

# TikZ tensor network diagrams

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Finite MPS:

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

Gauge transform:

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

Left-orthogonal form:

$$\begin{array}{c} A_i \\ \circ \\ | \end{array} \rightarrow \begin{array}{c} L_i \\ \lrcorner \\ | \end{array} , \quad \begin{array}{c} L_i \\ \lrcorner \\ | \\ \lrcorner \\ L_i \end{array} = \left[ \begin{array}{c} \\ \\ \end{array} \right] . \quad (3)$$

Right-orthogonal form:

$$\begin{array}{c} A_i \\ \circ \\ | \end{array} \rightarrow \begin{array}{c} R_i \\ \lrcorner \\ | \end{array} , \quad \begin{array}{c} R_i \\ \lrcorner \\ | \\ \lrcorner \\ R_i \end{array} = \left] \begin{array}{c} \\ \\ \end{array} \right] . \quad (4)$$

SVD:

$$\begin{array}{c} A_i \\ \circ \\ | \end{array} = \begin{array}{c} U \\ \lrcorner \\ | \end{array} \begin{array}{c} D \\ \diamond \\ | \end{array} \begin{array}{c} V^\dagger \\ \lrcorner \\ | \end{array} . \quad (5)$$

Mixed-canonical form:

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

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

Unitary gauge transformation:

$$\begin{array}{c} L_i \\ \lrcorner \\ | \end{array} \rightarrow \begin{array}{c} U_{i-1}^\dagger \quad L_i \quad U_i \\ \circ - \lrcorner - \circ \\ | \quad | \quad | \end{array} . \quad (8)$$

Expectation value:

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

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

Multi-site expectation value:

$$\langle \Psi | O | \Psi \rangle = \begin{array}{c} L_{i-1} \quad C_i \quad R_{i+1} \\ \text{---} \square \text{---} \square \text{---} \square \text{---} \square \text{---} \\ | \quad | \quad | \quad | \\ \text{---} \square \text{---} \square \text{---} \square \text{---} \square \text{---} \\ | \quad | \quad | \quad | \\ \text{---} \square \text{---} \square \text{---} \square \text{---} \square \text{---} \end{array} \quad (11)$$

MPO:

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

MPO expectation value:

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

Environment tensors:

$$E_1 \begin{array}{c} L_1 \\ \text{---} \square \text{---} \square \text{---} \square \text{---} \end{array} \equiv \begin{array}{c} L_1 \\ \text{---} \square \text{---} \square \text{---} \square \text{---} \end{array}, \quad E_i \begin{array}{c} L_i \\ \text{---} \square \text{---} \square \text{---} \square \text{---} \end{array} \equiv E_{i-1} \begin{array}{c} L_i \\ \text{---} \square \text{---} \square \text{---} \square \text{---} \end{array} \quad (14)$$

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

iMPS:

$$|\Psi\rangle = \cdots \text{---} \circ \text{---} \circ \text{---} \circ \text{---} \circ \text{---} \circ \text{---} \cdots \quad (16)$$

Transfer matrix:

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

MPS norm:

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

Left-orthogonal form:

$$\begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square.} \end{array} = \left[ \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square.} \end{array} \right], \quad \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square, followed by a circle labeled } \rho_L. \end{array} = \left[ \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square.} \end{array} \right] \rho_L. \quad (19)$$

Right-orthogonal form:

$$\begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square.} \end{array} = \left[ \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square.} \end{array} \right], \quad \rho_R \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square, followed by a circle labeled } \rho_R. \end{array} = \rho_R \left[ \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square.} \end{array} \right]. \quad (20)$$

Mixed-canonical form:

$$|\Psi\rangle = \dots \text{Diagram: A horizontal line with a sequence of squares and circles.} \dots \quad (21)$$

$$= \dots \text{Diagram: A horizontal line with a sequence of squares and circles.} \dots \quad (22)$$

iMPS expectation value:

$$\langle \Psi | O_i | \Psi \rangle = \begin{array}{c} \text{Diagram: A horizontal line with a sequence of squares and circles, with a square labeled } O_i. \end{array} = \left[ \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square, followed by a circle labeled } \rho_L. \end{array} \right] \rho_L. \quad (23)$$

$$\langle \Psi | O_i | \Psi \rangle = \begin{array}{c} \text{Diagram: A horizontal line with a sequence of squares and circles, with a square labeled } O_i. \end{array} = \left[ \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square, followed by a circle labeled } \rho_R. \end{array} \right] \rho_R. \quad (24)$$

Environment tensor recursion relation:

$$E(n+1) \left[ \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square.} \end{array} \right] \alpha = E(n) \left[ \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square, followed by a circle labeled } \alpha. \end{array} \right] \alpha + \sum_{\beta < \alpha} E(n) \left[ \begin{array}{c} \text{Diagram: A vertical line with two horizontal lines extending from the top and bottom, each ending in a small square, followed by a circle labeled } \beta. \end{array} \right] \beta. \quad (25)$$

Big diagram:

$$|\Psi\rangle = \begin{array}{c} \text{Diagram: A horizontal line with a sequence of circles labeled } A_1, A_2, A_3, \dots, A_{N-1}, A_N. \end{array}. \quad (26)$$

Inline diagram:  $|\Psi\rangle = \text{Diagram: A horizontal line with a sequence of circles.}$