Machine Learning Applied to Bioinformatics and Speech Technology

UEF SUMMER SCHOOL 2017

Course content and organizers

General machine learning track (both campuses)

    Organizer: Dr. Ville Hautamäki

Bioinformatics track (Kuopio campus)

    Organizers: Prof. Merja Heinäniemi and Prof. Jussi Tohka

Speech track (Joensuu campus)

    Organizers: Prof. Tomi Kinnunen and Dr. Ville Hautamäki

Instructors

Merja Heinäniemi
Coordinator

Tomi Kinnunen
Coordinator

Ville Hautamaki
Coordinator

Jussi Tohka
Coordinator

Kong Aik Lee

Pekka Ruusuvuori

Thanneer Perumal

Hansjörg Mixdorff

Akihiro Kato

Petri Pölönen

Robert Ciszek

Teaching assistants (TAs)

Anssi Kanervisto
anssk {at} cs.uef.fi

Trung Ngo Trong
trungt {at} cs.uef.fi

Alp Celik
alpac {at} cs.uef.fi

Juha Mehtonen
juha.mehtonen {at} uef.fi

Course schedule (general machine learning)

	Monday	Tuesday
9:00-10:00	-	Deep neural networks 1, Ville Hautamäki
10:00-11:00	Introduction (Speech data and Bio data)	Deep neural networks 2, Ville Hautamäki
11:00-12:00	Lunch	Lunch
12:00-13:00	Statistics, Lauri Mehtätalo	Sequence modeling 1, Ville Hautamäki
13:00-14:00	Machine learning basics, Jussi Tohka	Evaluation in machine learning, Tomi Kinnunen
14:00-16:00	PhD students' presentations * 1. Linear Prediction, Frequency Domain Linear Prediction, and Time-Varying Linear Prediction for Speaker Verification in Reverberant Conditions, Ville Vestman 2. Predicting Personal Nutrition Recommendations, Jari Turkia 3. Teaching computer to play Doom from visual input, Anssi Kanervisto 4. Effects of human-induced voice modification on speaker recognition, Rosa Gonzalez Hautamäki	CSC, Markus Koskela

Each lecture starts at the hour and lasts 45 mins. So we will 15 min break between sessions.

PhD student presentations are each 10 min + 5 min QA.

Speech track

	Monday	Tuesday	Wednesday	Thursday	Friday (practicals)
9:00-10:00	-	-	Introduction to speech data, Ville Hautamäki	Spoofing and ASV, Tomi Kinnunen	Speech practicals 1
10:00-11:00	-	-	Speech synthesis, Akihiro Kato	Spoofing, Tomi Kinnunen	Speech practicals 1
11:00-12:00	-	-	Lunch	Lunch	Speech practicals 1
12:00-13:00	-	-	Factor analysis for speaker recognition, Kong Aik Lee	SIDEKIT - toolkit for speaker recognition, Kong Aik Lee	Lunch
13:00-14:00	-	-	Factor analysis for speaker recognition, Kong Aik Lee	SIDEKIT - toolkit for speaker recognition, Kong Aik Lee	Speech practicals 2
14:00-15:00	-	-	Prosody Prediction, Hansjörg Mixdorff	Speech enhancement, Akihiro Kato	Speech practicals 2
15:00-16:00	-	-	ML tools for speech data, Trung Ngo Trong	Speech enhancement, Akihiro Kato	Speech practicals 2

Bioinformatics track

	Monday	Tuesday	Wednesday	Thursday	Friday (practicals)
9:00-10:00	-	-	Introduction to biomedical data - Merja Heinäniemi	Features from imaging data, Jussi Tohka	Imaging data
10:00-11:00	-	-	Cell type deconvolution problem, Petri Pölönen	Example application, Jussi Tohka	Imaging data
11:00-12:00	-	-	Lunch	Multiscale application, Pekka Ruusuvuori	Imaging data
12:00-13:00	-	-	Unsupervised dimensionality reduction, Juha Mehtonen	Lunch	Lunch
13:00-14:00	-	-	Multiview dimensionality reduction, Robert Ciszek + Break	ML tools for MRI data, Jussi Tohka	Molecular data
14:00-15:00	-	-	Deep neural network applications, overview, Merja Heinäniemi	Break	Molecular data
15:00-16:00	-	-	Deep neural network configurations for DNA motif analysis, Juha Mehtonen	ML tools for multiscale models, Pekka Ruusuvuori	Molecular data

Grading and how to pass this course

- Grading is PASS / FAIL
- For PASS grade you will need to do following:
  - Follow lectures and complete Learning Diary based on the lectures. Template for the Learning Diary will be given later.
  - Participate in the Friday Practicals.
  - Complete one of the three 2nd week challenges (submission must have at least written report and code)
- Completing only one week earns you 2 ECTS and completing both weeks earns you 5 ECTS.
- By Wednesday morning you will need to decide whether to take Speech or Bioinformatics track. No jumping between classrooms :-)
- Friday Practicals are only held locally (Speech practicals are in Joensuu and Bioinformatics practicals are in Kuopio).

Challenge 1: Detecting Parkinson's Disease (PD)

- Task is to use speech data '/aaaa/' sound to predict whether speaker has PD or not.
- Speakers used iphone app to self collect the data. Large number of speakers and samples are available (> 50k samples).
- We will pre-select samples for training, validation and test sets. We will give the baseline performance on the test set and hope is that students will come up with novel ideas which exceed the baseline performance.
- Finally, the interesting thing is to see what features in the speech are predictive of the PD. This can lead to new biology and possibly practical diagnostic tools.