Valence Bond states with generative modeling

Jung-Shen Kao
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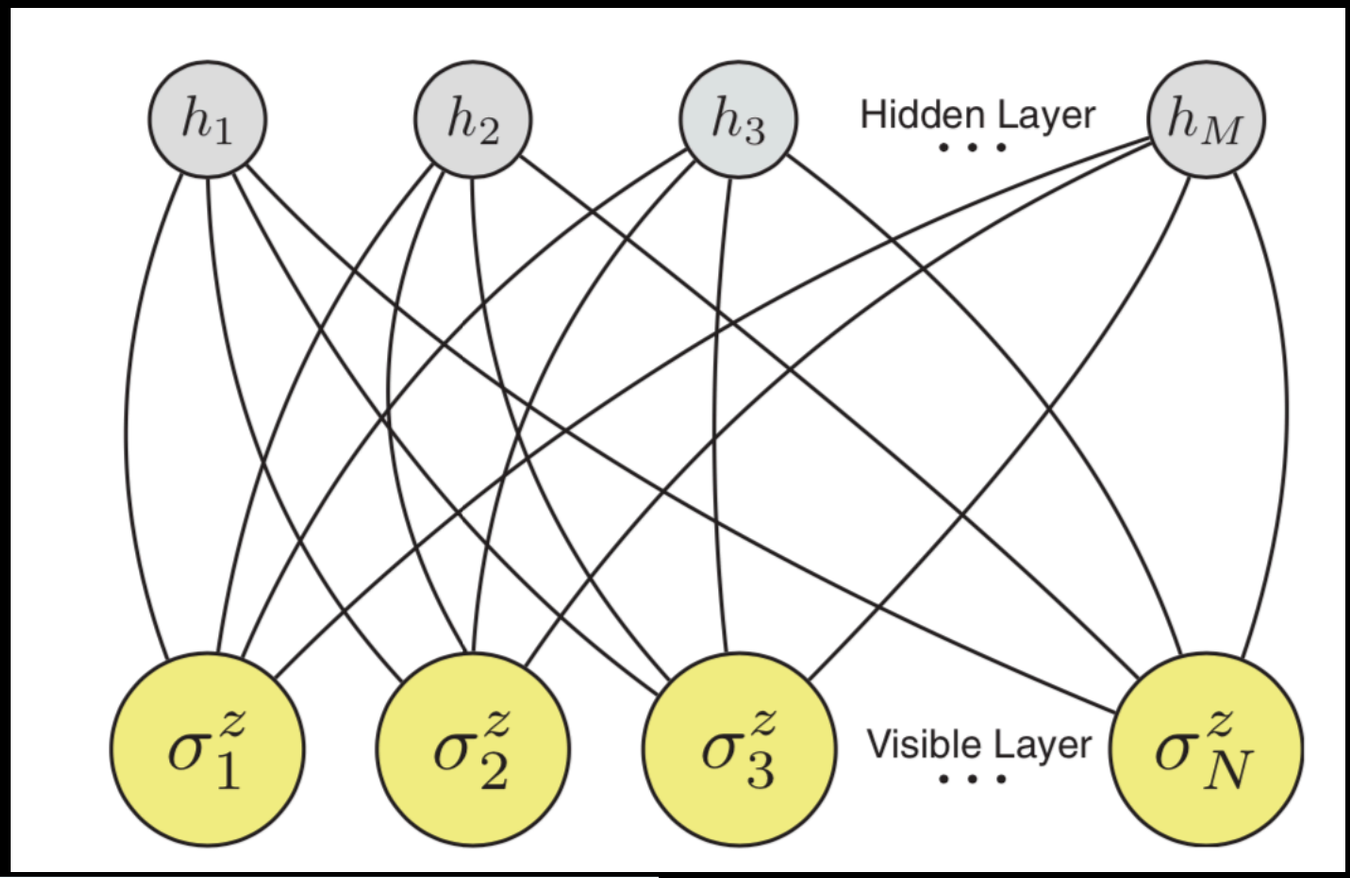
OUTLINE

- Quantum state tomography(QST) in valence bond (VB) states using Restricted Boltzmann Machine(RBM)

- Find a new energy-based graphical model (such as a modified RBM) inspired by VB states or apply other generative model that is perfect for VB states.

RBM QST



$$E_\lambda(\mathbf{v},\mathbf{h}) = -\sum_{i,j} W_{ij} h_i v_j - \sum_{j=1}^{V} b_j v_j - \sum_{i=1}^{H} c_i h_i$$

$$p_\lambda(\mathbf{v},\mathbf{h}) = \frac{1}{Z_\lambda} e^{-E_\lambda}$$

+ **Born's Rule**

QST VB states

- Superposed Ising basis => VB basis
- Superposed VB basis => AP, CAP states, …
- Sample from AP or CAP states
- RBM reconstruction of those states.

$$|Z\rangle = |S_1^z, \ldots, S_N^z\rangle,$$

$$|V\rangle = \frac{1}{2^{N/2}} \sum_Z \psi_V(Z)|Z\rangle,$$

$$\psi(V) = \prod_{\mathbf{r}} h(\mathbf{r})^{n_{\mathbf{r}}},$$

$$\psi(V) = \prod_{\mathbf{r}} h(\mathbf{r})^{n_{\mathbf{r}}} \prod_b C_b[\mathbf{r}_1(b), \mathbf{r}_2(b)].$$

Energy based graphical model(EBGM)

- RBM is good for Ising-like model.
- Are there some other kinds of EBGM, with energy function E(x,h) different from the Ising one, perfect for VB based model?