REASON COURSES in 2002 given by "Politehnica" University of Bucharest in Romania

Compact neural architectures with mixed-signal implementation for reconfigurable computing and on-chip intelligent signal processing

Radu Dogaru, October, 7-9

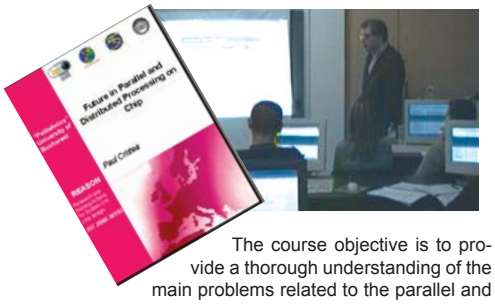
In recent years there is a huge demand for highly compact devices capable to perform reconfigurable computing and intelligent signal processing. This course introduces a novel approach, based on piecewise-linear function approximations, for designing such compact and VLSI-friendly neural systems. The multi-nested cell performs arbitrary Boolean functions with an implementation complexity of only O(n), where n is the number of inputs, while the simplicial neuron is a powerful device with a very simple and convenient mixed-signal VLSI implementation. It is functionally equivalent with classic neuro-fuzzy architectures (such as multi-layer perceptrons, radial basis functions networks etc.) while it has a much simpler VLSI implementation based on digital RAM storage of knowledge instead of analogic weights.

Topics:

1. Particularities of designing compact yet highly functional intelligent systems
2. Projection tapes and orientation vectors
3. Canonical piecewise-linear discriminants and their applications for designing adaptive Boolean neurons
4. Multi-nested neurons.
5. Stochastic algorithms for training multi-nested neurons.
6. A nanotechnology implementation solution using resonant tunneling diodes
7. Simplicial neural cell - mixed circuit realizations
8. Applications of the simplicial neural cell in intelligent signal processing
9. Demonstration of multi-nested cell and simplicial neural cell

Future in Parallel and Distributed Processing on Chip

Valentin Cristea,



The course objective is to provide a thorough understanding of the main problems related to the parallel and distributed application development with examples from different engineering domains, in particular from circuit design. Several aspects will be presented related to categories of applications, conceptual models of parallel and distributed algorithms, development techniques for shared variable and message passing programming models.

Topics:

1. Application categories.
2. Conceptual models.
3. Programming methods.
4. Parallel system architectures.
5. Algorithm description language.
6. Parallel algorithm complexity.
7. Algorithms development using shared variables.
8. Algorithms development using messages passing.
9. Synchronous message passing.
10. Graphs algorithms.
11. Parallel genetic algorithms.
12. Parallel and distributed software engineering

Self-Organizing Systems

Monica Dascalu, October, 14-16

The main objective of the course was to provide basic information on self-organizing systems to specialists in microelectronics and VLSI design. Self-organizing systems are appreciated by specialists to be the computing architectures of the future. However, the research about their VLSI implementation is only at the beginning - but with remarkable results. The course was focused on hardware implementation of artificial self-organizing architectures, in order to provide to specialists in hardware design new models and implementation solutions.

The lectures included a brief overview of self-organization and artificial self-organizing systems. The main computing models that imply self-organization (cellular automata, neural networks and genetic algorithms) was introduced, as well as possible self-organizing architectures. Various applications and implementations was presented, in order to give an objective perspective of the VLSI applications. Typical structures and implementation problems was also overviewed.

Applications of Neural Networks in Speech Processing

Dragos Burileanu, October, 10-12

Language is the ability to express one's thoughts by means of a set of signs, whether graphical, gestual, or acoustic; it is a distinctive feature of human beings, who are the only creatures to use such a structured system. Speech is one of its main components. It is by far the oldest means of communication between people and it is also the most widely used. No wonder, then, that people have extensively studied it and often tried to handle it in an automatic way. What is more, for many engineers and speech scientists, the ability to converse freely with a machine represents the ultimate challenge to our understanding of the production and perception processes involved in human speech communications. But in addition to being a provocative topic, spoken language interfaces are fast becoming a necessity. In the near future, interactive systems and networks will provide easy access to a wealth of information and services that will fundamentally affect how people work, play or conduct their daily affairs.

However, despite the remarkable advances in human language technologies in the last decade, many problems are not yet completely solved and the current technology is far from human-like; for example, we are still far from obtaining a machine able to read as fluent, intelligible and natural as a human speaker, or to fully recognize conversational or spontaneous speech.

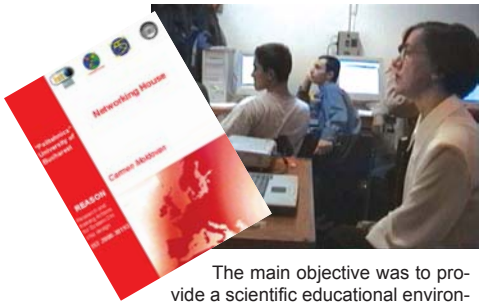
Important efforts are presently done to extend the theoretical studies at both acoustic and linguistic levels, but also to better understand the incredible performances and efficiency of the human brain in pattern recognition tasks. In this respect, artificial neural networks successfully begun to be used as subsystems in complex speech processing systems. Their ability to adapt, learning from examples, and to generalize the learned information, is clearly one of the most useful attributes.

Taking into account the above considerations, the present course has three main objectives:

- to introduce the neural network paradigm and to discuss the philosophy of the connectionist approach in speech processing researches;
- to present a number of neural-based applications reported by the speech community and to explain the advantages of using neural networks as alternatives to classic pattern recognition problems;
- to describe the design and implementation of some practical systems based on the neural approach and used in automatic speech recognition and text-to-speech synthesis (these systems being developed by the author of this course).

Networking house

Carmen Moldovan, November, 1-4



The main objective was to provide a scientific educational environment, to increase the interest of young educated people in Microsystems and microelectronics field in order to bring theme in the technical universities, to create links between technical Universities and High schools oriented on information, physics, mathematics.

The course will describe the connections between the microsystems and the information technology, and the real world. We will try to define how depth the microtechnology get into our houses and improve the quality of our daily life. The course will offer also, an overview of the large area of microsystems applications and the large possibilities for the young people to work in the research or production in microtechnologies field.

After the course, the attendees were able to understand what is the importance of the microsystems domain in our real life and to be conscience about the importance and the possibilities of the young and educated people involvement into.

The course was open also, to teachers coming from the high school, in order to inform theme about the possibilities offered to young people by microsystems and microelectronics field.

The course introduced the show and demonstration event, which presented practical different types of sensors and technologies.

A few courses will be repeated the next year (2003) following the request from institutions. The courses have been done in English and are opened to REASON and non-REASON participants. The proceedings of courses are available in the REASON consortium.