

# 1st Meeting

## 1 Objective

The laboratory course covers the implementation of basic methods of speech and image recognition. The main objective is to get familiar with techniques and algorithms applied in the field of statistical pattern recognition. To successfully complete the laboratory course, it is recommended to attend at least one of the lectures “Pattern Recognition and Neural Networks”, “Speech Recognition”, “Digital Processing of Speech and Image Signals”, and “Statistical Methods in Natural Language Processing”. It is recommended that you refresh your knowledge by reviewing the appropriate sections of the lecture notes, available on the homepage of Lehrstuhl für Informatik 6, <http://www-i6.informatik.rwth-aachen.de>. The course homepage is also available there.

## 2 Introduction

The laboratory course will be carried out as a block event at the end of the winter term at Lehrstuhl für Informatik 6. During the laboratory course you will have to solve 11 different tasks. The tasks have to be solved in groups comprising two persons. Groups of three are only allowed to ensure that no one must work alone.

The amount of time necessary for solving the tasks depends on the size of the groups and the experience in programming of the participants. Typically you should assume at least 5-8 hours for each task.

Login accounts for solving the tasks will be provided. You are expected to use your account at the CIP-Pool to work via remote-login using `ssh`. The required internet addresses will be announced during the beginning of the course.

## 3 Schedule

The lab course begins on **Tuesday, February 10**, and ends on **Friday, February 27, 2009**. Each day will start with a meeting at **10:00** in the seminar room of Lehrstuhl für Informatik 6 (room 6124), where the solution to the last exercise will be discussed and the exercise of the day will be handed out. Presence on the introductory meetings is mandatory. The exercises have to be solved before the next morning’s meeting.

- Calendar Week (KW) 7
  - Tues-Wed: Image processing (Philippe Dreuw ”dreuw@i6...”)
  - Thur-Fri: Signal analysis (Jonas Löff ”loof@i6...”)
- Calendar Week (KW) 8
  - Mon-Wed: Acoustic model training (Christian Plahl ”plahl@i6...”)
- Calendar Week (KW) 9
  - Tues-Wed: Connected digit recognition (Christian Plahl ”plahl@i6...”)
  - Thur-Fri: Language modelling (Sasa Hasan ”hasan@i6...”)

## 4 Conditions for receiving a certificate

To obtain a certificate you must meet the following conditions:

- all tasks must be solved
- all introductions (morning sessions) must be attended

## 5 Topics

### 5.1 Image Object Recognition (2 tasks)

Philippe Dreuw

- basics
  - k-NN classifier
  - Gaussian single and mixture densities
- tangent distance
  - implementation of the Gram-Schmidt orthogonalization
  - integrating tangent distance into the k-NN classifier
  - analysis of tangent distance

### 5.2 Digital Processing of Speech Signals (2 tasks)

Jonas Lööf

- samples, spectrogram, and cepstral coefficients
  - visualizing wave files
  - fast Fourier transform (FFT)
  - discrete cosine transformation
- filter bank and dynamic features
  - cepstral coefficients from Mel scaled filter bank
  - dynamic features: discrete derivations

### 5.3 Training and Recognition (5 tasks)

Christian Plahl

- training
  - Expectation-Maximization (EM) algorithm
  - linear segmentation
  - non-linear alignment (dynamic time warping)
- recognition
  - connected digit recognizer
  - parameter optimization

### 5.4 Language Modeling (2 tasks)

Sasa Hasan

- language model tools
  - corpus analysis
  - estimating trigrams
- bigram
  - implementation of a bigram language model
  - smoothing and perplexity