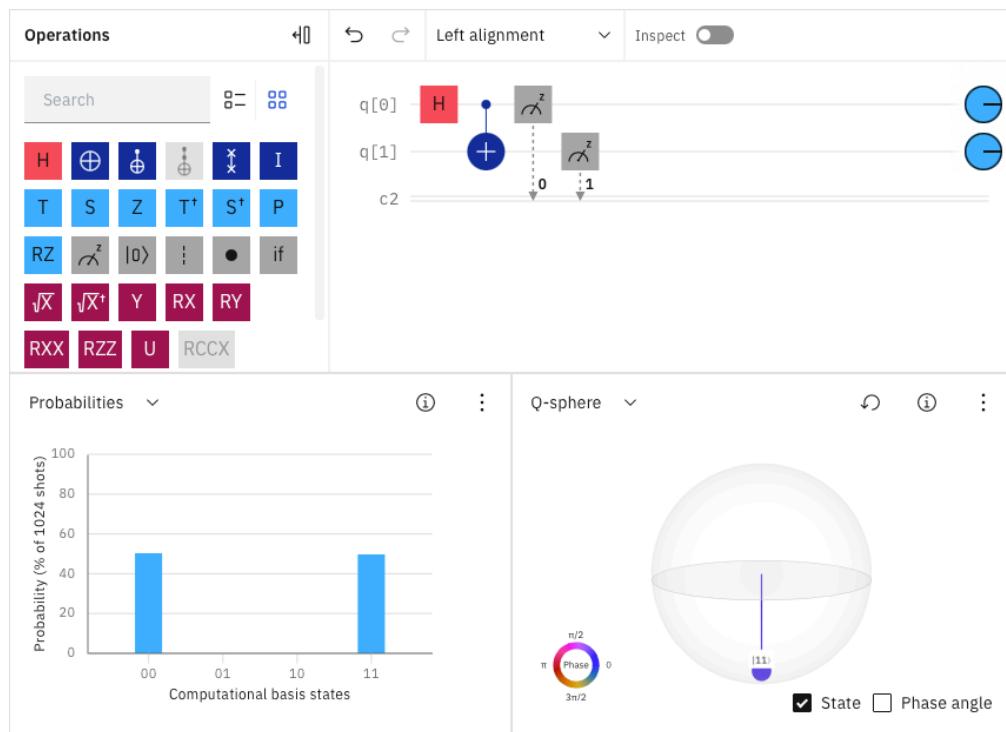


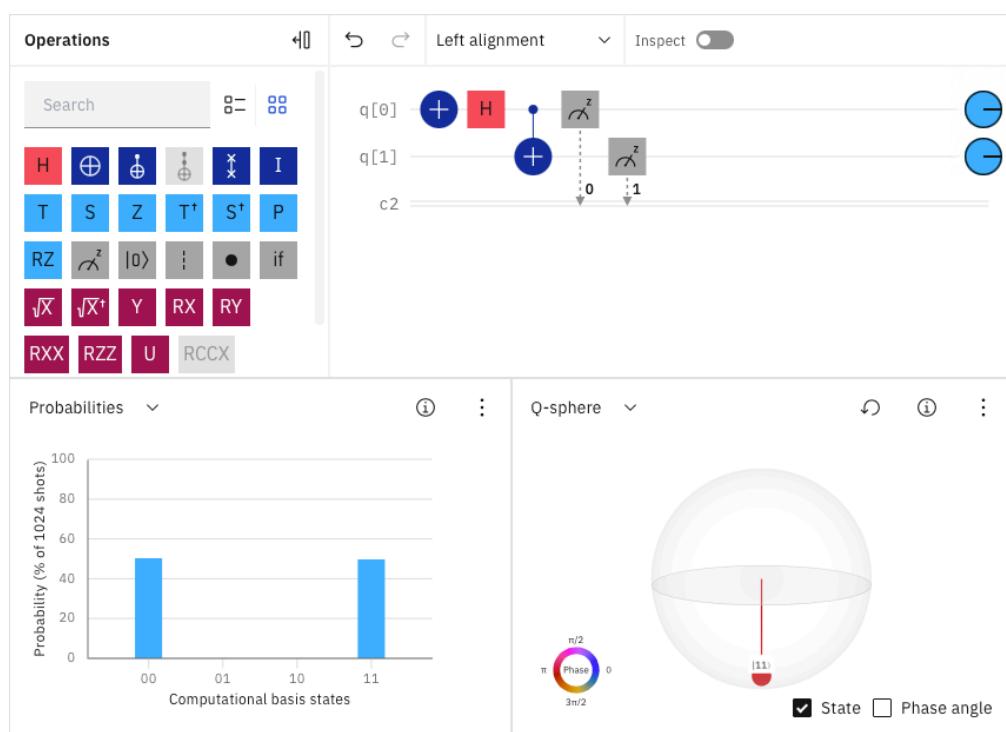
Report 2

Kacper Dobek 148247

Task 1



Task 2



TASK 2

$$|\phi\rangle = CX(I \otimes H)(I \otimes X)|00\rangle$$

$$|00\rangle = \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \end{pmatrix} \quad (I \otimes X) = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{pmatrix}$$

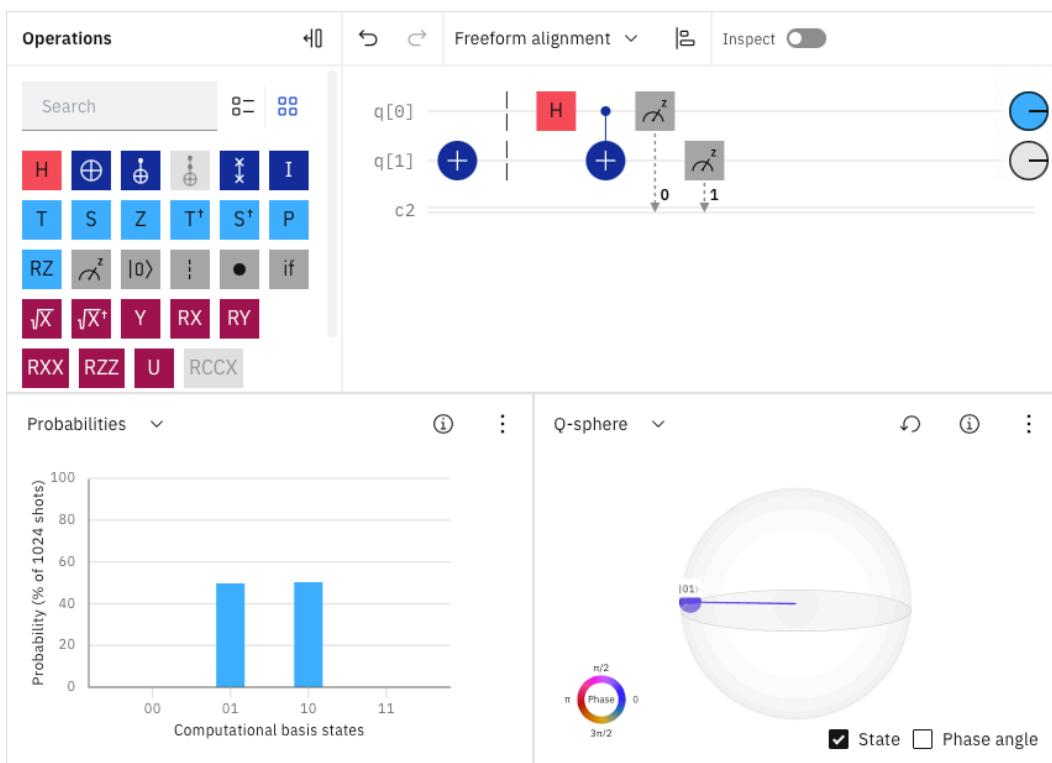
$$CX = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix} \quad (I \otimes H) = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 & 0 & 0 \\ 1 & -1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & -1 \end{pmatrix}$$

