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# The interaction between physics and machine learning: attractive or repulsive?

*Thursday, 12 June 2025 14:00 (40 minutes)*

The recent surge in machine learning (ML) capabilities, most widely known through the ascent of large language models, mirrors the transformative impact of microprocessors in the 1970s, indicating a potential paradigm shift in the computational toolset used in scientific research workflows, including physics. This talk aims to ignite interest in investigating the multifaceted relationship between physics and ML, mentioning both their "attractive" synergies and "repulsive" challenges. The nature of neural networks (NNs) makes them powerful, universal function approximators that are capable of solving the supervised learning problem, yet they suffer from a lack of interpretability which is critical for precise sciences. At the same time, there are striking parallels between the high-dimensional optimization landscapes of NN training and concepts from statistical physics, including phenomena akin to phase transitions, suggesting immense potential for physicists to contribute to the ML field. The field known today as physics-informed machine learning seeks to bridge these gaps by, for example, embedding physical symmetries directly into NN architectures, or by leveraging NNs as the solvers for the differential equations that underpin our physics-based simulation models. This talk will explore some of these avenues, aiming to ensure that the interaction between physics and machine learning can ultimately evolve into a 'stable, bound state' - a truly 'attractive' proposition for both disciplines.

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