Brain-inspired Machine learning Technologies

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ABSTRACT.

The talk discusses briefly current challenges in machine learning (ML), including: efficient learning of data (interactive, adaptive, life-long; transfer); interpretability and explainability; personalised predictive modelling and profiling; multiple modality of data (e.g. genetic, clinical, behaviour, cognitive, static, temporal, longitudinal); computational complexity; energy consumption; human-machine interaction.

Opportunities to address these challenges are presented through advancement in ***N***euroinformatics, ***N***eural networks and ***N***eurocomputers (the 3N). **Neuroinformatics** offer a tremendous amount of data and knowledge about how the human brain and the nervous system learn. Many brain information processing principles can be now implemented in novel **Neural network** computational models. The latter ones have inspired the development of neuromorphic hardware chips and N**eurocomputers,** characterised by much low power consumption, massive parallelism and fast processing.

The talk presents also the main principles of evolving connections systems (ECOS) [1,2] and spiking neural networks (SNN) [3,4] along with a brain-inspired ML architecture based on SNN, **NeuCube to** address the above ML challenges. NeuCube is first used for brain data modelling and then developed as a generic spatio-temporal ML machine and an open source development environment for a wide scope of applications. Some experimental results include: modelling EEG, fMRI and other multimodal brain data; predicting AD; predicting response to treatment; early diagnosis of psychosis; personalised prediction of stroke; brain-computer interfaces; on-line learning of multisensory data for pollution and earthquake prediction; integrating financial time series and on-line news; and other.

In future, a fast development of novel **Neural network** ML models for the now available massively parallel and low power consuming **Neurocomputers** is expected, along with successful applications in **Neuroinformatics**, and in all areas of ML to overcome the current challenges in in ML. And this is the future trend in ML after the current deep neural network technologies.

[1] N.Kasabov, Evolving Connectionist Systems, Springer, 2007
[2] NeuCom: https://theneucom.com
[3] N.Kasabov, *Time-Space, Spiking Neural Networks and Brain-Inspired Artificial Intelligence*, Springer, 2019, https://www.springer.com/gp/book/9783662577134.
[4] NeuCube: https://kedri.aut.ac.nz/neucube

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