$$(I \otimes X)|00\rangle = \begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}$$

$$(I \otimes H)(I \otimes X)|00\rangle = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 & 0 & 0 \\ 1 & -1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & -1 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ -1 \\ 0 \\ 0 \end{pmatrix}$$

$$CX(I \otimes H)(I \otimes X)|00\rangle = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix} \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ -1 \\ 0 \\ 0 \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ 0 \\ 0 \\ -1 \end{pmatrix} = |\phi\rangle$$

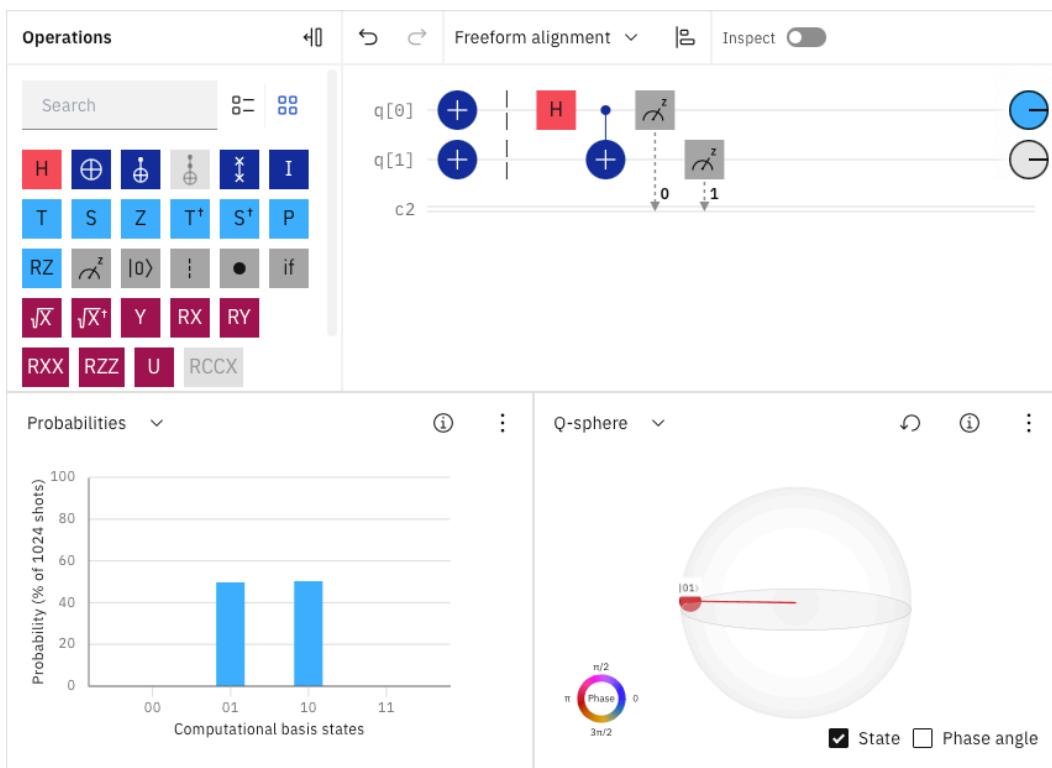
Task 3



TASK 3

$$\begin{aligned}
 |100\rangle &= |10\rangle \otimes |0\rangle \xrightarrow{\hat{X} \otimes \hat{I}} (\hat{X}|10\rangle \otimes (\hat{I}|0\rangle)) = \\
 &= |11\rangle \otimes |0\rangle \xrightarrow{\hat{I} \otimes \hat{A}} (\hat{I}|11\rangle \otimes (\hat{A}|0\rangle)) = \\
 &= |11\rangle \otimes \left(\frac{1}{\sqrt{2}}(|10\rangle + |11\rangle)\right) = \frac{1}{\sqrt{2}}(|11\rangle \otimes |0\rangle + \\
 &\quad |11\rangle \otimes |11\rangle) \xrightarrow{\hat{C}_x} \frac{1}{\sqrt{2}}(\hat{C}_x(|11\rangle \otimes |0\rangle) + \hat{C}_x(|11\rangle \otimes \\
 &\quad |11\rangle)) = \frac{1}{\sqrt{2}}(|110\rangle + |101\rangle) = |\Psi^+\rangle
 \end{aligned}$$

