

Problem Set 1

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Problem 1 To check that the square loss function can be written as $\mathcal{L}(-yf(x))$ lets expand $\|f(x) - y\|^2$:

$$(y - f(x))^2 = (1 - 2yf(x) + f(x)^2)$$

but $y^2 = 1$ thus:

$$\mathcal{L}(-yf(x)) = (1 - 2yf(x) + (yf(x))^2)$$

To find the minimizer $c(x)$ we need to minimize:

$$\mathbb{E}_{x,y}[(y - f(x))^2]$$

and specify the function that achieves this minimum. Lets find it by taking the derivative of the above wrt to $f(x)$ and setting it to zero:

$$\frac{d}{df(x)} \mathbb{E}_x \mathbb{E}_{y|x}[(y - f(x))^2] = \mathbb{E}_x \frac{d}{df(x)} \mathbb{E}_{y|x}[(y - f(x))^2]$$

which can be minimized by finding the minimum of $\frac{d}{df(x)} \mathbb{E}_{y|x}[(y - f(x))^2]$:

$$\frac{d}{df(x)} \mathbb{E}_{y|x}[(y - f(x))^2] = \mathbb{E}_{y|x} \left[\frac{d}{df(x)} (y - f(x))^2 \right] = 0$$

$$\mathbb{E}_{y|x}[2(y - f(x))] = 0$$

$$\mathbb{E}_{y|x}[y] = \mathbb{E}_{y|x}[f(x)]$$

$$\mathbb{E}_{y|x}[y] = f(x) \mathbb{E}_{y|x}[1]$$

$$\mathbb{E}_{y|x}[y] = f(x)$$

$$p_{y|x}(1|x) - p_{y|x}(-1|x) = f(x) \mathbb{E}_{y|x}[1]$$

Since $p_{y|x}(1|x) + p_{y|x}(-1|x) = 1$ then:

$$2p_{y|x}(1|x) - 1 = f(x) \mathbb{E}_{y|x}[1]$$

Problem 2 Please write your analysis on Problem 2 here

Problem 3 Please write your analysis on Problem 3 here

Problem 4 a)

Problem 5 (MATLAB) Please write your analysis on Problem 5 here