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Designing exact MPS ground state solutions in 1D and 2D

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We propose a protocol to design an exact MPS as a ground state of the bulk Hamiltonian based on cluster units that share their sites with the neighboring clusters.
We first decide what kind of clusters we use, and define a state that we want to have on each cluster as constituents of the local density matrix.
By entangling these clusters by partially projecting out the components that we want to discard, we can obtain a highly entangled ground state.
Of course this treatment is not always successful for all given models or conditions, and the protocol tells us how to judge or search for such set of exact ground state and the corresponding bulk Hamiltonian.
We demonstrate many cases that we are able to successfully obtain an exact multicritical ground state in the form of MPS, and show that we could further construct a series of solutions in the two dimensional lattices.
This method is useful to design a reference system in numerical tensor network-based or other calculations and helps us to understand the similarities between different solutions belonging to apparently different models.

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