

# Quantum Information and Computing

Assignment 8 (due on January 9th)

December 12, 2023

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

$$\hat{H} = \lambda \sum_i^N \sigma_i^z + \sum_i^{N-1} \sigma_i^x \sigma_{i+1}^x \quad (1)$$

where  $\sigma_x$  and  $\sigma_z$  are the Pauli matrices and  $\lambda$  is the transverse field.

- (a) Compute the ground state energy as a function of the transverse field  $\lambda$  by means of the real-space RG algorithm.
- (b) *Optional*: Compute the ground state energy as a function of  $\lambda$  by means of the INFINITE DMRG algorithm. Compare the results between them and with the mean field solution.