QUANTUM DISTANCE - based CLASSIFIER

$|a\rangle = |0\rangle$ — H —
$|m\rangle = |0\rangle$ — H —
$|i\rangle = |0\rangle$
$|c\rangle = |0\rangle$

$$\begin{array}{ccccc} c & i & m & a \\ |0 & 0 & 0 & 0 & 0\rangle \end{array} \xrightarrow{\;H_a\;} \frac{1}{\sqrt{2}}\left(\overset{c\,i\,m\,a}{|00000\rangle} + \overset{c\,i\,m\,a}{|00001\rangle} \right)$$

$$\xrightarrow{\;H_m\;} \frac{1}{\sqrt{2}}\left(\frac{1}{\sqrt{2}}\left(\overset{c\,i\,m\,a}{|00000\rangle} + \overset{c\,i\,m\,a}{|00010\rangle} \right) + \frac{1}{\sqrt{2}}\left(\overset{c\,i\,m\,a}{|00001\rangle} + \overset{c\,i\,m\,a}{|00011\rangle} \right) \right)$$
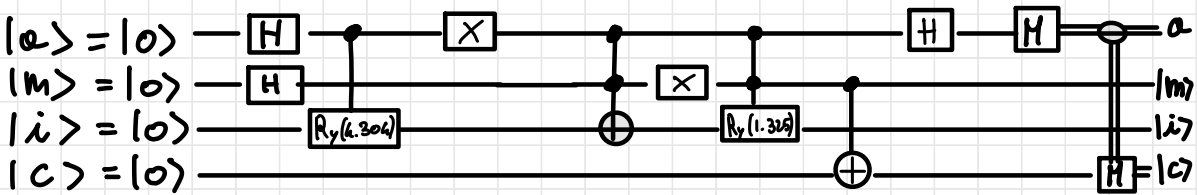
$$\longrightarrow \frac{1}{2}\left(|00000\rangle + |00010\rangle + |00001\rangle + |00011\rangle \right)$$

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

$$\longrightarrow \frac{1}{2}\left(|00000\rangle + |00\psi0\rangle + |0\psi01\rangle + |0\psi11\rangle \right)$$

$$\xrightarrow{\;X_a\;} \frac{1}{2}\left(|00001\rangle + |00\psi1\rangle + |0\psi00\rangle + |0\psi10\rangle \right)$$

$$\xrightarrow{\;Toffoli\;} \frac{1}{2}\left(|00001\rangle + |0\psi11\rangle + |0\psi00\rangle + |0\psi10\rangle \right)$$

$$\xrightarrow{\;X_m\;} \frac{1}{2}\left(|00011\rangle + |0\psi01\rangle + |0\psi10\rangle + |0\psi00\rangle \right)$$

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

$$\xrightarrow{\;CCR_y\;} \frac{1}{2}\left(|0\phi11\rangle + |0\psi01\rangle + |0\psi10\rangle + |0\psi00\rangle \right)$$

$$\xrightarrow{\;CNOT\;} \frac{1}{2}\left(|1\phi11\rangle + |0\psi01\rangle + |1\psi10\rangle + |0\psi00\rangle \right)$$

$$\longrightarrow \frac{1}{2}\left(|\overset{cm}{111}\rangle\left(|\overset{i}{\phi}\overset{a}{1}\rangle+|\overset{\tilde{i}}{\psi}\overset{a}{0}\rangle\right)+|00\rangle\left(|\overset{i}{1}\overset{a}{1}\rangle+|\overset{i}{\psi}\overset{a}{0}\rangle\right)\right)$$

$$\overset{H_a}{\longrightarrow} \frac{1}{2}\left(|111\rangle\left(\frac{1}{\sqrt{2}}\left(|\phi 0\rangle-|\phi 1\rangle\right)+\frac{1}{\sqrt{2}}\left(|\psi 0\rangle+|\psi 1\rangle\right)\right)+$$

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

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

$$+|007\rangle\left(\frac{1}{\sqrt{2}}\left(|10\rangle-|11\rangle+|\psi 0\rangle+|\psi 1\rangle\right)\right)\right)$$

$$\longrightarrow \frac{1}{2}\left(|\overset{cm}{111}\rangle\left(\frac{1}{\sqrt{2}}|\overset{a}{0}\rangle\underline{\left(|\phi\rangle+|\psi\rangle\right)}+\frac{1}{\sqrt{2}}|\overset{a}{1}\rangle\left(|\psi\rangle-|\phi\rangle\right)\right)+$$

— BRANCH 2 — BRANCH 3 — CLASH

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

— BRANCH 2 — BRANCH 4 —

WE FOCUS ONLY ON THE VALUES IN PURPLE
WHICH HAVE $|a\rangle \approx |0\rangle \implies$ CONSTRUCTIVE
INTERFERENCE

YOU CAN SUBSTITUTE THE FOLLOWING VALUES AND SEE WHAT HAPPENS!
$$|\psi\rangle = -0.549|0\rangle + 0.836|1\rangle$$

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