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On equivariance and explainability

Thursday 27 March 2025 10:00 (1 hour)

Permutation equivariant and Lorentz invariant neural networks have garnered the attention of the ML community at large for a while now, finding particular success in cases where symmetries in the data space can be exploited to overcome issues of low statistics and constraints on training time or model size. In high energy physics, however, neither problem is common to us: due to the inherent probabilistic nature of our experiments, we can simulate datasets that would excite even the most ingrained OpenAI engineer, and our computational power is on a vastly different scale compared to the average ML enthusiast.

The main strength of equivariant networks in our field lies in a different aspect, in fact, one of the main aspects that had the HEP community hesitant to adopt ML solutions in the first place, namely that of explainability. Compared to other approaches that use non-specialized architectures with many parameters and high flexibility but don't take into account underlying physics principles, equivariant networks provide reduced complexity and increased interpretability—two key factors when searching for new physics phenomena in underexplored parameter spaces.

This talk will introduce the audience to the concepts and benefits of equivariant methods in ML. After a brief motivation for this subfield, accompanied by a short maths lesson, the audience will be introduced to the core concepts of equivariant networks, followed by examples of architectures and applications. The hour will conclude with a discussion of the newest developments in this and related fields, perhaps with a brief look at applications outside of physics.

Number of lecture hours

1

Number of exercise hours

0 (no exercises)

Attended school

CSC 2024 (Hamburg)

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