

TikZ tensor network diagrams

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Finite MPS:

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

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:

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

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

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:

$$\langle \Psi | O_i | \Psi \rangle = \begin{array}{c} \text{Diagram: A horizontal chain of circles. The top row has circles labeled } A_{i-1}, A_i, A_{i+1}. \text{ The bottom row has circles. A square box labeled } O \text{ is connected to the } A_i \text{ circle and the circle below it. Ellipses indicate continuation of the chain.} \end{array} \quad (9)$$

$$\langle \Psi | O_i | \Psi \rangle = \begin{array}{c} \text{Diagram: A chain of tensors. Top row: D-shaped tensors labeled } L_{i-1}, C_i, R_{i+1}. \text{ Bottom row: D-shaped tensors. A square box labeled } O \text{ is connected to } C_i \text{ and the tensor below it.} \end{array} = \begin{array}{c} \text{Diagram: A single tensor } C_i \text{ with a square box } O \text{ inside it, connected to the top and bottom legs.} \end{array} \quad (10)$$

Multi-site expectation value:

$$\langle \Psi | O | \Psi \rangle = \begin{array}{c} \text{Diagram: A rectangular box representing a multi-site operator } O, \text{ with legs connecting to tensors } L_{i-1}, C_i, R_{i+1} \text{ on top and bottom.} \end{array} \quad (11)$$

MPO:

$$\begin{array}{c} \text{Diagram: A rectangular box with four legs (top, bottom, left, right).} \end{array} = \begin{array}{c} \text{Diagram: Three square tensors connected in series horizontally.} \end{array} \quad (12)$$

MPO expectation value:

$$\langle \Psi | H | \Psi \rangle = \begin{array}{c} \text{Diagram: A chain of tensors. Top row: D-shaped tensors labeled } L_{i-1}, C_i, R_{i+1}. \text{ Bottom row: D-shaped tensors. A square box labeled } O \text{ is connected to } C_i \text{ and the tensor below it.} \end{array} = E_{i-1} \begin{array}{c} \text{Diagram: A vertical rectangle with } C_i \text{ on top and } F_{i+1} \text{ on the right.} \end{array} F_{i+1} = E_i \begin{array}{c} \text{Diagram: A vertical rectangle with } D_i \text{ on top and } F_{i+1} \text{ on the right.} \end{array} F_{i+1}. \quad (13)$$

Environment tensors:

$$E_1 \begin{array}{c} \text{Diagram: A vertical rectangle with three legs on the left.} \end{array} \equiv \begin{array}{c} \text{Diagram: Three D-shaped tensors labeled } L_1 \text{ on top, connected to the legs of } E_1. \end{array}, \quad E_i \begin{array}{c} \text{Diagram: A vertical rectangle with three legs on the left.} \end{array} \equiv E_{i-1} \begin{array}{c} \text{Diagram: A vertical rectangle with } L_i \text{ on top and three legs on the right.} \end{array}. \quad (14)$$

$$F_N \begin{array}{c} \text{Diagram: A vertical rectangle with three legs on the left.} \end{array} \equiv \begin{array}{c} \text{Diagram: Three D-shaped tensors labeled } R_N \text{ on top, connected to the legs of } F_N. \end{array}, \quad F_i \begin{array}{c} \text{Diagram: A vertical rectangle with three legs on the left.} \end{array} \equiv \begin{array}{c} \text{Diagram: Three D-shaped tensors labeled } R_i \text{ on top, connected to the legs of } F_i. \end{array} F_{i+1}. \quad (15)$$

iMPS:

$$|\Psi\rangle = \cdots \text{---} \begin{array}{c} \text{Diagram: A circle with a vertical line extending downwards.} \end{array} \text{---} \begin{array}{c} \text{Diagram: A circle with a vertical line extending downwards.} \end{array} \text{---} \begin{array}{c} \text{Diagram: A circle with a vertical line extending downwards.} \end{array} \text{---} \begin{array}{c} \text{Diagram: A circle with a vertical line extending downwards.} \end{array} \text{---} \begin{array}{c} \text{Diagram: A circle with a vertical line extending downwards.} \end{array} \text{---} \cdots \quad (16)$$

Transfer matrix:

$$T = \begin{array}{c} \text{Diagram: Two circles connected by a vertical line. The top circle has a horizontal line extending to the left. The bottom circle has a horizontal line extending to the left.} \end{array} \quad (17)$$

MPS norm:

$$\langle \Psi | \Psi \rangle = \begin{array}{c} \text{Diagram: Two horizontal chains of circles. The top chain has circles, and the bottom chain has circles. Vertical lines connect corresponding circles in the two chains. Ellipses indicate continuation of the chains.} \end{array} \quad (18)$$

Left-orthogonal form:

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

Right-orthogonal form:

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

Mixed-canonical form:

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

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

iMPS expectation value:

$$\langle \Psi | O_i | \Psi \rangle = \begin{array}{c} \text{Diagram: A grid of tensors (squares and circles) with vertical lines.} \end{array} = \begin{array}{c} \text{Diagram: A vertical line with two horizontal segments, each ending in a small square, connected by a vertical line, followed by a circle labeled } \rho_L. \end{array} \quad (23)$$

$$\langle \Psi | O_i | \Psi \rangle = \begin{array}{c} \text{Diagram: A grid of tensors (squares and circles) with vertical lines.} \end{array} = \begin{array}{c} \text{Diagram: A vertical line with two horizontal segments, each ending in a small square, connected by a vertical line, followed by a circle labeled } \rho_R. \end{array} \quad (24)$$

Environment tensor recursion relation:

$$E(n+1) \left[\begin{array}{c} \text{Diagram: A vertical line with two horizontal segments, each ending in a small square, connected by a vertical line.} \end{array} \right] \alpha = E(n) \left[\begin{array}{c} \text{Diagram: A vertical line with two horizontal segments, each ending in a small square, connected by a vertical line.} \end{array} \right] \alpha + \sum_{\beta < \alpha} E(n) \left[\begin{array}{c} \text{Diagram: A vertical line with two horizontal segments, each ending in a small square, connected by a vertical line.} \end{array} \right] \beta \alpha. \quad (25)$$

Big diagram:

$$|\Psi\rangle = \begin{array}{c} \text{Diagram: A horizontal line with a sequence of tensors (squares and circles) and vertical lines.} \end{array} \quad (26)$$

Inline diagram: $|\Psi\rangle = \text{Diagram: A horizontal line with a sequence of tensors (squares and circles) and vertical lines.}$

Patterns for tensors:

$$B^s = \text{Diagram: A vertical line with two horizontal segments, each ending in a small square, connected by a vertical line, followed by a circle labeled } N_L \text{ and } X. \quad (27)$$

iPEPS:

$$|\Psi\rangle = \dots \begin{array}{c} \text{Diagram: A grid of tensors (squares and circles) with vertical lines.} \end{array} \dots \quad (28)$$

Schmidt decomposition:

$$\begin{array}{c} \boxed{} \\ | \quad | \quad | \quad | \\ 1 \quad 2 \quad 3 \quad \dots \quad N \end{array} = \begin{array}{c} \boxed{} \\ | \quad \dots \quad | \\ 1 \quad \quad n \end{array} \text{---} \bigcirc \text{---} \begin{array}{c} \boxed{} \\ | \quad \dots \quad | \\ n+1 \quad \dots \quad N \end{array} . \tag{29}$$