# **DMRG**

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### 1 Purpose

- This program is used for initial learning of tensor network methods to be used in my bachelor thesis.
- It is an implementation of Matrix Product States (MPS) and Density Matrix Renormalization Group (DMRG) for finding the ground state of an arbitrary Hamiltonian.

### 2 Steps

- 1. Initialize a Hamiltonian tensor for N particles
- 2. Decompose it with the MPS method
- 3. Apply variational method to determine energy value
- 4. Minimize energy one matrix at a time while holding others constant
- 5. Apply DMRG? (TBD)

## 3 Description

We choose an arbitrary N-particle 1D Hamiltonian with nearest-neighbor spin interaction.

$$H = \sum_{i}^{N} \sigma_{i}^{z} \sigma_{i+1}^{z} + g \sigma_{i}^{x}$$

with  $j^{th}$  Pauli matrix of the  $i^{th}$  lattice position  $\sigma_i^j \in M(\mathbb{C}, 2x2)$  and parameter g.