$$H = \sum_{\substack{ij \\ i<j}} w_{ij} Z_i Z_j \qquad i, j \in \{0, 1, 3\}$$

$$f(x) = X^T H X \qquad |X\rangle = \sum_i \frac{x_i |i\rangle}{\|X\|}$$

$$\nabla f(x) = 2HX$$

$$|X^{t+1}\rangle = |X^t\rangle - \gamma_0 \nabla f(x) |X^t\rangle$$

$$= \underline{(I - 2\gamma_0 H)} |X^t\rangle$$

$$= H^2 |X^t\rangle$$

$$H^2 = (I - \underline{2\gamma_0} H) =$$

$$= \underset{\substack{\downarrow \\ H_0^2}}{I} + \underset{\substack{\downarrow \\ B_1}}{\underline{\gamma w_{01}}} \underset{\substack{\downarrow \\ H_1^2}}{\underline{Z_0 Z_1}} + \underset{\substack{\downarrow \\ B_2}}{\underline{\gamma w_{02}}} \underset{\substack{\downarrow \\ H_2^2}}{\underline{Z_0 Z_2}} + \underset{\substack{\downarrow \\ B_3}}{\underline{\gamma w_{12}}} \underset{\substack{\downarrow \\ H_3^2}}{\underline{Z_1 Z_2}}$$

$-2\gamma_0 = \gamma$

$B_0 = 1$

$$C = \sqrt{B_0^2 + B_1^2 + B_2^2 + B_3^2 + 0 \ldots}$$

$$Y = \frac{1}{C} \sum_{i=0}^{n} B_i |i\rangle =$$

$$= \frac{B_0}{C}|00\rangle + \frac{B_1}{C}|01\rangle + \frac{B_2}{C}|10\rangle + \frac{B_3}{C}|11\rangle$$

$$|\phi_0\rangle = |Y\rangle |X^t\rangle$$

$$|\phi_1\rangle = |Y\rangle H^2 |X^t\rangle =$$

$$= \frac{B_0}{C}|00\rangle H_0^2 |X^t\rangle + \frac{B_1}{C}|01\rangle H_1^2 |X^t\rangle +$$

$$\frac{B_2}{C}|10\rangle H_2^2 |X^t\rangle + \frac{B_3}{C}|11\rangle H_3^2 |X^t\rangle =$$

$$|\phi_2\rangle = \frac{1}{\sqrt{2^2}} \Big(\mathcal{H}^2 \frac{B_0}{C}|00\rangle H_0^2 |X^t\rangle + \mathcal{H}^2 \frac{B_1}{C}|01\rangle H_1^2 |X^t\rangle +$$

Hadamard

$$\mathcal{H}^2 \frac{B_2}{C}|10\rangle H_2^2 |X^t\rangle + \mathcal{H}^2 \frac{B_3}{C}|11\rangle H_3^2 |X^t\rangle$$

$$\{|10\rangle; |10\rangle \ldots$$

$$= \frac{1}{2} \frac{1}{C} \big(\underline{|00\rangle \mathcal{H}^2 |X^t\rangle} \big) + \ldots$$

$$H^2 \cdot |X^t\rangle = |X^{t+1}\rangle$$