* Train / Test procedure for classification problem

① fit parameters by minimizing $J(\vec{w},b)$ to find $\vec{w},b$

$$J(\vec{w},b) = -\frac{1}{m}\sum_{i=1}^{m}\left[y^{(i)}\log\left(f_{\vec{w},b}(\vec{x}^{(i)})\right)+(1-y^{(i)})\log\left(1-f_{\vec{w},b}(\vec{x}^{(i)})\right)\right] + \frac{\lambda}{2m}\sum_{j=1}^{n} w_j^2$$

② Complete test error

$$J_{test}(\vec{w},b) = -\frac{1}{m_{test}}\sum_{i=1}^{m_{test}}\left[y_{test}^{(i)}\log\left(f_{\vec{w},b}(\vec{x}_{test}^{(i)})\right)+(1-y_{test}^{(i)})\log\left(1-f_{\vec{w},b}(\vec{x}_{test}^{(i)})\right)\right]$$

③ Compute train error

$$J_{train}(\vec{w},b) = -\frac{1}{m_{train}}\sum_{i=1}^{m_{train}}\left[y_{train}^{(i)}\log\left(f_{\vec{w},b}(\vec{x}_{train}^{(i)})\right)+(1-y_{train}^{(i)})\log\left(1-f_{\vec{w},b}(\vec{x}_{train}^{(i)})\right)\right]$$

* test error, train error other definition

⇒ fraction of the test set and the fraction of the train set that the algorithm has misclassified

$$\hat{y} = \begin{cases} 1 & \text{if } f_{\vec{w},b}(\vec{x}^{(i)}) \geq 0.5 \\ 0 & \text{if } f_{\vec{w},b}(\vec{x}^{(i)}) < 0.5 \end{cases} \quad \Rightarrow \text{ count } \hat{y} \neq y$$

$J_{test}(\vec{w},b)$: the fraction of the test set that has been misclassified

$J_{train}(\vec{w},b)$: the fraction of the train set that has been misclassified.