

## Themen und Termine für Perlen 3 WS11/12

### Alexey Minin

#### Complex Valued Neural Network - Significant Step towards Understanding of the Brain

Modern life is becoming more and more challenging. Factories and plants require more and more sophisticated algorithms for operating the production processes, transportation systems require the most intelligent logistics, financial markets require the processing of the thousands of information streams and the mankind wants to create the artificial intelligence to increase its performance.

Artificial Intelligence Community is trying to create a sophisticated but at the same time simple models of the brain. One of the outcomes of this science development was the creation of the perceptron - feed forward neural network which became a breakthrough in the neuroscience. After some time it became evident, that traditional neural networks do not cover growing needs of applications. Thus recurrent neural networks appeared. Recurrent models are very popular and sophisticated enough to cover many applications in industrial applications. Nevertheless the main goal, which is to explain the brain has not been reached. Real Valued Neural Networks were studied very good, they are not "black boxes" anymore. One can induce constraints, lead the network training to a predefined results. One of the natural extensions of real valued neural networks is the so called complex valued neural network. Complex Valued Neural Networks start a new era in understanding the signal processing and inspire more and more scientists to go into this area or research. These networks can deal with complex numbers instead of the real ones. Dealing with complex data which is the natural data representation for waves e.g. in Quantum Mechanics, breaks down nearly all machine learning paradigms and makes training far much more difficult and unpredictable. On the other hand complex numbers allow the user to operate the Nature language which is dealing with continuous waves instead of the discrete signals.

The content of the lectures is like follows. First we will make the introduction into the well studied real valued neural network discuss the history of neural networks and learn the computational and training paradigms. Then we will discuss the extension of the real valued neural networks to a recurrent case. After that we will discuss the philosophical needs in the change of the computational paradigms. As a result of the philosophical findings we will make a transition from the real valued networks to complex neural networks, we will discuss the differences and similarities, advantages and disadvantages of complex valued networks. A significant part of lectures will be devoted to recurrent neural networks. This is a new chapter for a complex valued neural networks theory. We will show, that training of recurrent complex valued neural networks can be the same as for real valued recurrent networks and there is no need to change the training paradigms. Several applications of complex valued neural networks to prediction problems, continuous time modeling, brain synchronization effects simulation will be presented. One of the most significant steps is a continuous time modeling with a historical consistent complex valued recurrent neural network which can learn with temporally inconsistent data and still produce valuable results. This model will be the first time presented at these lectures. No one in the world has not seen it before. Lectures will end up with an informatics things related to implementation discussions and realizations. We will try to predict markets at the lectures, discuss the pattern recognition applications and we will see how neural network can describe the whole world with the simple model. As a result of these lectures attendees will be able to do any network despite it is real valued or complex valued by themselves, will be able to train it and use it for their purpose. Do not miss your chance to become experts in neural networks!

## **Patrick Cheng**

Thema: Synthesis

0. Introduction to synthesis: definition, challenges, opportunities
1. Game-based Synthesis for reactive system design
2. Sketching and Schema-based Synthesis
3. Modern SAT and SMT solvers and their use
4. Synthesis in TUM (work by I-6) and other interesting work
5. Concluding remarks

## **Dr. Harald Ruess**

1. Byzantinische Generäle: Theorie der Lüge und des Verrats
2. (W)S1S: Die unbekannte Schöne
3. call/cc: Fortsetzung folgt

## **Prof. R. Bauernschmitt**

Aktuelle Anforderungen der HighTech Medizin am Herzen an die Informatik  
- Etablierung interventioneller Techniken statt offener Operationen

## **Dr. van der Smagt**

Machine Learning in the context of text processing.

The students are introduced to two basic models used in machine learning. The first, the perceptron, is a historical classifier which spawned the field of neural networks in the 60s. The other one is a rather recent method, latent semantic indexing, which is a matrix factorization method for finding topics in text documents. The students will be given an overview of the techniques, their theoretical properties and capacities. In a practical part, the students are required to implement both techniques and apply them to documents crawled from the web.

Idee

### Termine im Seminarraum 03.07.023

Jeweils 17:15 – 18:45 Uhr	Dozent	Vorlesung
18.10.2011	Knoll	
25.10.2011	Minin	
01.11.2011	entfällt	
08.11.2011	Minin	
15.11.2011	Minin	
22.11.2011	Cheng	
29.11.2011	Cheng	
06.12.2011	Cheng	
13.12.2011	Ruess	
20.12.2011	Ruess	In Raum 02.07.023
10.01.2012	Bauernschmitt	
17.01.2012	van der Smagt	
24.01.2012	van der Smagt	
31.01.2012	van der Smagt	
07.02.2012		