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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environmental biology

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public relations

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internet of things

machine learning

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animation

art

crafts

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design

drama

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film studies

fine art

graphic design

interior design

music

music technology

photography

theatre studies

other

Economics

econometrics

financial economics

macroeconomics

microeconomics

political economics

other

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further education

higher education

nursery education

primary education

secondary education

special needs education

other

Engineering

acoustics engineering

aerospace engineering

atomic engineering

automotive engineering

bioengineering

biomedical engineering

chemical engineering

civil engineering

communications engineering

control systems

cybernetics

dynamics

electrical engineering

electronic engineering

energy technologies

environmental engineering

fluid mechanics

gas engineering

geotechnical engineering

integrated engineering

manufacturing engineering

marine engineering

mechanical engineering

mechanics

mechatronics

nanotechnology

offshore engineering

petroleum engineering

robotics

solid mechanics

structural engineering

structural mechanics

systems engineering

thermodynamics

other

Environmental Sciences

climate science

hydrology

marine sciences

meteorology

pollution

soil science

other

Finance

actuarial science

banking

financial management

insurance

investment

taxation

other

Food Sciences

food hygiene

food production

other

Forensic and Archaeological Sciences

archaeological science

forensic science

other

Geography

agricultural geography

cultural geography

economic geography

environmental geography

geographical information systems gis

historical geography

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marine geography

physical geography

political geography

remote sensing

social geography

transport geography

urban geography

other

Geology

applied geology

geochemistry

geophysics

geoscience

geotechnology

hydrogeology

marine geology

palaeontology

seismology

volcanology

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african history

american history

ancient history

archaeology

asian history

australasian history

british and irish history

economic history

european history

heritage studies

history

history of art

history of religions

history of science

medieval history

military history

modern history

russian history

social history

world history

other

Information Services

information security

information systems

librarianship

other

Languages, Literature & Culture

african studies

american studies

asian studies

australasian studies

chinese

danish

dutch

english language

english literature

european studies

finnish

french

german

italian

japanese

middle eastern studies

norwegian

portuguese

russian

spanish

swedish

other

Law

criminal law

commercial law

contract law

property law

other

Linguistics & Classics

ancient greek

celtic studies

classics

latin

linguistics

other

Materials Science

ceramics

glass

metallurgy

polymers

textiles

other

Mathematics

applied mathematics

applied statistics

computational mathematics

data analysis

engineering mathematics

mathematical modelling

medical statistics

operational research

probability

pure mathematics

statistics

stochastic processes

other

Medicine

anatomy

audiology

biomechanics

cardiology

complementary medicine

dentistry

endocrinology

epidemiology

neural engineering

neurology

nutrition

ophthalmology

optometry

pathology

pharmacology

pharmacy

physiology

physiotherapy

podiatry

radiology

speech science

tissue engineering

toxicology

other

Nursing & Health

adult nursing

community nursing

counselling

dental nursing

environmental health

health informatics

medical nursing

mental health nursing

midwifery

occupational health

occupational therapy

paediatric nursing

paramedical science

surgical nursing

other

Philosophy

ethics

metaphysics

philosophy of science

other

Physics

acoustics

astronomy

astrophysics

chemical physics

computational physics

electromagnetism

environmental physics

experimental physics

medical physics

nuclear physics

optical physics

particle physics

quantum mechanics

solid state physics

space science

theoretical physics

other

Politics & Government

development studies

government

international relations

politics

public policy

other

Psychology

child psychology

clinical psychology

community psychology

counselling psychology

developmental psychology

educational psychology

forensic psychology

health psychology

neuropsychology

occupational psychology

organisational psychology

psychotherapy

sport psychology

other

Sociology

criminology

disability studies

gender studies

socio economics

social work

other

Sport & Exercise Science

sport coaching

sport development

sport performance

sport technology

sport therapy

other

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divinity

religious studies

theology

other

Veterinary Sciences

animal welfare

veterinary dentistry

veterinary medicine

veterinary nursing

veterinary nutrition

veterinary pathology

other