Cogsys Courses WS 2017/2018

1 Phonological Cognition

Instructor	Gafos
Where	II.14.222
When	Wednesdays 8 - 12
Module	CSAM11/CSAM12

Meaning in spoken languages is communicated via sound. All sound (in spoken languages) is generated by the movements of a small set of speech articulators and their acoustic consequences. How can this physical system, the human vocal tract, communicate such richness of distinctions in meaning? To what extent is the structure of sound patterns in language influenced by constraints of this physical system? This course addresses these questions by seeking to identify ways to better understand the relation between the sound patterns of different languages and their manifestation as physical activity in the vocal tracts of actual speakers. The course begins by providing the necessary concepts and tools for exploring language sound structure. Using software for visualizing dynamic articulatory movements, we study how humans produce consonants and vowels of different languages in isolation and in sequences. We then study how language-specific patterns of consonants and vowels can be described as formal systems of rules and how such patterns can be modeled using tools from mathematics. In the final part, through a sequence of readings and group projects, students tackle issues in the relation between sound patterns and their realization in terms of activity in the vocal tract. This course emphasizes hands-on laboratory exercises and projects through which students grasp and sharpen conceptually complex notions met across different areas in cognitive science. Examples include the relation between continuous and discrete dimensions of cognition, basic notions from the mathematics of non-linearity (attractor, bifurcation, dynamic stability), and the competence/performance distinction. The leading notions are developed in lectures and then applied and sharpened in the laboratory by students working individually or in teams. The course's programming environment is Matlab. However, this is not a how-to-program course; rather, the course uses Matlab to convey concepts and tools for processing and analysis of speech data which are relevant to the problems take up in the course.

Further sources:
Description
Tutorial
Electromagnetic Articulometry
Example

2 Intelligent Data Analysis 2

Instructor	Scheffer
Where	Griebnitzsee III.04.002
When	Mondays (Dates: 16.10. 10-12; 17.10. 12-14; 19.10.2017 10-12)
Module	CSAM21/CSAM22
Prerequisites	Intelligent Data Analysis I

The module embraces a selection of more advanced Machine Learning topics, such as graphical models, deep neural networks, neural networks for images and time series, recommendation and cluster algorithms, as well as reinforcement learning.

3 Foundations of Mathematics

Instructor	Maetzig
Where	II.14.035
When	Wednesdays 10-12 (starts on the 25th of October)
Module	CSFM1

The course serves as a bridge module for students who lack some of the foundations in mathematical techniques required for the programme. The course covers basic linear algebra, calculus and probability theory. Students are expected to acquire most of these foundations through self-study of the provided readings and video lectures. The class meetings provide summaries of the topics and serve as points of discussion for questions and homework assignments. Additionally, a tutorial is offered where students can discuss their solutions to homework assignments individually.

4 Advanced Natural Language Processing

Instructor	Scheffler
Where	(Tuesdays) II.12.001, (Fridays) II.14.009
When	Tuesdays & Fridays 10-12
Module	CSBM1

This class is the graduate-level introduction to computational linguistics, a

first-year class in the MSc Cognitive Systems. The purpose of this class is to introduce the important concepts, models and methods used in natural language processing (NLP). The lecture is complemented by practical exercises where students implement the main NLP algorithms in Python. After the successful completion of this course, students should be able to (i) read and understand the scientific literature in the area of computational linguistics and (ii) start implementing their own NLP projects.

We will cover the following topics:

- statistical models of language
- part of speech tagging (HMMs)
- syntactic parsing (mainly PCFGs)
- semantics
- machine translation
- speech processing

5 Bayesian Data Analysis

Instructor	von der Malsburg
Where	II.06.101
When	Wednesdays 10-12
Module	CSE_OM5

Here are some of the things that you will have the chance to learn in this course:

- What is Bayesian statistics and how does it differ from frequentist statistics?
- What is Markov Chain Monte Carlo?
- What are priors and posteriors?
- How to fit Bayesian generalized linear models in R (brms package)?
- How to prepare data for the analysis (dplyr package et al.)?
- How to plot and interpret the results of a Bayesian data analysis (ggplot2 package et al.)?

Given time and interest, we will also look into Stan, a programming language full Bayesian inference.
Prior experience with R is going to be very helpful. If you don't know R yet, you will have to learn it. Here is some literature for those who are new to R:

- Free online course "introduction to R": https://www.datacamp.com/courses/free-introduction-to-r
- Free online book "R for data science": http://r4ds.had.co.nz/

6 Learning Generative Models

Instructor	Krug
Where	II.10.026
When	Wednesdays 12-14
Module	CSAM21/CSAM22/AM1
Prerequisites	experience with basic Deep Learning, for instance from the "Representation Learning" or "Introduction to Deep Learning"

Background Deep Learning techniques gained popularity and yielded astonishing results in a wide range of applications, like computer vision or speech recognition. In most of these applications, deep neural nets are trained in a supervised way, that means the network is trained to predict a particular label for high-dimensional data. In order to perform well, they need large amounts of data. In many real-world applications there neither are lots of data, nor is this data annotated with the desired labels. For instance, training a deep neural network to reliably detect malfunction in a nuclear power plant would require a lot of measurements during melt-down, which obviously is infeasible. Generative models can be used to tackle such problems. They learn to represent the probability distribution over multiple variables from training data. While deep neural networks may discard any information unrelated to the desired prediction, generative models learn to represent the data in its entirety. As such, they can be applied to tasks like imputing missing values, repairing damaged data, detecting anomalies or generating new data from the learnt distribution.

