

## Day 4 (Poster F)

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Title: Binary and Gray code encoding for Ising problem

Abstract:

Representing integers using binary values is necessary for Ising machines when solving optimization problems that consists of integer variables. Such a representation can be obtained by various encodings such as the binary encoding, the one-hot encoding, the domain-wall encoding, the hamming-weight encoding, and the gray-code encoding. We focus on the binary and the gray-code encoding since they can represent integers using the same number of the binary variables. In this presentation, we discuss the difficulty of the binary encoding for Ising machines, and its solution using the gray-code encoding. To reveal the difficulty of the binary encoding, we consider the shortest-vector problem as an example. We show nonuniform energy scale in the Hamiltonian using the binary encoding, leading to the failure of finding the ground state using Ising machines. The gray-code encoding is expected to reduce the nonuniformity of energy. We show the expression of integer variable based on the gray-code encoding, and the success probability of finding the ground state using numerical simulation of Ising machine.