

$$\begin{array}{c}
 \begin{array}{|c|} \hline X^{(1,2)} \\ \hline \end{array} \\
 \begin{array}{c} n_1 n_2 \\ n_3 n_4 \end{array}
 \end{array}
 =
 \begin{array}{c}
 \begin{array}{|c|} \hline U_{12} \\ \hline \end{array} \\
 \begin{array}{c} n_1 n_2 \\ k_{12} \end{array}
 \end{array}
 \begin{array}{c}
 \begin{array}{|c|} \hline B_{1234}^T \\ \hline \end{array} \\
 \begin{array}{c} k_{12} \\ k_{34} \end{array}
 \end{array}
 \begin{array}{c}
 \begin{array}{|c|} \hline U_{34}^T \\ \hline \end{array} \\
 \begin{array}{c} k_{34} \\ n_3 n_4 \end{array}
 \end{array}$$

Diagram illustrating the decomposition of a matrix U_{12} into a product of three tensors:

$$U_{12} \rightarrow n_1 \begin{matrix} \text{Cube } U_{12} \\ \text{Dimensions: } n_1, n_2, k_{12} \end{matrix} \rightarrow n_1 \begin{matrix} \text{Rect } U_1 \\ \text{Dimensions: } n_1, k_1 \end{matrix} \begin{matrix} \text{Rect } U_2^T \\ \text{Dimensions: } n_2, k_2 \end{matrix} B_{12}$$