PhD Advert Template

Project title: Next-Generation Spiking Neural Networks Architectures and Machine Learning Algorithms

Project ID *(optional)*: *Please leave blank*

Accept all year-round applications

Funding information: Self-funded students only

Project description:

Spiking Neural Networks (SNNs) represent the so called ‘third generation’ of artificial neural network models, that bridge the gap between neuroscience and artificial intelligence by relying on biologically realistic models of neurons and network architectures to carry out computations. Specifically, Information transfer between the neurons in the spiking neural network is via the precise timing of spikes generated by the individual neurons.

SNNs exploit temporal encoding and asynchronous processing to perform complex information processing and learning tasks in a fast and efficient manner. This makes SNNs suitable for real-time applications that that exploit energy-efficient neuromorphic hardware platforms rather than conventional microprocessor-based systems.

SNNs have been shown to be as computationally powerful as conventional artificial neural networks (ANNs). However, SNNs have not quite reached the same accuracy levels of ANNs in traditional machine learning tasks largely because of the lack of adequate training algorithms for deep SNNs. The non-differentiable nature of spike events precludes the direct application of gradient descent methods that are by far the most widely used algorithms for training deep neural networks.

The problem of synthesizing sparse, energy-efficient spiking neural circuits that perform desired computations from individual spiking neurons as well as simple, previously characterised neural circuits is still an open question.

This project aims to advance the theoretical foundations of spiking neural networks and develop new spike-based methodologies for synthesizing and training spiking neural networks that perform conventional machine learning tasks, implement optimal control policies or provide biologically realistic models of neural computations.

Numerical simulations will be carried out in MATLAB, C/C++, Python. Optional, depending on interest and experience, simulations could be implemented on neuromorphic hardware such as Intel’s Loihi neuromorphic chip.

**Entry Requirements**

To be considered for the project, candidates must be highly motivated and should possess a 1st Class honours undergraduate degree or MSc Distinction (or international equivalent) in Engineering, Computer Science, Mathematics, Physics, or a closely related subject. Outstanding candidates with an upper 2nd Class degree may also be considered. Good programming skills and experience with Python and/or Matlab is essential.

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References (optional):

Application enquires: *Daniel Coca, Daniel.Coca@newcastle.ac.uk, https://www.ncl.ac.uk/engineering/staff/profile/danielcoca.html*

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[ ]  social anthropology

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[ ]  surveying

[ ]  urban planning

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[ ]  behavioural biology

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[ ]  biotechnology

[ ]  cancer biology

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Communication & Media Studies

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Computer Science

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Education

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Environmental Sciences

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Finance

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Food Sciences

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Forensic and Archaeological Sciences

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Geography

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Geology

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History & Archaeology

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Mathematics

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Medicine

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