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PAC learning exercise _ homa Barghamadi 400422042

(۳.۲) ۲.۱: we have two situation for this hypothesis. if we have a positive value that appear in S the answer will be h_+ and if we have negative value the answer will be h_- so according to the rule of ERM this algorithm is an ERM

(۲.۲) according to PAC learnbility we should fix distribution D over $\mathcal{X}$ so if x_+ appear in training data's our algorithm returns a perfect hypothesis. and if $D\{x_+\} < \varepsilon \Rightarrow$ in any case we have error of at most ε and if $P\{x_+\} > \varepsilon \Rightarrow x_+ \notin S$.
so H is PAC learnable & $m_H(\varepsilon, \delta) \leq \left\lceil \frac{\log(1/\delta)}{\varepsilon} \right\rceil$

(10.10) By attention to ERM we should find tightest circle which contain all the positive contains. if h^* be a circle with zero error it has radius by r^* & if we consider $\bar{r}$ as a scaler radius and for $\varepsilon, \delta \in (0,1)$ we can define $D_x(\{x : \bar{r} \leq |x| \leq r^*\}) = \varepsilon$ and for this distribution we know $L_D(h_S) \geq \varepsilon$

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P.Q we can write by definition:

$$\frac{P_{x\sim D_1}[h(x)=f(x)]+\cdots+P_{x\sim D_m}[h(x)=f(x)]}{m} < 1-\varepsilon$$

and we know $L_S(h)=0$

$$\Rightarrow [L_S(h)=0] = \prod_{i=1}^{m} P_{x\sim D_i}[h(x)=f(x)]$$

$$= \left(\left(\prod_{i=1}^{m} P_{x\sim D_i}[h(x)=f(x)]\right)^{\frac{1}{m}}\right)^m$$

$$\left(\frac{\sum_{i=1}^{m} P_{x\sim D_i}[h(x)=f(x)]}{m}\right)^m$$

$$< (1-\varepsilon)^m = e^{-\varepsilon m}$$

P.04 suppose that H is agnosive PAC learnable and let A be a learning algorithm. show H is PAC learnable using A and also we have D & and we have $\inf L_D(h) = 0$

$\forall$ every positive integer $m \geq m_H(\epsilon, \delta) \Rightarrow L_D(h) \leq \inf L_D(h') + \epsilon$

$= 0 + \epsilon$

$= \epsilon$

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(w.r) we know that H_d is the class in R^d, Since $H_4 \subseteq H_5$ the error class of H_5 is smaller however the complexity of H_5 is larger so the estimation error be larger if we have limited amount of training example we would prefer to learn the smaller class.