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To be or not to be Equivariant?

Wednesday 13 March 2024 17:30 (20 minutes)

Equivariant models have provided state-of-the-art performance in many ML applications, from image recognition to chemistry and beyond. In particle physics, the relevant symmetries are permutations and the Lorentz group, and the best-performing networks are either custom-built Lorentz-equivariant architectures or more generic large transformer models. A major unanswered question is whether the high performance of Lorentz-equivariant architectures is in fact due to their equivariance. Here we report a study designed to isolate and investigate effects of equivariance on network performance. A particular equivariant model, PELICAN, has its symmetry broken down with no to minimal architectural changes via both explicit and implicit methods. Equivariance is broken explicitly by supplying model inputs that are equivariant under strict Lorentz subgroups, while it is broken implicitly by adding spurious particles which imply laboratory-frame geometry. We compare its performance on common benchmark tasks in the equivariant and non-equivariant regimes.

Significance

This talk presents a thorough investigation of the usefulness of equivariance in the context of a particular state-of-the-art neural network architecture. The topic of equivariance is a pressing issue as particle physics experiments continue to adopt machine learning methods for both data analysis and detector operation. to which this presentation will be a novel addition.

References

Main pedagogical paper: https://arxiv.org/abs/2307.16506

Experiment context, if any

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