HW 7 XG BOOST

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SCENARIO A

$$\lambda^* = \underset{\lambda}{\operatorname{argmin}} \sum_{i=1}^{n} L(y_i, \lambda) \qquad \sigma(z) = \frac{1}{1+e^{-z}}$$

$$L(y, \lambda) = -y \log(\sigma(\lambda)) - (1-y) \log(1-\sigma(\lambda))$$

$$L(y, \lambda) = -y \log\left(\frac{1}{1+e^{-\lambda}}\right) - (1-y) \operatorname{Log}\left(\frac{e^{-\lambda}}{1+e^{-\lambda}}\right)$$

$$= -y\left(\log 1 - \log(1+e^{-\lambda})\right) - (1-y)\left(\log e^{-\lambda} - \log(1+e^{-\lambda})\right)$$

$$= -y\left(0 - \log(1+e^{-\lambda})\right) - (1-y)\left(-\lambda - \log(1+e^{-\lambda})\right)$$

$$= y \log(1+e^{-\lambda}) + (y-1)\left(-\lambda - \operatorname{Log}(1+e^{-\lambda})\right)$$

$$\frac{\partial L}{\partial \lambda} = \frac{y}{1+e^{-\lambda}} \cdot (-e^{-\lambda}) + (y-1)\left(-1 - \frac{1}{1+e^{-\lambda}} \cdot (-e^{-\lambda})\right)$$

$$= y \cancel{- \frac{e^{-\lambda}}{1+e^{-\lambda}}} + (\cancel{y} - 1)\left(\cancel{\frac{e^{-\lambda}}{1+e^{-\lambda}}} - 1\right) =$$

$$= -y - \frac{e^{-\lambda}}{1+e^{-\lambda}} + 1 = 0 \Rightarrow \cancel{1} - y = \cancel{1} - \frac{1}{1+e^{-\lambda}}$$

$$e^{-\lambda}+1 = \frac{1}{y} \quad / \log \qquad -\lambda = \log\left(\frac{1}{y}-1\right)$$

$$\lambda^* = -\log\left(\frac{1-y}{y}\right) = \log\left(\frac{y}{1-y}\right)$$

$$f(\lambda) = \sum_{i=1}^{n} L(y_i, \lambda) = \sum_{i=1}^{n}\left[-y_i \log(\sigma(\lambda)) - (1-y_i)\log(1-\sigma(\lambda))\right]$$

$$= -\log(\sigma(\lambda))\cdot\sum y_i - \log(1-\sigma(\lambda))\cdot\sum(1-y_i)$$

$$= -\log(\sigma(\lambda))\, m - \log(1-\sigma(\lambda))\, k$$

... tak samo

$$\lambda^* = \log\left(\frac{\frac{m}{n}}{1-\frac{m}{n}}\right) = \log\left(\frac{m}{k}\right)$$

SCENARIO 1B

$$\sigma'(x) = \sigma(x)(1-\sigma(x))$$

$$f(\lambda) = \sum_{i=1}^{n} L(y_i, f_i+\lambda) =$$

$$= \sum_{i=1}^{n}\left[-y_i \log(\sigma(f_i+\lambda)) - (1-y_i)\log(1-\sigma(f_i+\lambda))\right]$$

TO SIĘ ZMIENIA NIE WYLICZĘ TEGO