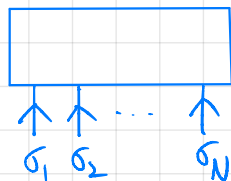
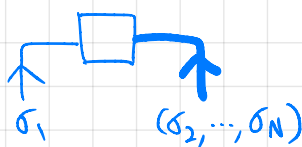


Decompose tensors into matrix product states (MPS)

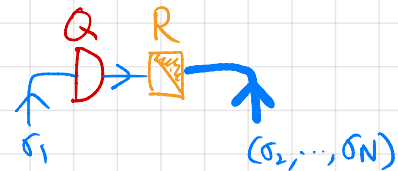
With
(thin) QR:



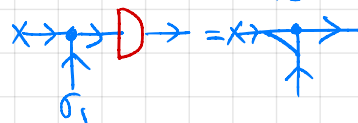
reshape



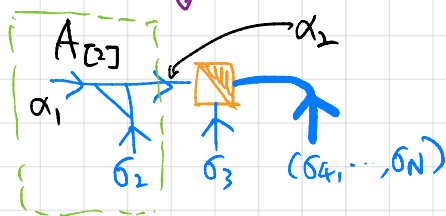
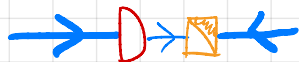
QR



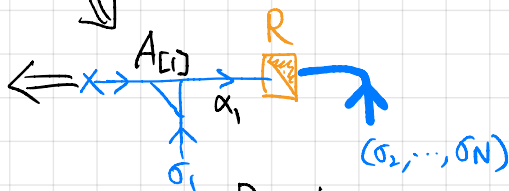
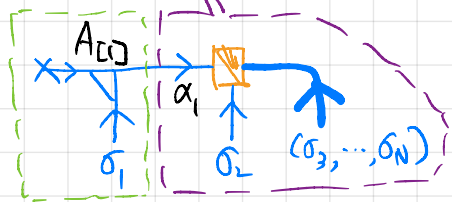
left isometry



QR

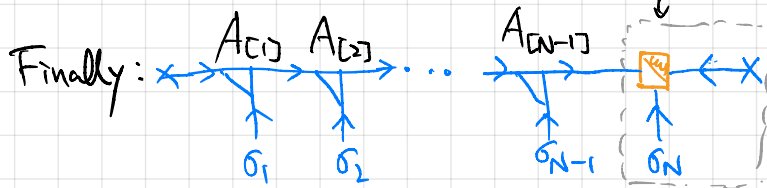


$$D_{\alpha_2} = \min(D_{\alpha_1}, d_{\sigma_2}, d_{\sigma_3}, \dots, d_{\sigma_N})$$

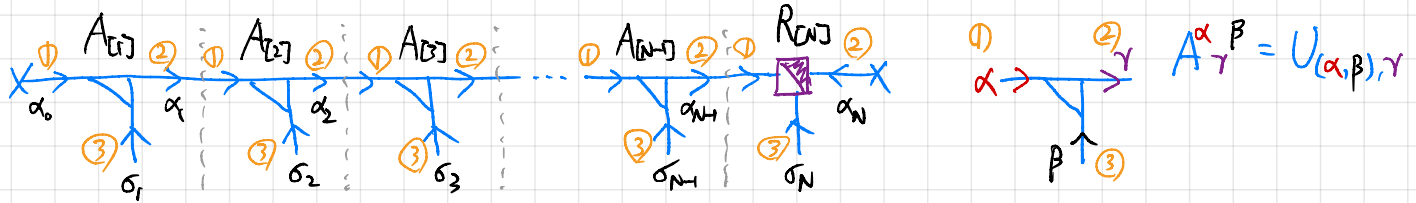


$$D_{\alpha_1} = d_{\sigma_1}$$

Neither left nor
right isometry



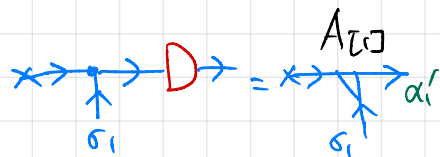
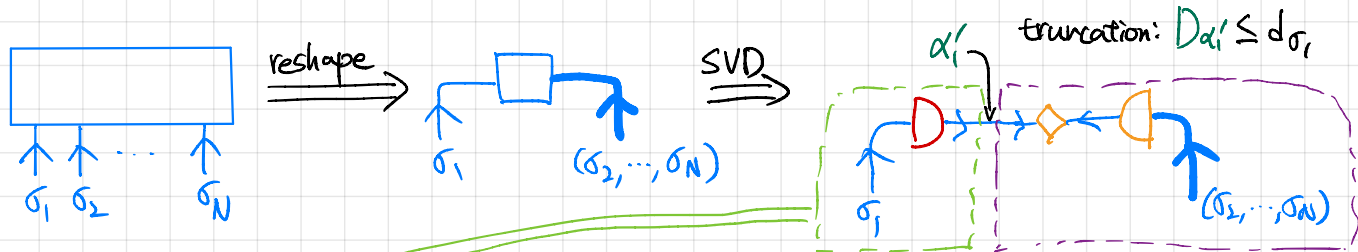
Why called matrix product states?



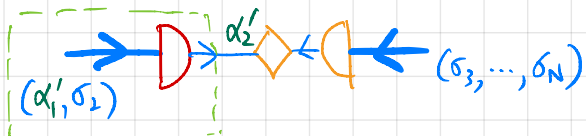
$$|\psi\rangle = |\sigma_N\rangle |\sigma_{N-1}\rangle \dots |\sigma_2\rangle |\sigma_1\rangle \underbrace{A^{(\alpha_0, \sigma_1)}_{[1]} A^{(\alpha_1, \sigma_2)}_{[2]} \dots A^{(\alpha_{N-2}, \sigma_{N-1})}_{[N-1]} R^{(\alpha_{N-1}, \sigma_N)}_{[N]}}_{\text{Rank-3 tensors with fixed indices for their physical legs = matrices}}$$

Rank-3 tensors with fixed indices for their physical legs = matrices

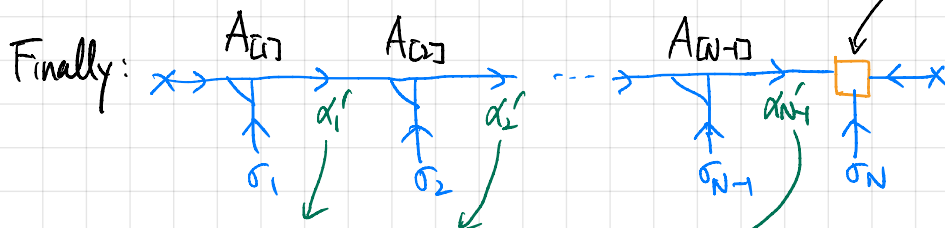
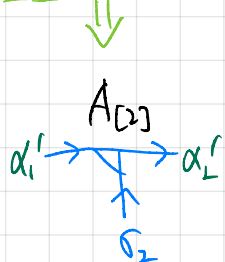
With SVD:



truncation: $D_{\alpha'_1} \leq \min(D_{\sigma_1}, d_{\sigma_2}, d_{\sigma_3}, \dots, d_{\sigma_N})$



SVD



"Bonds" can be truncated
 \Rightarrow More compact representation of MPS

Neither left nor right isometry