IRTM Assignment 4

Ex 2.1 $p_\lambda(y|x) = \frac{1}{Z(x)} \exp \sum_i \lambda_i f_i(y, x)$

$p(SPAM | x_1)$ x_1 = \$1 million from Nigerian defense minister

$\sum_i \lambda_i f_i(y, x_1)^{SPAM} = \lambda_1 f_1 + \lambda_2 f_2 + \lambda_3 f_3 + \lambda_4 f_4 + \lambda_5 f_5 + \lambda_6 f_6 + \lambda_7 f_7 + \lambda_8 f_8$

$= \underline{0,2 \cdot 1} + (0,1) \cdot 0 + \underline{0,5 \cdot 1} + (-0,2) \cdot 0 + (-0,1)\, 0 + 0,4 \cdot 0 + \underline{0,1 \cdot 1} + 0,0 \cdot 0$

$= 0,2 + 0,5 + 0,1$

$\boxed{\sum_i \lambda_i f_i(SPAM | x) = 0,8}$

~~$\sum_i \lambda_i f_i(HAM | x_1)$~~ $\sum_i \lambda_i f_i(HAM | x) = -0,1 + -0,2$

$\boxed{\sum_i \lambda_i f_i(HAM | x_1) = -0,3}$

$\boxed{\exp \sum_i \lambda_i f_i(SPAM | x_1) \approx 2,23}$

$\boxed{\exp \sum_i \lambda_i f_i(HAM | x_1) \approx 0,74}$

$p(SPAM | x_1) \approx \frac{2,23}{2,23 + 0,74} = \frac{2,23}{2,97} \approx 0,75$

$p(HAM | x_1) \approx \frac{0,74}{2,23 + 0,74} = \frac{0,74}{2,97} \approx 0,25$

Ex 2.2 $\lambda_6 = 0,4$ $f_6(y, x) = 1$ if "you" in x and $y \neq HAM$

$\sum_{(y,x) \in (Y,X)} f_i(y, x) = \frac{\partial A}{\partial \lambda_i} \underset{i=6}{=} 0 + 0 + 0 + 0 + 1 + 1 = 2$

$\sum_{(y,x) \in (Y,X)} \sum_{y'} p_\lambda(y'|x) f_i(y'|x) = \frac{\partial B}{\partial \lambda_i} \underset{i=6}{=} p_\lambda(HAM | x_3) + p_\lambda(HAM | x_5) + p_\lambda(HAM | x_6)$

~~$p_\lambda(HAM | x_3) = \frac{\exp(0,3)}{\exp(0,3) + \exp(0,2)} \approx \frac{1,35}{2,57} \approx 0,53$~~

$p_\lambda(HAM | x_3) = \frac{\exp(0,3)}{\exp(0,3) + \exp(0,2)} \approx \frac{1,35}{2,57} \approx 0,53$

$p_\lambda(HAM | x_5) = \frac{\exp(0,2)}{\exp(0,2) + \exp(0,5)} \approx \frac{1,22}{2,87} \approx 0,43$

$p_\lambda(HAM | x_6) = \frac{\exp(0,3)}{\exp(0,3) + \exp(0,2)} \approx \frac{1,35}{2,57} \approx 0,53$

$\frac{\partial A}{\partial \lambda_6} - \frac{\partial B}{\partial \lambda_6} = 2 - (0,53 + 0,43 + 0,53) = 0,51$