1 Introduction

Generative machine learning algorithms have taken both the scientific community, and the general public by storm in later years. The ability to generate new data at will, based on a set of training data, has proven to be a powerful tool in a wide range of applications, from image recognition to natural language processing, and even in art - where sophisticated models can produce music and video that even experts struggle to differentiate from human-made content. We are entering a new era of digital content, where the line between human and machine is becoming increasingly blurred.

In this report, we will build one of earliest algorithms in generative machine learning, the Restricted Boltzmann Machine (RBM), and use it to model the Ising model in one dimension. We will follow in the footsteps on some of the pioneers in the field, Carleo and Troyer [**carleo2017solving**], and attempt to recreate, in simpler terms, their revolutionary work.
The Ising model is a simple model of a ferromagnetic material, where the spins of the atoms are aligned in a lattice. The model is simple enough to be solved analytically, but complex enough to exhibit interesting phase transitions in higher dimensions. Our work will focus on the 1D Ising model, where the ground state can be found by brute force. However, we will use the RBM to model the wavefunction of the system, and use it to find the ground state in a more delicate manner. We will do MCMC sampling of various spin configurations in the lattice, and use the marginal probability of the RBM as a quantum wavefunction - and attempt to minimize the local energy to identify the ground state of the system.

This means, that our RBM will generate a probability distribution which will "mimic" the true distribution of the wavefunction that solves the Ising model in one dimension. We will use Metropolis sampling to sample the probability distribution generated by the RBM, and use the samples to calculate the local energy of the system. To optimize the RBM, a standard gradient descent method will be employed. The theoretical framework for our project will be presented in the theory section, and the methods and implementations will be sketched out in the method section. The results from our simulations will be presented in the results section, and analyzed in the discussion section. Finally, we will conclude our report with a summary of our findings and suggestions for further research.