Exercises for
Pattern Recognition
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General Information:

Exercises (1 SWS):	Tue 12:15 – 13:45 (0.154-115) and Fri 08:15 – 09:45 (0.151-115)
Certificate:	Oral exam at the end of the semester
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Maximum Likelihood Estimation

Exercise 1 Let $x_1 \dots x_k$ be a set of observations according to the exponential density

$$p(x; \lambda) = \lambda \exp(-\lambda x) \text{ for } x > 0.$$

The observed samples are considered i.i.d. (independent and identically distributed).

(a) Derive the log-likelihood function $L(\lambda)$ for the parameter λ based on a given set of observations.

(b) Determine the Maximum Likelihood estimate for λ.

Exercise 2 Create a logistic regression classifier for the toolbox. Assume a decision boundary that is affine in the original variables $F(\boldsymbol{x}) = \boldsymbol{\theta}^T \boldsymbol{x}$, where $\boldsymbol{x} = (x_1, x_2, \dots, 1)^T$. Create a new `m`-file, and modify `Classification.txt` and `contents.m`.

(a) What are the training formulas for the logistic regression?

(b) Implement the training step using the Newton-Raphson algorithm. Use the modeled posterior probabilities to compute the classification result.

(c) The shape of the decision boundary is linear. What does this imply for the class-conditional densities? How can you achieve nonlinear decision boundaries?