Problem 7.4

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May 22, 2024

1 Problem

Calculate the derivative $\frac{\partial l_i}{\partial f[\boldsymbol{x}_i, \boldsymbol{\phi}]}$ for the least squares loss function $l_i = (y_i - f[\boldsymbol{x}_i, \boldsymbol{\phi}])^2$.

2 Answer

$$\text{Let } u = (y_i - f[\boldsymbol{x}_i, \boldsymbol{\phi}])$$
$$l_i = u^2$$
$$\text{Using the Chain Rule } \frac{\partial l_i}{\partial f[\boldsymbol{x}_i, \boldsymbol{\phi}]} = \frac{\partial l_i}{\partial u} \cdot \frac{\partial u}{\partial f[\boldsymbol{x}_i, \boldsymbol{\phi}]}$$
$$\text{We have } \frac{\partial u}{\partial f[\boldsymbol{x}_i, \boldsymbol{\phi}]} = -1$$
$$\frac{\partial l_i}{\partial f[\boldsymbol{x}_i, \boldsymbol{\phi}]} = 2 \cdot u \cdot -1$$
$$\frac{\partial l_i}{\partial f[\boldsymbol{x}_i, \boldsymbol{\phi}]} = -2 (y_i - f[\boldsymbol{x}_i, \boldsymbol{\phi}])$$