Machine Learning Foundations/hw4

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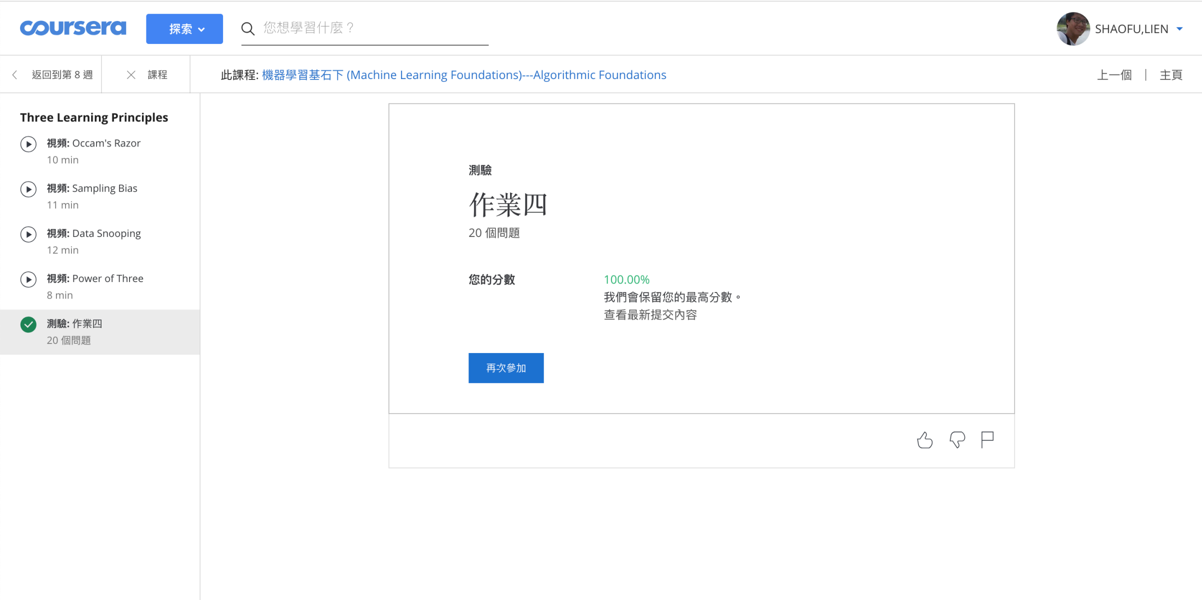
1.



2.

已知加入正規化後的公式為：$E_{aug}(w) = E_{in}(W) + \frac{\lambda}{N} w^T w$

接著對$E_{aug}(w)$微分得到下式：

$$\bigtriangledown E_{aug}(w) = \bigtriangledown E_{in}(W) + \frac{2\lambda w}{N}$$

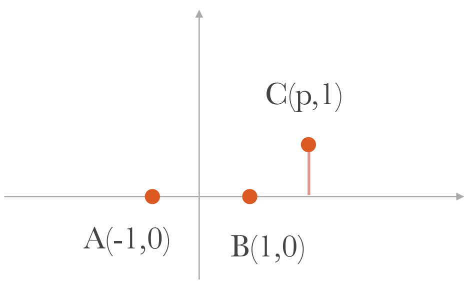
已之更新公式為：$w_{t+1} = w_t - \eta \bigtriangledown E_{aug}(w)$

將$\bigtriangledown E_{aug}(w)$替換掉後得到更新公式如下：

$$w_{t+1} = (1 - \frac{2\eta\lambda}{B})w_t - \eta \bigtriangledown E_{in}(w(t))$$

3.

固定AB時：$e_C = 1$，如粉紅色的線條所示。

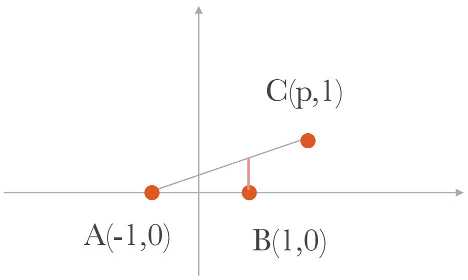


固定AC時：

AC直線方程式為$y = \frac{1}{p+1}(x+1)$

$x = 1$時$y = \frac{2}{p+1}$

$e_B = (\frac{2}{p+1})^2$，如粉紅色的線條所示。



固定BC時：

BC直線方程式為$y = \frac{1}{1-p}(1-x)$

$e_A = (\frac{2}{1-p})^2$

總error=$\frac{1}{3}(e_A + e_B + e_C) = \frac{1}{3}(1 + (\frac{2}{p+1})^2 + (\frac{2}{1-p})^2)$

4.

step1:從{1,2,3,...,N+K}中選取一個整數，記為s

step2:計算 $\nabla E_{in} = 2 * (wx_s - y)x_s$

step3:計算 $\nabla E_{aug} = 2\lambda w$

$$w_{t+1} = w_t - \eta(\nabla E_{in} + \nabla E_{aug})$$

和第三題的更新公式主要差在E_{in}的算法不同。

Bonus:

令x_i為$sin(ax)$上的採樣點$i = 1,2,3,...,N$

$error = (sin(ax_1) - wx_1)^2 + (sin(ax_2) - wx_2)^2 + ... + (sin(ax_N) - wx_N)^2$

對error中的w微分得下式：

$\nabla error = 2(wx_1^2 - x_1 sin(ax_1)) + 2(wx_2^2 - x_2 sin(ax_2)) + ...2(wx_N^2 - x_N sin(ax_N))$

當 $\bigtriangledown error = 0$時，$w = \dfrac{x_1 sin(ax_1) + x_2 sin(ax_2) + \ldots + x_N sin(ax_N)}{x_1^2 + x_2^2 + \ldots + x_N^2}$，對分子積分，$\int_0^{2\pi} xsin(dx) = (sin(2\pi) - 2\pi cos(2\pi) + c) - (sin(0) - 0 * cos(0) + c) = -2\pi$，所以當n夠大時，$w = \dfrac{-2\pi}{x_1^2 + x_2^2 + \ldots + x_N^2} \approx 0$。所以任取一點$x$其deterministic noise=$|sin(ax)|$