

TikZ tensor network diagrams

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Finite MPS:

$$|\Psi\rangle = \begin{array}{c} A_1 \quad A_2 \quad A_3 \quad \dots \quad A_{N-1} \quad A_N \\ \textcircled{1} \quad \textcircled{2} \quad \textcircled{3} \quad \dots \quad \textcircled{N-1} \quad \textcircled{N} \end{array} . \quad (1)$$

Gauge transform:

$$\begin{array}{c} A_i \\ \textcircled{1} \end{array} \rightarrow \begin{array}{c} G_{i-1}^{-1} \quad A_i \quad G_i \\ \textcircled{1} \quad \textcircled{2} \quad \textcircled{3} \end{array} . \quad (2)$$

Left-orthogonal form:

$$\begin{array}{c} A_i \\ \textcircled{1} \end{array} \rightarrow \begin{array}{c} L_i \\ \textcircled{1} \end{array}, \quad \begin{array}{c} L_i \\ \textcircled{1} \quad \textcircled{2} \\ \textcircled{2} \quad \textcircled{1} \end{array} = \left[\begin{array}{c} \textcircled{1} \\ \textcircled{2} \end{array} \right] . \quad (3)$$

Right-orthogonal form:

$$\begin{array}{c} A_i \\ \textcircled{1} \end{array} \rightarrow \begin{array}{c} R_i \\ \textcircled{1} \end{array}, \quad \begin{array}{c} R_i \\ \textcircled{1} \quad \textcircled{2} \\ \textcircled{2} \quad \textcircled{1} \end{array} = \left] \begin{array}{c} \textcircled{1} \\ \textcircled{2} \end{array} \right] . \quad (4)$$

SVD:

$$\begin{array}{c} A_i \\ \textcircled{1} \end{array} = \begin{array}{c} U \quad D \quad V^\dagger \\ \textcircled{1} \quad \textcircled{2} \quad \textcircled{3} \end{array} . \quad (5)$$

Mixed-canonical form:

$$|\Psi\rangle = \begin{array}{c} L_1 \quad L_2 \quad \dots \quad L_{i-1} \quad C_i \quad R_{i+1} \quad \dots \quad R_{N-1} \quad R_N \\ \textcircled{1} \quad \textcircled{2} \quad \dots \quad \textcircled{i-1} \quad \textcircled{i} \quad \textcircled{i+1} \quad \dots \quad \textcircled{N-1} \quad \textcircled{N} \end{array} . \quad (6)$$

$$|\Psi\rangle = \begin{array}{c} L_1 \quad L_2 \quad \dots \quad L_{i-1} \quad L_i \quad D_i \quad R_{i+1} \quad \dots \quad R_{N-1} \quad R_N \\ \textcircled{1} \quad \textcircled{2} \quad \dots \quad \textcircled{i-1} \quad \textcircled{i} \quad \textcircled{i+1} \quad \textcircled{i+2} \quad \dots \quad \textcircled{N-1} \quad \textcircled{N} \end{array} . \quad (7)$$

Unitary gauge transformation:

$$\begin{array}{c} L_i \\ \textcircled{1} \end{array} \rightarrow \begin{array}{c} U_{i-1}^\dagger \quad L_i \quad U_i \\ \textcircled{1} \quad \textcircled{2} \quad \textcircled{3} \end{array} . \quad (8)$$

Expectation value:

$$\langle \Psi | O_i | \Psi \rangle = \begin{array}{c} \text{---} \\ | \\ \text{---} \end{array} \dots \begin{array}{c} \text{---} \\ | \\ \text{---} \end{array} \begin{array}{c} A_{i-1} \\ | \\ A_i \\ | \\ A_{i+1} \end{array} \dots \begin{array}{c} \text{---} \\ | \\ \text{---} \end{array} . \quad (9)$$

$$\langle \Psi | O_i | \Psi \rangle = \begin{array}{c} \text{---} \\ | \\ \text{---} \end{array} \dots \begin{array}{c} \text{---} \\ | \\ \text{---} \end{array} \begin{array}{c} L_{i-1} \\ | \\ C_i \\ | \\ R_{i+1} \end{array} \dots \begin{array}{c} \text{---} \\ | \\ \text{---} \end{array} = \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \quad (10)$$

Multi-site expectation value:

$$\langle \Psi | O | \Psi \rangle = \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \quad (11)$$

MPO:

$$\boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} = \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \quad (12)$$

