LEARNING SPIN ICE MANIFOLD WITH BOLTZMANN MACHINES. Jackson C. Glass & Gia-Wei Chern, Dept. of Physics, University of Virginia. Frustrated magnetic ice phases, modeled by Ising spins, are a natural candidate for study via machine learning due to their high disorder. Generative models such as the Restricted Boltzmann Machine (RBM) allow approximation of these phases by learning the distribution function of spins on the lattice. We study the Ice 1 and Ice 2 phases of classical Ising spins embedded on Kagome Lattices. These Ice phases are governed by effective anti-ferromagnetic first and second neighbor spin interactions. Though they exhibit spin disorder, each phase has an underlying sublattice order and short-range spin-spin correlation function. An RBM is trained to learn the spin distribution of each phase. This is accomplished by using Markov Chain Monte Carlo simulations of both phases to create a training dataset for each RBM, which is trained to create new samples of each phase which approximate the spin distribution. Through the training process, we explore the relationship between model architecture and symmetries present in systems the model is learning. In successfully training the RBM, it becomes clear that symmetry breaking in physical systems must be reflected by a similar broken symmetry in the model architecture. (Supported by: US Department of Energy Basic Energy Sciences under Award No. DE-SC0020330). Author contact: Jackson Glass, gzy5jd@virginia.edu