SEMINAR ANNOUNCEMENT

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
COLLEGE OF DESIGN AND ENGINEERING
Website: https://cde.nus.edu.sg/ece

Area: Microelectronic Technologies & Devices (MTD)

Host: Asst Prof Fong Xuanyao Kelvin

TOPIC	:	**Neuromorphic Computing: Bridging the gap between Nanoelectronics, Neuroscience and Machine Learning**
SPEAKER	:	**A/Prof Abhronil Sengupta** **Associate Professor, School of Electrical Engineering and Computer Science,** **Penn State University**
DATE	:	**Wednesday, 30 July 2025**
TIME	:	**11:00AM-12:00PM**
VENUE	:	**E5-03-20**

ABSTRACT

While research in designing AI algorithms has attained a stage where such platforms are able to outperform humans at several cognitive tasks, an often-unnoticed cost is the huge computational expenses required for running these algorithms in hardware. Recent explorations have also revealed several algorithmic vulnerabilities of deep learning systems like adversarial susceptibility, lack of explainability, and catastrophic forgetting, to name a few. Brain-inspired neuromorphic computing has the potential to overcome these challenges of current AI systems. This talk reviews recent developments in the domain of neuromorphic computing from my group guided by an overarching system-science perspective with an end-to-end co-design focus from computational neuroscience and machine learning to hardware and applications. From the top-down algorithm side, I will delve into methodologies that treat neuromorphic spiking architectures as continuously evolving dynamical systems, revealing intriguing parallels with the learning dynamics in the brain. The methodologies discussed enable spiking architectures to transition beyond simple vision-related tasks to complex sequence learning problems and large language model (LLM) architectures. Complimentary to this effort, I will also elaborate on a bottom-up perspective of leveraging the intrinsic physics of emerging post-CMOS technologies like ferroelectrics and spintronics to mimic several neuro-synaptic functionalities in novel device structures operated at low terminal voltages. In-Memory computing architectures enabled by such neuromimetic devices have the potential of enabling two to three orders of magnitude energy efficiency in comparison to state-of-the-art CMOS implementations. I will outline several hardware-software co-design strategies to enable variation-aware, robust, self-healing neuromorphic systems. I will conclude my talk with my vision of expanding the scope of neuromorphic computing beyond simple neurons and synapses by forging stronger connections with computational neuroscience, thereby enabling a new generation of brain-inspired computers.

BIOGRAPHY

Dr. Abhronil Sengupta is an Associate Professor in the School of Electrical Engineering and Computer Science at Penn State University and holds the Joseph R. and Janice M. Monkowski Career Development Professorship. Dr. Sengupta received the PhD degree in Electrical and Computer Engineering from Purdue University in 2018 and the B.E. degree from Jadavpur University, India in 2013. He worked as a DAAD (German Academic Exchange Service) Fellow at the University of Hamburg, Germany in 2012, and as a graduate research intern at Intel Labs in 2016 and Meta Reality Labs in 2017.
The ultimate goal of Dr. Sengupta's research is to bridge the gap between Nanoelectronics, Neuroscience and Machine Learning. He is pursuing an inter-disciplinary research agenda at the intersection of hardware and software across the stack of sensors, devices, circuits, systems and algorithms for enabling low-power event-driven cognitive intelligence. Dr. Sengupta has published over 100 articles in referred journals and conferences and holds 3 US patents. He has been awarded the ARO Early Career Award (2024), Purdue Engineering 38 by 38 Award (2024), NSF CAREER Award (2023), IEEE Electron Devices Society (EDS) Early Career Award (2023), IEEE Circuits and Systems Society (CASS) Outstanding Young Author Award (2019), Meta Faculty Award (2018), IEEE SiPS Best Paper Award (2018), Schmidt Science Fellows Award nominee (2017), Purdue Bilsland Dissertation Fellowship (2017), CSPIN Student Presenter Award (2015), Birck Fellowship from Purdue University (2013), and the DAAD WISE Fellowship (2012). His work on neuromorphic computing has been highlighted in media by MIT Technology Review, ZDNet, US Department of Defense, American Institute of Physics, IEEE Spectrum, and Nature Materials, among others. Dr. Sengupta is a Senior Member of the IEEE and ACM. He currently serves as an ACM Distinguished Speaker (2024-2027) and IEEE CASS Distinguished Lecturer (2025-2026).