

Summary

TTT4185 Machine Learning for Signal Processing

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A course on Machine Learning

Teaching and learning activities:

- 24 lectures
- 3 computer exercises

Assessment

- computer exercise submission
- computer exercise oral discussion
- written exam (2020-12-17, 9:00-13:00)
- Grade: A-F
- permitted examination aids: D (basic calculator)

You can find previous exams in Blackboard. Expect small changes (the course has evolved in the past years)

Finding balance between

- theory vs practice
- general methods vs bleeding edge state-of-the-art
- probabilistic vs connectionist
- bayesian vs frequentist

Course content

Domain Knowledge

- speech production (source/filter model)
- speech perception (frequency and amplitude scales)
- speech analysis (linear prediction, cepstrum, MFCCs)
- for other fields you will need specific domain knowledge

Prerequisites

- probability theory
- decision theory
- information theory

Methods (next slide)

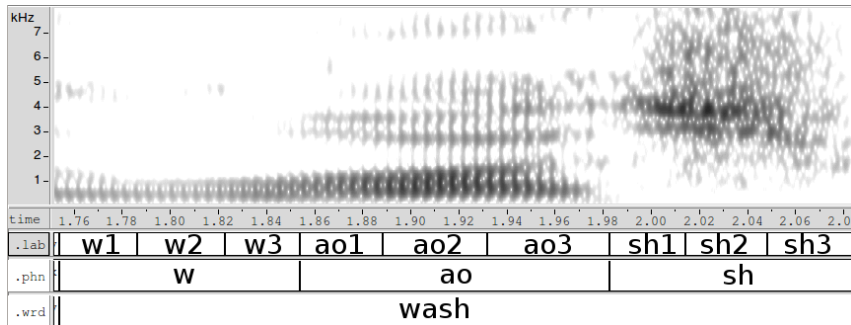
Methods

- probabilistic linear regression
- probabilistic classification (Bayes classifier)
- ML vs MAP estimates (regularization)
- least squares, fisher's discriminant, perceptron
- logistic regression
- kernel methods and support vector machines
- deep neural networks (DNNs, CNNs, RNNs, LSTMs, GANs)
- graphical models (Bayesian networks)
- k-means and mixture models (unsupervised learning)
- hidden Markov models (sequence learning)
- dimensionality reduction (PCA, FA, ICA, AEs, Isomap, t-SNE)

- Supervised vs unsupervised learning
- Supervised classification vs regression
- Unsupervised clustering vs distribution estimation
- Dimensionality reduction (compression or visualization)

Kind of observations

- independent and identically drawn (i.i.d.)
- sequences (order matters)



Theoretical aspects

- model complexity and overfitting
- bias vs variance trade-off
- curse of dimensionality
- generative vs discriminative methods

What we left out

- ensemble methods (boosting, decision trees, decision forests)
- probabilistic neural networks
- fully Bayesian methods
- approximated inference (sampling and variational methods)
- reinforcement learning
- active learning
- ...

Oral Presentations

- you will receive an announcement today on Blackboard
- book a time for oral presentations
- dates will be around the end of week 47 (next week)
- questions will be mostly based on understanding rather than implementation

- three exercises giving a number of points each
- motivating your answer is as important as giving the correct answer
- correct answers with no motivation give zero points
- the final grade is based on the total number of points

Previous exams in Blackboard have detailed solutions.

Pablo Ortiz (Telenor Research, Oslo)

“Spoken language understanding: from RNNs to Transformers”

This lecture will start by introducing real-world problems in the field of machine learning for language understanding, in particular machine translation and speech recognition. In the first part we will see how neural networks such as CNNs and RNNs can be applied to these problems. Towards the second part we will focus on attention mechanisms, and discuss in detail the Transformer. In particular we will cover some of the most recent transformer-based architectures that are producing groundbreaking results in the fields of natural language and computer vision, such as BERT and GPT-3. Throughout the lecture the focus will be on the concepts and we will refer to the literature for the mathematical or technical details.