Course Content The course will first focus on understanding and applying shallow and deep energy-based models as a particular type of generative models. Furthermore, the course will cover more recent generative models, like Variational Autoencoder (VAE) and Generative Adversarial Networks (GAN). Starting in December 2017, you will explore applications of generative models in a team-based project, using real-world data, for instance from the domain of Natural Language Processing. For implementation, we will use Python and TensorFlow. This course requires active participation as it follows a "flipped classroom" design. You will prepare for contents before the class using selected text book chapters or recent publications. You will share your learning and project progress with the other participants by writing short blog posts on a weekly basis. The in-class time will be used for discussions and for strengthening the understanding.

Requirements This course addresses students within the Cognitive Systems Master and is limited to 20 participants.

7 Foundations of Linguistics

Instructor	Das
Where	II.06.101
When	Tuesdays 14-16
Module	CSFM3/ CSFM2

This course provides an introduction to the study of linguistic analysis, emphasizing on the formal models used in the discipline. It focuses on the central topics of linguistics, such as morphology (the study of word structure), syntax (the study of sentence structure) and semantics (the study of meaning), and also touches upon other sub-areas in the discipline such as psycholinguistics (the study of the relationship between language and mind) and discourse analysis (the study of the use of language in context).

8 Grundlagen der Informatik

Instructor	Bordihn
Where	III.04.1.02
When	Thursdays 16-18, 1st meeting 19.10.2017
Module	CSFM2

This is a reading course. Video lectures provided in the internet can be used in addition. Details are given in the slides of the Introduction.
The course covers two fundamental topics:

1. Fundamentals of Computing
Algorithms and their complexity; Growth of functions Algorithmic Paradigms (Recursion, Divide and Conquer, Dynamic Programming) Fast algorithms (searching, sorting, ...)

2. Theory of Computation
Finite state automata Determinism versus non-determinism Regular expressions Context-free grammars and pushdown automata Turing machines and undecidability NP-completeness

For more, see http://www.cs.uni-potsdam.de/bordihn/teaching/ws16/focs/announce.php

9 Advanced Problem Solving Techniques

Instructor	Schaub/Davila
Where	III.06.H01
When	20.10. 12 to 16; 24.10. 14 to 16
Module	CSBM3

10 Introduction to Deep Learning

Instructor	Stober
Where	II.14.009
When	Thursdays 12-14 & Fridays 12-16
Module	CSAM11/CSAM12/CSAM21/CSAM22

This is an intense course following a "flipped classroom" design that builds on everybody's active participation. The curriculum roughly follows Part II of the Deep Learning Book but also covers recently published advances in the field. You will be responsible to prepare for each class by reading selected literature or watching online video lectures and talks. Each student will further reflect on their learning progress in a brief weekly blog post. This can, for instance, include open questions, self-discovered answers or pointers to additional helpful material. Most of the in-class time will be used to discuss the open questions about the concepts under study. There will also be increasingly complex programming tasks where you can apply and practice what you just learned and develop new ideas. All implementations will be in Python using Tensorflow as base framework. (see full description at https://mlcogup.github.io/idl2017/)

11 Argumentation Mining

Instructor	Stede
Where	II.14.009
When	Tuesdays 16-18
Module	CSPM1

The automatic search for arguments (structures of claims, premises, objections) has become a "hot topic" in natural language processing in recent years. One perspective sees it as an extension of opinion mining, such that you do not just search for an opinion but also for its justification (if the author has provided one). But in addition to commercial applications, there are interesting research topics also in the social sciences. In this class, we will survey the state of the art and then run experiments with automatic argumentation mining techniques on several existing datasets (newspaper, social media, crowdsourced texts).
Reading: J. Schneider, M. Stede: Argumentation Mining. Morgan/Claypool, Synthesis Lectures in Human Language Technology (to appear)

12 Extensive Declarative Problem Solving

Instructor	Schaub/Gebser
Where	III.06.H01
When	Friday 18-20, beginning 26.10
Module	CSPM3

13 Extensive Logistics

Instructor	Schaub/Gebser
Where	III.06.H01
When	Friday 18-20, beginning 26.10
Module	CSPM3

14 Extensive Solver Construction

Instructor	Schaub/Gebser
Where	III.06.H01
When	Friday 18-20, beginning 26.10
Module	CSPM3