Assignment_1

March 6, 2019

1 Assignment 1

1.1 Task 1

Suppose we have a two-class classification problem, where we denote the two classes with $+1$ and -1. Further assume that the joint distribution of $\mathbf{x}$ and y, $p(\mathbf{x}, y)$, is known and that the distributions of the two classes do not overlap, i.e.

$$\min\{p(\mathbf{x}|y = +1), p(\mathbf{x}|y = -1)\} = 0.$$

Determine an optimal classification function g and compute the generalization error using the zero-one loss function.

1.1.1 Solution

- your explanation goes here (enable editing by double click)

1.2 Task 2

Assume that the two classes in data set `DataSet6` are distributed according to multivariate normal distributions. Estimate the means and covariance matrices as well as $p(y = +1)$ and $p(y = -1)$ from the data (you may use all 200 samples), compute an optimal classification function (see slide 9) and visualize it graphically(a two-dimensional plot suffices).

1.2.1 Solution

```
In [2]: import sklearn
        import numpy as np
        import matplotlib.pyplot as plt

        # your code goes here
```

1.3 Task 3

1.3.1 Part 1

Given the model class M of all exponential distributions with parameter λ. i.e. $M = \{f_\lambda(x) \mid \lambda > 0\}$ with

$$f_\lambda(x) = \begin{cases} \lambda e^{-\lambda x} & x \geq 0 \\ 0 & x < 0 \end{cases}$$

Derive a formula for the maximum likelihood estimator λ^* for the parameter λ.

Hint: Maximize the logarithm of the likelihood function instead of the likelihood function itself.

1.3.2 Solution

- your explanation goes here

1.3.3 Part 2

Apply the formula for λ^* from the previous part to the data of `DataSet7`. Visualize the density defined by this optimal λ^* and compare it to the true data distribution (e.g. by using a histogram).

1.3.4 Solution

```
In [3]: # your code goes here
```