CS280 Fall 2018 Assignment 1
Part A
ML Background
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1.MLE

Solution：

$$KL\left(p_{emp}(x)\,||\,\mathrm{q(x)}\right)=\int p_{emp}(x)\left(\log p_{emp}(x)-\log q(x)\right)dx$$

The $p_{emp}(x)=\frac{1}{n}\sum_{i=1}^{n}\delta(x,x_i)$ is the empirical distribution.

The $q(x\,|\,\theta)$ is probabilistic model.

And, the $q(x\,|\,\theta)$ and $p_{emp}(x)$ will be similar,when the n is large.

At the same time,the $p_{emp}(x)=\frac{1}{n}\sum_{i=1}^{n}\delta(x,x_i)\approx 1$.

So,the

$$\begin{aligned}KL\left(p_{emp}(x)\,||\,\mathrm{q(x)}\right)&=\int p_{emp}(x)\left(\log p_{emp}(x)-\log q(x)\right)dx\\&=-\int\left[\log q(x)\right]dx\end{aligned}$$

Obviously,the

$$\arg\min_q KL\left(p_{emp}(x)\,||\,\mathrm{q(x)}\right)=\int p_{emp}(x)\left(\log p_{emp}(x)-\log q(x)\right)dx$$

is obtained by $q(x)=q\left(x\,|\,\hat{\theta}\right)$.

2.

Solution: