



Machine Learning for Particle and Astroparticle Physics

ML4HEP 2024

Today, Artificial Intelligence and Machine Learning techniques have wide applications. The application of machine learning techniques is gaining momentum in the research field of high energy physics (HEP) and astroparticle physics. The experiments at large hadron collider (LHC) as well as several other collider-based and astroparticle experiments are accumulating large amounts of data for the precision measurement of parameters of the Standard Model of particle physics and to search for existence of beyond Standard Model physics at higher energy scale for which there are compelling theoretical and experimental reasons. In the future, the high luminosity LHC is expected to deliver ten times more data than what is available till date. Already, remarkable progress has been achieved in the application of machine learning in HEP, in terms of developing event classification, object identification, and estimation strategies. ML methods are expected to be heavily employed in future data analysis.

The primary objective of this school-cum-workshop is development of human resources and capacity building in frameworks related to deep machine learning and artificial intelligence for high energy and astroparticle physics. The programme consists of two parts: a preschool (online) to prepare the students and an in-person school-cum-workshop. The programme will begin with a set of pedagogical lectures, tutorials and hands-on coding sessions to train the introductory group of participants (mostly students and post-docs). The second part will be a working-group style workshop, with well-spaced brainstorming sessions seeding possible collaborative activities.

We invite applications from interested students and post-docs in the area of high energy physics and astroparticle physics. The senior (faculty) participants for the workshop will be on invitation only.

The previous workshop in this series was held at ICTS, Bengaluru : <https://www.icts.res.in/program/ML4HEP>

Topics

Statistical methods for particle physics:

Basics of statistics, error propagation, density functions, point estimation, chi-square and likelihood method, interval estimation, hypothesis testing, goodness of fit.

Machine Learning:

Python

Basics of Neural Network, Deep Learning, Convolutional Neural Network (CNN)

Keras/Tensorflow and PyTorch

Sequential models (RNN, LSTM, GRU), Autoencoders, Variational Autoencoders (VAE) Generative Adversarial Networks (GANs), Graph neural networks (GNNs), transformers etc. with applications in HEP

Differential programming

Deploying NN onto an FPGA

Local Organisers

Aruna Kumar Nayak, Debottam Das, Kirtiman Ghosh, Manimala Mitra, Sanjib Kumar Agarwalla

National Advisory

Satyaki Bhattacharya SINP, Kolkata

Partha Konar, PRL, Ahmedabad

Ritesh Singh IISER, Kolkata

Sanmay Ganguly IIT, Kanpur

Date

1 July 2024 - 13th July 2024

Venue

Institute of Physics Bhubaneswar and Online

Contact Us

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Website

<https://iopb.res.in/ml4hep/index.php>

Speakers

Subir Sarkar (SINP, Kolkata)

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Amit Chakraborty (SRM Amaravati)

Shilpi Jain (TIFR, Mumbai)

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