

CRUNCH Seminars at Brown, Division of Applied Mathematics

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**Physics-informed Learning for Data-driven Discovery of
Governing Laws**

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Harnessing data to model and discover complex physical systems has become a critical scientific problem in many science and engineering areas. The state-of-the-art advances of AI (in particular deep learning thanks to its rich representations for learning complex nonlinear functions) have great potential to tackle this challenge, but in general (i) rely on a large amount of rich data to train a robust model, (ii) have generalization/extrapolation issues, and (iii) lack of interpretability and explainability, with little physical meaning. To bridge the knowledge gaps between AI and complex physical systems in the sparse/small data regime, this talk will introduce the integration of bottom-up (data-driven) and top-down (physics-based) processes through a Physics-informed Learning and Reasoning paradigm for discovery of discrete and continuous dynamical systems. In particular, this talk will discuss several methods that fuse deep neural networks, spline learning and symbolic reasoning for data-driven discovery of mathematical equations (e.g., nonlinear ODEs/PDEs) that govern the behavior of complex physical systems, e.g., chaotic systems, reaction-diffusion processes, fluid flows, cell dynamics, etc.