T-61.5030

Advanced Course in Neural Computing (5 cp)

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General information on the course

Some basic matters:

- Code T-61.5030, 5 credit points.
- Replaces our former course T-61.263 (3 credit weeks) with the same name.
- No computer project.
- It is included in our basic course T-61.3030 Principles of Neural Computing, 5 cp (formerly T-61.261, 3 cr).
- That basic course is recommendable, but not a necessary prerequisite.
- This advanced course can be included into graduate studies.

Registration:

- You should tap in your personal information for being a valid participant.
- Use the TOPI system: `http://wwwtopi.hut.fi`
- Write your information also to the announcement list circulating on the lectures.

Lectures:

- Mondays 14-16 in the lecture hall T3.
- *The first lecture is exceptionally on Thursday 14th September 10-12 in T3!*
- No changes to the course this year.
- Lectures proceed faster than in the basic course, dealing with important points.
- More emphasis is laid on self-study (reading the book and slides yourself).

- You can find the details in the book.
- It suffices to read some matters from the slides only.
- There will probably be a 'demo' lecture showing a few practical applications at the end of the course.
- Tentatively on Monday, December 11
- On the examination week (October 26 - November 1) there will be no lecture and exercises.

Exercises:

- Thursdays 10-12 in the lecture hall T3.
- The same as during the last year.
- There will be a total of 11 exercises.
- Assistant: Dr. **Jaakko Peltonen**.
- Email: Jaakko.Peltonen@hut.fi
- Room A326, Tel. 451 4429.

- The first exercises will be held on 21st September.
- Problem sheets and solutions will be available on the home page of the course.
- Problems will be available before each exercise, solutions after it.

Examinations:

- First examination is on Monday 18th December 16-19 o'clock in the lecture room T1.
- Second exam will be on Sat. 17th February 2007, and the third one in fall 2007.
- Exact requirements for the examination will appear on the home pages of the course.
- They will be copied to the participants.
- They define which matters you should

read from the textbook and for which the slides alone are sufficient.

- Problem sheets in examination are in Finnish.
- You must ask an English problem sheet a week before the examination!

Materials and language:

- The lectures and exercises are presented orally in Finnish.
- However, all the written course materials are available in English.
- Including the textbook, lecture slides, exercise problems, and their solutions.
- Examination requirements and home page are both in Finnish and English.
- Lecture slides, problems, and their solutions as well as some extra material will be copied via Edita Prima Oy.

Course textbook and coverage:

- S. Haykin: *Neural Networks - A Comprehensive Foundation*, 2nd ed., Prentice-Hall 1998.
- Ordered to the bookshop in the main building, arrives in mid-September.
- Price: 74 euros, soft-covered.
- Or you can buy the book via internet etc.
- The same book is used also in our basic course Tik-61.3030 Principles of Neural Computing.
- The book is graduate level; but more difficult parts are skipped or discussed loosely.
- Most chapters (9 out of 15) of the textbook are discussed in this course.
- Chapters 3-6, 9, and 14 are skipped completely, and from Chapters 1 and 2

only the main points are briefly repetited.

- If necessary, you can also copy the chapters discussed in this course from master copies.
- They are located in our secretary Tarja Pihamaa's room B326.

Opintoyhdysmies (Contact person taking the materials to Edita Prima Oy):

Sami Virpioja
Email: Sami.Virpioja@tkk.fi

Contents of Haykin's book and matters discussed in this course

1. Introduction
   - **Repetition of basic matters**
2. Learning Processes
   - **Statistical nature of learning**
3. Single Layer Perceptrons
4. Multilayer Perceptrons
5. Radial-Basis Function Networks
6. Support Vector Machines
7. **Committee Machines**
8. **Principal Components Analysis**
9. Self-Organizing Maps
10. **Information-theoretic Models**
    - In particular **Independent**

Component Analysis (ICA), from a separate tutorial paper

11. **Stochastic Machines and Their Approximates Rooted in Statistical Mechanics**
12. **Neurodynamic Programming**
13. **Temporal Processing Using Feedforward Networks**
14. Neurodynamics
15. **Dynamically Driven Recurrent Networks**

The **boldfaced** chapters will be discussed in this course.

Some "real-world" applications will be presented in a separate **demo lecture.**

More information will be provided later on.