

Exercise

01

TUM Department of Informatics

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Linear Classification

Problem 1:

a) It must be Bernoulli because it is a binary classification model. y can only become 0 or 1.

b) For a x to be classified as 1 the probability of $p(y = 1|x)$ must be greater than the probability of $p(y = 0|x)$ which is equal to $\log \frac{p(y=1|x)}{p(y=0|x)} > 0$.

$$\begin{aligned}\log \frac{p(y = 1|x)}{p(y = 0|x)} &= \log \frac{p(x|y = 1) \cdot p(y = 1)}{p(x|y = 0) \cdot p(y = 0)} \\&= \log \frac{p(x|y = 1) \cdot \frac{1}{2}}{p(x|y = 0) \cdot \frac{1}{2}} \\&= \log \frac{p(x|y = 1)}{p(x|y = 0)} \\&= \log \frac{\lambda_1 \exp(-\lambda_1 x)}{\lambda_0 \exp(-\lambda_0 x)} \\&= \log \frac{\lambda_1}{\lambda_0} + \lambda_0 x - \lambda_1 x \\&= (\log(\lambda_1) - \log(\lambda_0)) + (\lambda_0 - \lambda_1)x \\&\Rightarrow (\lambda_0 - \lambda_1)x > \log(\lambda_1) - \log(\lambda_0) \\&\Rightarrow x > \frac{\log(\lambda_1) - \log(\lambda_0)}{\lambda_0 - \lambda_1}\end{aligned}$$

For $\lambda_0 > \lambda_1$, x must be bigger than $\frac{\log(\lambda_0) - \log(\lambda_1)}{\lambda_0 - \lambda_1}$. In the other case where $\lambda_1 > \lambda_0$, x must be bigger or equal to 0 but smaller than $\frac{\log(\lambda_0) - \log(\lambda_1)}{\lambda_0 - \lambda_1}$.

Problem 2:

Problem 3:

Problem 4:

Appendix

We confirm that the submitted solution is original work and was written by us without further assistance.
Appropriate credit has been given where reference has been made to the work of others.

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