MPO expectation value:

$$\langle \Psi | H | \Psi \rangle = \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \dots \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \begin{array}{c} L_{i-1} \\ | \\ C_i \\ | \\ R_{i+1} \end{array} \dots \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} = E_{i-1} \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \begin{array}{c} C_i \\ | \\ D_i \end{array} F_{i+1} = E_i \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \begin{array}{c} D_i \\ | \\ C_i \end{array} F_{i+1} . \quad (13)$$

Environment tensors:

$$E_1 \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \equiv \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \quad , \quad E_i \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \equiv E_{i-1} \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \begin{array}{c} L_i \\ | \\ D_i \end{array} F_{i+1} . \quad (14)$$

$$F_N \equiv \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \quad , \quad F_i \equiv \boxed{\begin{array}{c} \text{---} \\ | \\ \text{---} \end{array}} \begin{array}{c} R_N \\ | \\ R_i \end{array} F_{i+1} . \quad (15)$$

iMPS:

$$|\Psi\rangle = \dots \begin{array}{c} \text{---} \\ | \\ \text{---} \end{array} \dots \quad (16)$$

Transfer matrix:

$$T = \begin{array}{c} \text{---} \\ | \\ \text{---} \end{array} . \quad (17)$$

MPS norm:

$$\langle \Psi | \Psi \rangle = \dots \begin{array}{c} \text{---} \\ | \\ \text{---} \end{array} \dots \quad (18)$$

Left-orthogonal form:

$$\boxed{\text{Diagram: Tensor with 2 vertical indices, 1 horizontal index}} = \boxed{[}, \quad \boxed{\text{Diagram: Tensor with 3 indices (2 vertical, 1 horizontal), rho_L}} = \boxed{[\rho_L].} \quad (19)$$

Right-orthogonal form:

$$\boxed{\text{Diagram: Tensor with 2 vertical indices, 1 horizontal index}} = \boxed{]}, \quad \boxed{\text{Diagram: Tensor with 3 indices (2 vertical, 1 horizontal), rho_R}} = \boxed{]\rho_R}. \quad (20)$$

Mixed-canonical form:

$$|\Psi\rangle = \dots \boxed{\text{Diagram: Tensor}} \boxed{\text{Diagram: Tensor}} \dots = \dots \boxed{\text{Diagram: Tensor}} \boxed{\text{Diagram: Tensor}} \dots \quad (21)$$

iMPS expectation value:

$$\langle \Psi | O_i | \Psi \rangle = \dots \boxed{\text{Diagram: Tensor}} \boxed{\text{Diagram: Tensor}} \dots = \boxed{\text{Diagram: Tensor}} \rho_L. \quad (22)$$

$$\langle \Psi | O_i | \Psi \rangle = \dots \boxed{\text{Diagram: Tensor}} \boxed{\text{Diagram: Tensor}} \dots = \boxed{\text{Diagram: Tensor}} \rho_R. \quad (23)$$

Environment tensor recursion relation:

$$E(n+1) \boxed{\text{Diagram: Tensor}}_\alpha = E(n) \boxed{\text{Diagram: Tensor}}_{\alpha-\beta} + \sum_{\beta < \alpha} E(n) \boxed{\text{Diagram: Tensor}}_{\beta-\alpha}. \quad (24)$$

Big diagram:

$$|\Psi\rangle = \boxed{\text{Diagram: Tensor}}_{A_1} \boxed{\text{Diagram: Tensor}}_{A_2} \boxed{\text{Diagram: Tensor}}_{A_3} \dots \boxed{\text{Diagram: Tensor}}_{A_{N-1}} \boxed{\text{Diagram: Tensor}}_{A_N}. \quad (25)$$

Inline diagram: $|\Psi\rangle = \boxed{\text{Diagram: Tensor}} - \boxed{\text{Diagram: Tensor}} - \dots - \boxed{\text{Diagram: Tensor}}$. % Patterns for tensors:

$$B^s = \boxed{\text{Diagram: Tensor}}^{N_L}_X. \quad (26)$$

iPEPS:

$$|\Psi\rangle = \dots \boxed{\text{Diagram: Tensor}} \boxed{\text{Diagram: Tensor}} \dots \quad (27)$$

Schmidt decomposition:

$$\begin{array}{c} \boxed{} \\ | \quad | \quad | \quad \dots \quad | \\ 1 \quad 2 \quad 3 \quad \dots \quad N \end{array} = \begin{array}{c} \boxed{} \\ | \quad | \quad \dots \quad | \\ 1 \quad \dots \quad n \end{array} \text{---} \bigcirc \text{---} \begin{array}{c} \boxed{} \\ | \quad | \quad \dots \quad | \\ n+1 \quad \dots \quad N \end{array}. \quad (28)$$