

Machine learning phases of matter

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We start with Roger Melko's famous paper titled Machine learning phases of matter. Neural networks are used to detect phases and order parameter from raw configuration data generated using Monte Carlo methods.

1 Phase characterization (Image classification) of square-lattice Ising model configurations

1.1 ferromagnetic

$$H = -J \sum_{\langle ij \rangle} \sigma_i^z \sigma_j^z$$

where $\sigma_i^z = \pm 1$. Configurations are obtained using standard Monte Carlo method at various temperatures.

1.2 Anti-ferromagnetic

Neural networks are able to identify anti-ferromagnetic spin ordering as well which would be a relatively difficult task than finding global spin polarization.

1.3 Possible generalization

Neural networks trained on square lattice is also useful in identifying phase transitions on triangular lattice?

Question : Is it really a different scenario than square lattice?

My contribution to this knowledge

Nothing.

Important questions to be answered

1. Given it is learned on existing configurations and its labels, how do we trust it when there are no labels. i.e. in uncharted territories?
2. Why was it able to classify phases and how can we generalise it?
- 3.