\frac{\partial \text{loss}}{\partial \omega_j} = \sum \frac{\partial l(y_i, \hat{y}_i)}{\partial \omega_j} + 2\lambda \omega_j$$

Now  $\frac{\partial l(y_i, \hat{y}_i)}{\partial \omega_j} =$

PRIORITY

APPOINTMENTS

IMPORTANT NOTES

28

JULY

TUESDAY

31st Wk

210-156

JUNE 2020								JULY 2020							
WK	S	M	T	W	T	F	S	WK	S	M	T	W	T	F	S
23		1	2	3	4	5	6	27				1	2	3	4
24	7	8	9	10	11	12	13	28	5	6	7	8	9	10	11
25	14	15	16	17	18	19	20	29	12	13	14	15	16	17	18
26	21	22	23	24	25	26	27	30	19	20	21	22	23	24	25
27	28	29	30					31	26	27	28	29	30	31	

$$\frac{\partial}{\partial w_j} 2 \log(1 + \exp(-y_i \hat{y}_i))$$

$$= \frac{1}{\log(1 + \exp(-y_i \hat{y}_i))} \cdot \frac{\partial}{\partial w_j} e^{-y_i \hat{y}_i}$$

$$= \frac{1}{1 + \exp(-y_i \hat{y}_i)} \cdot e^{-y_i \hat{y}_i} \cdot (-y_i) \cdot \frac{\partial \hat{y}_i}{\partial w_j}$$

$$\text{Now } \hat{y}_i = \text{tanh}(w^T x_i) = \tanh\left(\sum_{j=1}^d w_j x_{ij}\right) \Rightarrow \frac{\partial \hat{y}_i}{\partial w_j} = x_{ij} \cdot (1 - \hat{y}_i^2)$$

$$\therefore \frac{\partial \ell(y_i, \hat{y}_i)}{\partial w_j} = \frac{e^{-y_i \hat{y}_i}}{1 + \exp(-y_i \hat{y}_i)} \cdot (-y_i) \cdot x_{ij} \cdot (1 - \hat{y}_i^2)$$

$$\therefore \frac{\partial \text{loss}}{\partial w_j} = \sum_{i=1}^n \frac{-y_i e^{-y_i \hat{y}_i}}{1 + \exp(-y_i \hat{y}_i)} x_{ij} + 2\lambda w_j$$

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APPOINTMENTS

IMPORTANT NOTES



AUGUST 2020								SEPTEMBER 2020							
WK	S	M	T	W	T	F	S	WK	S	M	T	W	T	F	S
31	30	31					1	36			1	2	3	4	5
32	2	3	4	5	6	7	8	37	6	7	8	9	10	11	12
33	9	10	11	12	13	14	15	38	13	14	15	16	17	18	19
34	16	17	18	19	20	21	22	39	20	21	22	23	24	25	26
35	23	24	25	26	27	28	29	40	27	28	29	30			

For  $j=1$  to  $n$

$$w_{t+1,j} = w_{t,j} - \eta \left( \sum_{i=1}^n \frac{-y_i \hat{y}_i}{1 + e^{y_i \hat{y}_i}} x_{ij} + 2\lambda w_j \right)$$

~~$$w_{t+1} = w_t - \eta \left( \sum_{i=1}^n \frac{-y_i \hat{y}_i}{1 + e^{y_i \hat{y}_i}} x_i + 2\lambda w_t \right)$$~~

$$w_{t+1} = w_t - \eta \left( x^T \cdot l + 2\lambda w_t \right)$$

Where  $l = [l_1 \ l_2 \ l_3 \ \dots \ l_n]^T$

$$l_i = \frac{-y_i e^{-y_i \hat{y}_i}}{1 + e^{-y_i \hat{y}_i}} (1 - \hat{y}_i^2)$$

PRIORITY

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