Quantum Information and Computing

Assignment 8 (due on January 13th)

December 17, 2024

1. **Renormalization Group** Given the quantum Ising Hamiltonian in transverse field on a one-dimensional lattice with nearest neighbor interaction:

$$\hat{H} = \lambda \sum_{i}^{N} \sigma_i^z + \sum_{i}^{N-1} \sigma_i^x \sigma_{i+1}^x \tag{1}$$

where σ_x and σ_z are the Pauli matrices and λ is the transverse field.

   (a) Compute the ground state energy as a function of the transverse field λ by means of the real-space RG algorithm.

   (b) *Optional*: Compute the ground state energy as a function of λ by means of the INFINITE DMRG algorithm. Compare the results between them and with the mean field solution.