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When Deep Learning meets Physics: Introducing Physics Informed Neural Networks and its Applications

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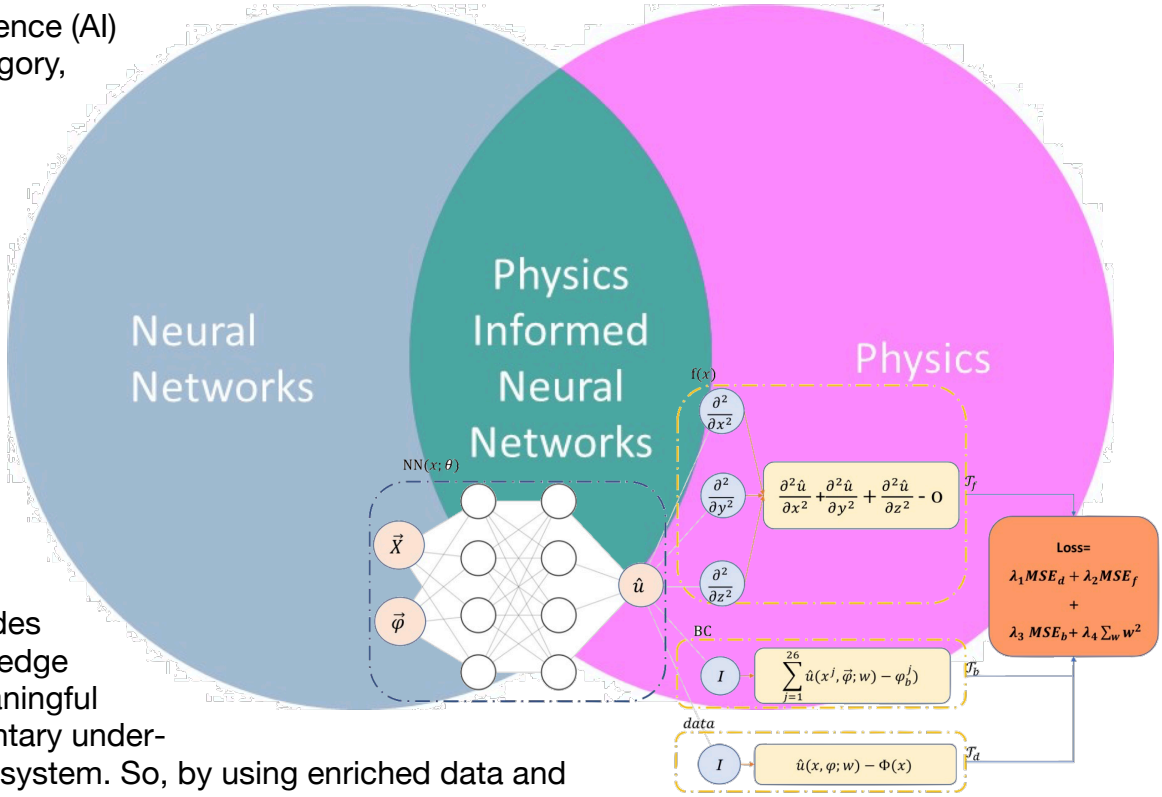

Artificial Intelligence (AI) and its subcategory, Deep Learning (DL), is of great current interest to scientists due to its variety range of applications. It can be considered a new technique for modeling and studying physical problems. Physical modeling provides data and knowledge that offer a meaningful and complementary understanding of the system. So, by using enriched data and training phases, the overall general integrated model achieves enhanced accuracy. One of the DL methods which recently been applied to many physical problems is Physics Informed Neural Networks (PINNs). PINNs represent a groundbreaking convergence of traditional physics-based modeling with the power and flexibility of modern deep-learning techniques. By embedding physical laws into the learning process, PINNs not only enhance predictive accuracy but also facilitate robust and interpretable models.

In this presentation, I will provide a brief introduction to Artificial Intelligence, Machine Learning, and Deep Learning, and their applications in the modeling of natural phenomena, then I will focus on PINNs as a special kind of DL. I will provide a comprehensive overview of PINNs, covering their theoretical foundations, training methodologies, and practical applications. The application of PINNs in molecular studying of modeling of ion transport through conductive pores will also be discussed.