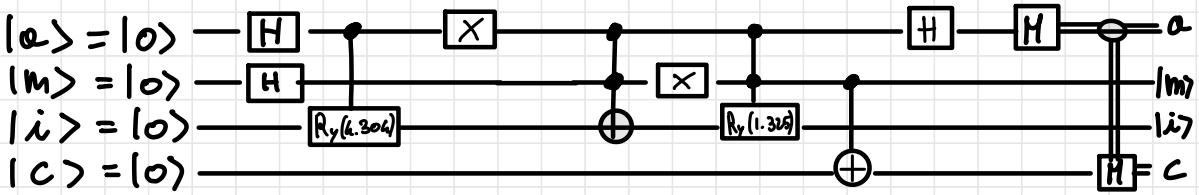
Quantum Distance-based Classifier



$$|\overset{c}{1}\overset{i}{0}\overset{m}{0}\overset{a}{0}\overset{}{0}\rangle \xrightarrow{H_a} \frac{1}{\sqrt{2}}\left(|10000\rangle + |10001\rangle\right)$$

$$\xrightarrow{H_m} \frac{1}{\sqrt{2}}\left(\frac{1}{\sqrt{2}}\left(|10000\rangle + |10010\rangle\right) + \frac{1}{\sqrt{2}}\left(|10001\rangle + |10011\rangle\right)\right)$$

$$\rightarrow \frac{1}{2}\left(|10000\rangle + |10010\rangle + |10001\rangle + |10011\rangle\right)$$

Let $CR_y(4.304) = |\psi\rangle$

$$\rightarrow \frac{1}{2}\left(|10000\rangle + |10010\rangle + |0\psi01\rangle + |0\psi11\rangle\right)$$

$$\xrightarrow{X_a} \frac{1}{2}\left(|10001\rangle + |10011\rangle + |0\psi00\rangle + |0\psi10\rangle\right)$$

$$\xrightarrow{\text{TOFFOLI}} \frac{1}{2}\left(|10001\rangle + |10111\rangle + |0\psi00\rangle + |0\psi10\rangle\right)$$

$$\xrightarrow{X_m} \frac{1}{2}\left(|10011\rangle + |10101\rangle + |0\psi10\rangle + |0\psi00\rangle\right)$$

Let $CCR_y(1.325) = |\phi\rangle$

$$\xrightarrow{CCR_y} \frac{1}{2}\left(|10\phi11\rangle + |10101\rangle + |0\psi10\rangle + |0\psi00\rangle\right)$$

$$\xrightarrow{\text{CNOT}} \frac{1}{2}\left(|1\,1\phi11\rangle + |10101\rangle + |1\psi10\rangle + |0\psi00\rangle\right)$$

$$\longrightarrow \frac{1}{2}\left(|1^{cm}1\rangle\left(|\phi^{ia}1\rangle+|\psi^{ia}0\rangle\right)+|00\rangle\left(|1^{ia}1\rangle+|\psi^{ia}0\rangle\right)\right.$$

$$\xrightarrow{H_a} \frac{1}{2}\left(|11\rangle\left(\frac{1}{\sqrt{2}}\left(|\phi 0\rangle-|\phi 1\rangle\right)+\frac{1}{\sqrt{2}}\left(|\psi 0\rangle+|\psi 1\rangle\right)\right)+\right.$$

$$+|00\rangle\left(\frac{1}{\sqrt{2}}\left(|10\rangle-|11\rangle\right)+\frac{1}{\sqrt{2}}\left(|\psi 0\rangle+|\psi 1\rangle\right)\right)\Big)$$

$$\longrightarrow \frac{1}{2}\left(|11\rangle\left(\frac{1}{\sqrt{2}}\left(|\phi 0\rangle-|\phi 1\rangle+|\psi 0\rangle+|\psi 1\rangle\right)\right)+\right.$$

$$+|00\rangle\left(\frac{1}{\sqrt{2}}\left(|10\rangle-|11\rangle+|\psi 0\rangle+|\psi 1\rangle\right)\right)\Big)$$

BRANCH 1 — BRANCH 3 — CLASH — BRANCH 2 — BRANCH 4

$$\longrightarrow \frac{1}{2}\left(|1^{cm}1\rangle\left(\frac{1}{\sqrt{2}}|0^{a}\rangle\left(|\phi\rangle+|\psi\rangle\right)+\frac{1}{\sqrt{2}}|1^{a}\rangle\left(|\psi\rangle-|\phi\rangle\right)\right)+\right.$$

$$+|00^{cm}\rangle\left(\frac{1}{\sqrt{2}}|0^{a}\rangle\left(|1\rangle+|\psi\rangle\right)+\frac{1}{\sqrt{2}}|1^{a}\rangle\left(|\psi\rangle-|1\rangle\right)\right)\Big)$$

WE FOCUS ONLY ON THE VALUES IN PURPLE WHICH HAVE $|0\rangle = |0\rangle$ $\Rightarrow$ CONSTRUCTIVE INTERFERENCE

YOU CAN SUBSTITUTE THE FOLLOWING VALUES AND SEE WHAT HAPPENS!

$|\psi\rangle = -0.549|0\rangle + 0.836|1\rangle$

$|\phi\rangle = 0.789|0\rangle + 0.615|1\rangle$