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Lattice Gauge Symmetry in Neural Networks

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With increasing interest in machine learning techniques for lattice gauge theory, it becomes important to develop suitable neural network architectures that are compatible with the fundamental symmetries that lie at the heart of lattice QCD. We propose a novel neural network architecture called lattice gauge equivariant convolutional neural networks (L-CNNs) [1] that can be applied to problems in lattice gauge theory while exactly preserving gauge symmetry by construction. This is realized by explicitly accounting for parallel transport in convolutional layers. In combination with bilinear layers, these networks can in principle approximate any gauge covariant function on the lattice. We demonstrate that L-CNNs outperform traditional CNNs when applied to tasks such as computing Wilson loops. Our models can be efficiently trained on small lattices and still generalize well to larger lattice sizes.

[1] "Lattice gauge equivariant convolutional neural networks", M.˜Favoni, A.˜Ipp, D.˜I.˜Müller, D.˜Schuh, https://arxiv.org/abs/2012.12901

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