$$\phi_t = \frac{\langle w_t, u\rangle}{\|w_t\| \ \cancel{\|u\|}}$$ (1

$\cancel{\|u\|} \to 1$

$$\langle w_{t+1}, u\rangle = \langle w_t + y_t x_t, u\rangle = \langle w_t, u\rangle + \underbrace{y_t\langle x_t, u\rangle}_{\geq \delta}$$

$$\leadsto \langle w_{T+1}, u\rangle \geq T\delta \quad (*)$$

$$\|w_{T+1}\|^2 = \langle w_t + y_t x_t, w_t + y_t x_t\rangle$$

$$= \|w_t\|^2 + \underbrace{\|x_t\|^2}_{1} + \underbrace{2y_t\langle x_t, w_t\rangle}_{\substack{\text{err} \\ \leq 0}} \longrightarrow \|w_{T+1}\|^2 \leq T$$

$$1 \geq \phi_{T+1} = \frac{\langle w_{T+1}, u\rangle}{\|w_{T+1}\|} \geq \frac{T\delta}{\sqrt{T}} \leadsto T \leq 1/\delta^2$$

$$D_{t+1}(i) = \frac{D_t(i)}{Z_t} e^{-\alpha_t y_i h_t(x_i)}$$ (2

$$D_{T+1}(i) = D_1(i) \frac{e^{-\alpha_1 y_1 h_1(x_i)}}{Z_1} \frac{e^{-\alpha_2 y_2 h_2(x_i)}}{Z_2} \cdots \frac{e^{-\alpha_T y_i h_T(x_i)}}{Z_T}$$

$$= 1/m \frac{e^{-y_i g_T(x_i)}}{\prod_t Z_t}$$

$$\hat{err}(g) = 1/m \sum_i \mathbb{1}\{g(x_i) \neq y_i\}$$

$$= 1/m \sum_i \mathbb{1}\{y_i g_T(x_i) \leq 0\}$$

$$\leq 1/m \sum_i e^{-y_i g_T(x_i)}$$

$$\leq 1/m \sum_i D_{T+1}(i)\, m \prod_t Z_t$$

$$= \prod_t Z_t \sum_i D_{T+1}(i)$$

$$= \prod_t Z_t$$