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F1: Neural Network Preconditioning for U(1) Wilson-type Dirac Operators

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We report progress in preconditioning Wilson-type Dirac operators in 1+1 dimensional U(1) lattice field theory using a neural network. We have developed a convolutional network that produces a preconditioner of comparable sparsity to the input operator. Once the model is trained, applying it to produce preconditioners is computationally cheap; with an optimized implementation, the neural network approach may provide a practical improvement over algebraic multigrid-based preconditioning, since the network is cheaper to apply and tends to produce much sparser preconditioners compared to AMG. So far, we have achieved a consistent reduction in iteration count during the solution of Dirac-operator linear systems using the conjugate gradient algorithm. Furthermore, the purely convolutional network architecture generalizes well across lattice volumes.

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