



ICTS String Seminar

Title : QFT for AI: A Framework for Robust & Interpretable Models

Speaker : Anindita Maiti (Perimeter Institute for Theoretical Physics, Canada)

Date : Wednesday, 22 January 2025

Time : 3:30 PM (IST)

Abstract : Artificial Intelligence (AI) and Machine Learning (ML) have revolutionized modern scientific inquiry, yet challenges in interpretability, robustness, and precision persist — barriers to their broader adoption in fundamental physics. This talk introduces a novel framework that leverages the principles of Quantum Field Theory (QFT) and Renormalization Group (RG) flows to address these issues, offering a new theoretical foundation for AI. I will first present the Neural Network Field Theory (NNFT) correspondence, a mapping between neural network architectures, the backbones of AI and ML, and quantum field theories — enabling AI models to inherently embody physical principles. Next, I will discuss a Wilsonian RG framework for understanding the learning behaviour and error quantification in overparameterized ML models. Additionally, insights from Random Matrix Theory will be utilized to explain in-context learning ability in a simplified version of Transformers, the backbone of large language models (LLM). Finally, I will outline the connections between Restricted Boltzmann Machines (RBM) and diffusion processes, establishing links to modern generative AI frameworks. This interdisciplinary approach not only enhances the reliability and scientific rigor of AI but also provides pathways to accelerate discoveries in fundamental physics and beyond.

Venue : Madhava Lecture Hall

Zoom Link: <https://icts-res-in.zoom.us/j/99134853293?pwd=SqcJfI2lfE9KLGx0YfoTrXAXhhaM1M.1>

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