MLCAD 2024 Tutorial-2

KAN: Interpretable Machine Learning with Kolmogorov-Arnold Networks

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Part I: Introduction (40 minutes)

In this section, I will introduce Kolmogorov-Arnold Networks (KANs), which offer a promising alternative to Multi-Layer Perceptrons (MLPs). We will explore the mathematical foundation and basic architecture of KANs, highlighting their distinct approach: unlike MLPs, KANs replace every linear weight parameter with a univariate function, parameterized as a spline. This seemingly simple adjustment significantly enhances both the accuracy and interpretability of KANs. In terms of accuracy, smaller KANs can achieve comparable or even superior performance compared to much larger MLPs in tasks such as data fitting and solving partial differential equations (PDEs). Moreover, KANs demonstrate faster neural scaling laws both theoretically and empirically. When it comes to interpretability, KANs offer intuitive visualization and seamless interaction with users. Through two examples drawn from mathematics and physics, I will illustrate how KANs can assist scientists in (re)discovering mathematical and physical laws. This section is primarily based on the paper “KAN: Kolmogorov-Arnold Networks” (arXiv: 2404.19756).

Part II: Hands-on Examples (20 minutes)

In this section, I will introduce the pykan package (built on PyTorch), demonstrating its core functionality through several hands-on examples. You will learn how to integrate scientific knowledge into KANs and extract insights from them. This includes incorporating symbolic equations, modular structures, and identifying key features. By the end of the tutorial, attendees should be able to apply KANs to their own problems using just 20 lines of code. This section is based on the GitHub repository: https://github.com/KindXiaoming/pykan.