SEMINAR ANNOUNCEMENT

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

Area: Power and Energy Systems (PES)

Host: Prof Dipti Srinivasan

Co-organized by: Green Energy Management and Smart Grid Research Center, ECE NUS and IEEE CIS Singapore Section

TOPIC	:	**Multiobjective optimization, Clustering and AI: Towards Intelligent Discovery**
SPEAKER	:	**Prof Sanghamitra Bandyopadhyay** **FIEEE; Indian Statistical Institute, Kolkata, India**
DATE	:	**Wednesday, 11 November 2026**
TIME	:	**2:00PM to 4:30PM**
VENUE	:	**Engineering Auditorium, Block EA, NUS**

ABSTRACT

Modern scientific discovery increasingly relies on computational methods that can explore complex search spaces, identify hidden structures in data, and learn meaningful representations from large and heterogeneous datasets. This tutorial talk will discuss ways of addressing these tasks from the perspectives of multiobjective optimization, clustering, and artificial intelligence. This talk will presentthe fundamental concepts, algorithms, and emerging connections among these three areas, with an emphasis on their role in intelligent discovery.

The tutorial will begin with the principles of multiobjective optimization, including conflicting objectives, Pareto dominance, Pareto-optimal solutions, and trade-off analysis. Two influential evolutionary approaches, the Non-dominated Sorting Genetic Algorithm II (NSGA-II) and the Archived MultiobjectiveSimulated Annealing (AMOSA) algorithm, will be introduced to illustrate population-based and simulated-annealing-based strategies for exploring multiobjective search spaces. An application to rational drug design will be briefly demonstrated.

The second part will introduce clustering as an unsupervised learning paradigm for discovering structure in unlabeled data. Fundamental methods, including K-means and Fuzzy C-means (FCM), will be explained, highlighting their assumptions, optimization principles, strengths, and limitations. Building on these foundations, the tutorial will examine multiobjective optimization for clustering, where competing criteria such as cluster compactness and separation can be optimized simultaneously. An innovative technique for providing a single comprehensive clustering of the data utilizing a novel combination of the multiple Pareto-optimal solutions in a supervised framework will be discussed. An application to clustering gene expression data will be briefly demonstrated.

The final part will connect these classical computational intelligence techniques with modern AI. Topics will include some historical facts about the evolution from traditional machine learning to deep learning, representation learning, attention mechanisms, and Transformer architecture. Selected contemporary trends, including foundation models, generative AI, retrieval-augmented generation, and AI-assisted scientific discovery, will be briefly mentioned alongside their opportunities and limitations.

It is expected that on conclusion of the tutorial, the participants will have a fair grasp of metaheuristics for multiobjective optimization, a couple of widely used clustering algorithms, a technique for multiobjectiveclustering, and the transformer model and some of its developments.

BIOGRAPHY



Prof. Sanghamitra Bandyopadhyay did her B Tech, M Tech and Ph. D. in Computer Science from Calcutta University, IIT Kharagpur and Indian Statistical Institute respectively. She then joined the Indian Statistical Institute as a faculty member, and continues there as a Professor. She was the Director of the Institute for two terms – 2015-2020 and 2020-2025. Her research interests include artificial intelligence and machine learning, computational biology, and evolutionary computation and multiobjective optimization where she has published more than 400 research articles. In these areas she has delivered numerous keynote/plenary and invited talks and participated in many panel discussions world-wide. Prof. Bandyopadhyay is a recipient of several awards including the Shanti Swarup Bhatnagar Prize in Engineering Science, TWAS Prize, Infosys Prize, JC Bose Fellowship, Swarnajayantifellowship, INAE Silver Jubilee award, INAE Woman Engineer of the Year award (academia), IIT Kharagpur Distinguished Alumni Award, Humboldt Fellowship from Germany, Senior Associateship of ICTP, Italy, young engineer/scientist awards from INSA, INAE and ISCA, and Dr. Shanker Dayal Sharma Gold Medal and Institute Silver from IIT, Kharagpur, India. She is a Fellow of all the National Science Academies and the Engineering Academy of India, the IEEE, The World Academy of Sciences (TWAS), and International Association for Pattern Recognition (IAPR). She serves as a member of the Science, Technology and Innovation Advisory Council of the Prime Minister of India (PM-STIAC). In 2022, she was conferred the Padma Shri of the Government of India.

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