polifab
POLITECNICO DI MILANO

12 May, 2016

Workshop on

Neuromorphic Computing Systems

Conference Room "Giulio Natta", Building 6

Politecnico di Milano

P.za L. da Vinci 32, 20133 Milano

With the aim of supporting and aggregating education and research activities, Polifab organizes a series of workshops on emerging themes related to micro and nanofabrication technologies. The second event is devoted to brain-like ("neuromorphic") computing devices and architectures. Three tutorials will provide the theoretical foundation of neural networks and an overview of the current and emerging hardware implementations and applications.

Programme

14.30 C. Alippi, Politecnico di Milano, *IEEE Distinguished Lecturer*
Neural networks: what did we learn from the theory and where are we going?

15.15 C. Bartolozzi, Istituto Italiano di Tecnologia, *iCub Facility*
Neuromorphic perception and robotics

16.00 D. Ielmini, Politecnico di Milano, *2014 ERC grantee*
Machine learning with memristive synapses

The next workshop is scheduled for:

10 June 2016: Micro-Electro-Mechanical Systems (MEMS)

Registration

The participation is free but subject to registration.
If not already registered, please follow the link below:

http://tinyurl.com/Polifab-workshop

Contact: infopolifab@polimi.it, Phone: +39 0223998980
How to reach the conference room: http://tinyurl.com/roomNatta

Neural networks: what did we learn from the theory and where are we going?

C. Alippi

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Many of us have been practicing with artificial neural networks for decades, some others have started after convolutional neural networks and deep learning showed their amazing impact on applications. Some others are following the Big data and data analytics mood.

Feedforward, recurrent, spiking, convolutional neural networks represent valid alternatives for many applications with the complexity of the model family and the learning procedure fully justifying both further investigation and neural accelerators.

What's beyond the plug-and-play magic? And what about the satisfaction of some hypotheses we do make to have the theory amenable?

Neuromorphic perception and robotic

C. Bartolozzi

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The performance of artificial systems is still very far from the requirements of robustness, compactness and autonomy, necessary for a meaningful and skilled interaction with the external world. Biological evolution developed computational strategies for making sense of the external noisy and ambiguous signals to produce appropriate behaviour in real time, at the lowest possible energetic cost and using an inhomogeneous substrate for computation comprising slow and stochastic elements.

Neuromorphic engineering studies the fundamental principles that shape neural perception and computation, and applies the same to the development of novel artificial devices that can better perform than current technology. In this talk we will review some key CMOS circuits that implement basic neural functions and see them in action. Neuromorphic technology can then be integrated in robots that face computational and energetic constraints and that should (in the near future) replicate basic human skills for reliable and robust interaction with the environment and cooperation with humans.

Machine learning with memristive synapses

D. Ielmini

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Neuromorphic systems are gaining strong momentum due to the inherent limitations of CMOS digital integrated circuits in addressing complex tasks such as learning, recognition and classification. Memristive devices, which can change their conductance in response to external stimuli, are ideally suited to synaptic connections in the neuromorphic network, thanks to their small size, high scalability, and low power needed to update the memristor state. This talk will summarize the state of the art of memristive neuromorphic networks, discussing the synapse architecture, the algorithms for weight update, (e.g. spike timing dependent plasticity), and the types of memristor devices that have been considered and tested. Finally, the overall performance of memristive systems will be assessed in comparison with conventional fully-CMOS neuromorphic approaches.