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MonoKAN: Certified monotonic Kolmogorov-Arnold network

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Abstract-

Artificial Neural Networks (ANNs) have significantly advanced various fields by effectively recognizing patterns and solving complex problems. Despite these advancements, their interpretability remains a critical challenge, especially in applications where transparency and accountability are essential. To address this, explainable AI (XAI) has made progress in demystifying ANNs, yet interpretability alone is often insufficient. In certain applications, model predictions must align with expert-imposed requirements, sometimes exemplified by partial monotonicity constraints. While monotonic approaches are found in the literature for traditional Multi-layer Perceptrons (MLPs), they still face difficulties in achieving both interpretability and certified partial monotonicity. Recently, the Kolmogorov-Arnold Network (KAN) architecture, based on learnable activation functions parametrized as splines, has been proposed as a more interpretable alternative to MLPs. Building on this, we introduce a novel ANN architecture called MonoKAN, which is based on the KAN architecture and achieves certified partial monotonicity while enhancing interpretability. To achieve this, we employ cubic Hermite splines, which guarantee monotonicity through a set of straightforward conditions. Additionally, by using positive weights in the linear combinations of these splines, we ensure that the network preserves the monotonic relationships between input and output. Our experiments demonstrate that MonoKAN not only enhances interpretability but also improves predictive performance across the majority of benchmarks, outperforming state-of-the-art monotonic MLP approaches.

Index Terms- Artificial neural network; Kolmogorov-Arnold network; Certified partial monotonic ANN; Explainable artificial intelligence

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