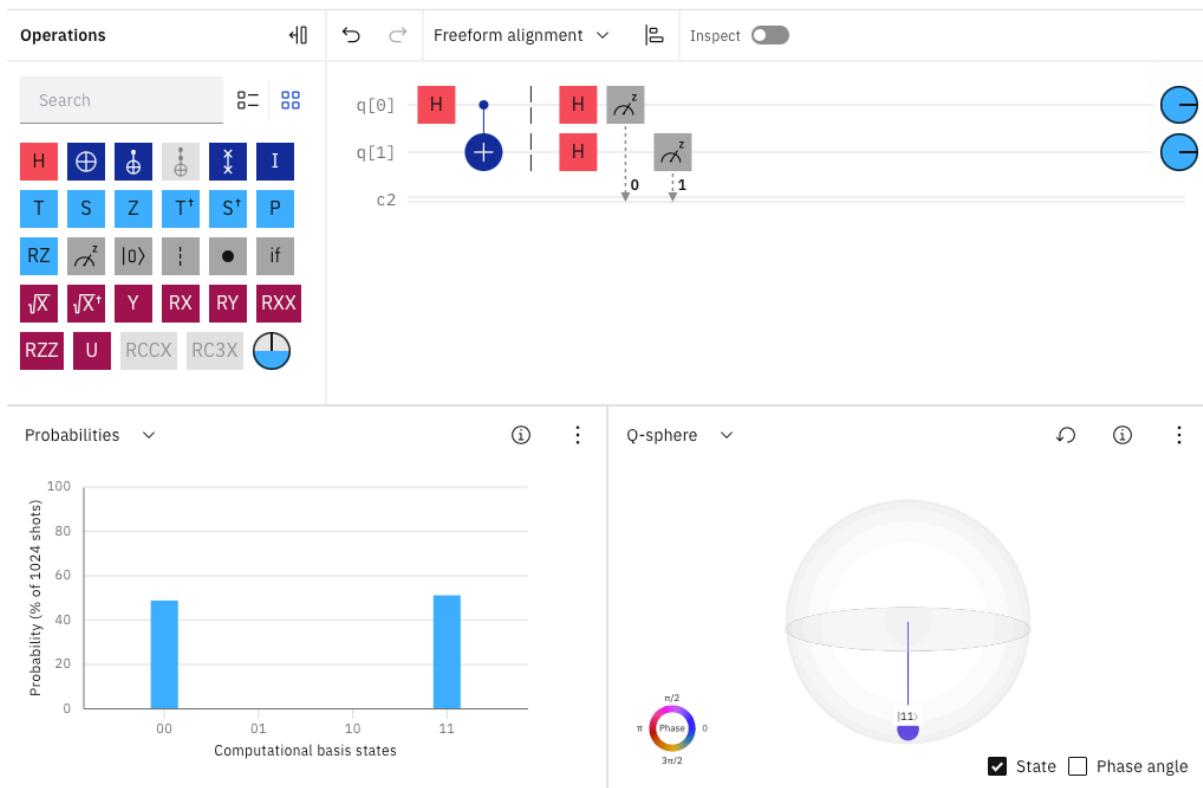
Task 4



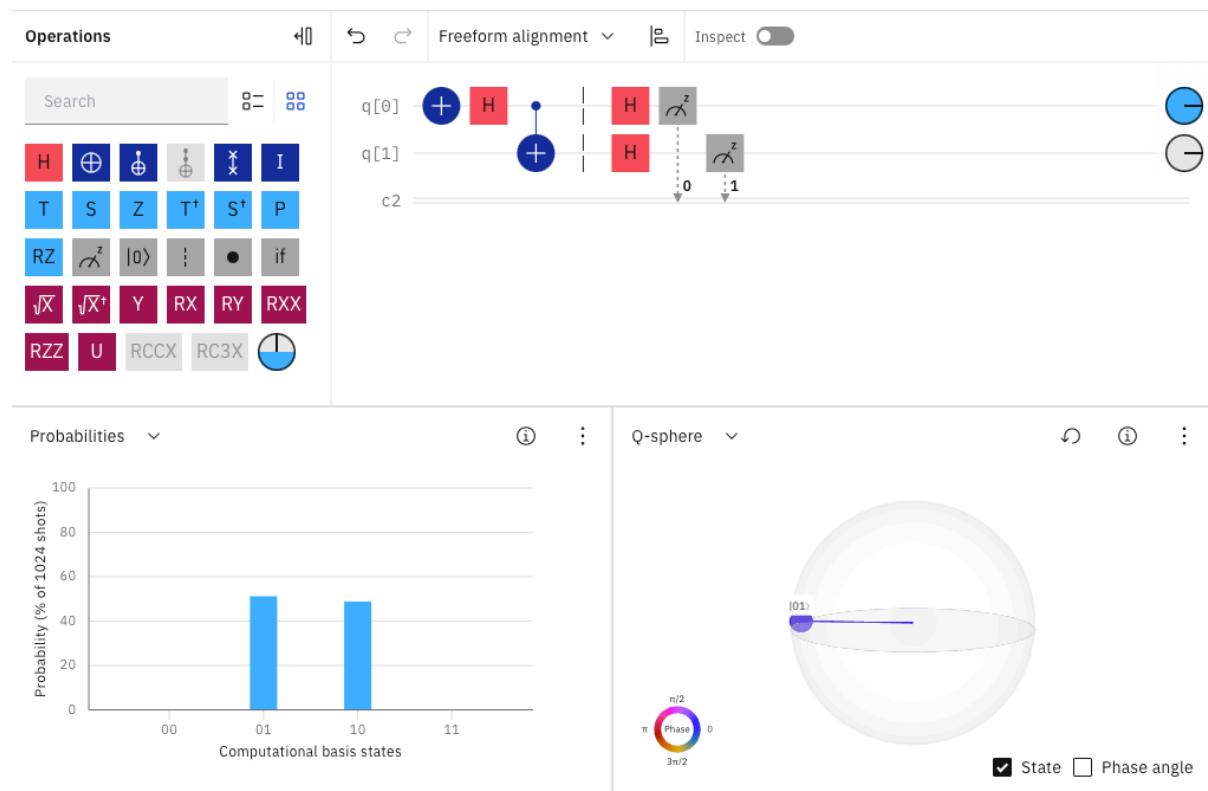
TASK 4

$$\begin{aligned}
 |100\rangle &= |10\rangle \otimes |10\rangle \xrightarrow{\hat{X} \otimes \hat{X}} (\hat{X}|10\rangle) \otimes (\hat{X}|10\rangle) = \\
 &= |11\rangle \otimes |11\rangle \xrightarrow{\hat{I} \otimes \hat{H}} (\hat{I}|11\rangle) \otimes (\hat{H}|11\rangle) = \\
 &= |11\rangle \otimes \left(\frac{1}{\sqrt{2}}(|10\rangle - |11\rangle) \right) = \frac{1}{\sqrt{2}} (|11\rangle \otimes |10\rangle \\
 &\quad - |11\rangle|11\rangle) \xrightarrow{\hat{C}_x} \frac{1}{\sqrt{2}} (\hat{C}_x(|110\rangle) - \hat{C}_x(|111\rangle) = \\
 &= \frac{1}{\sqrt{2}} (|110\rangle - |101\rangle)
 \end{aligned}$$

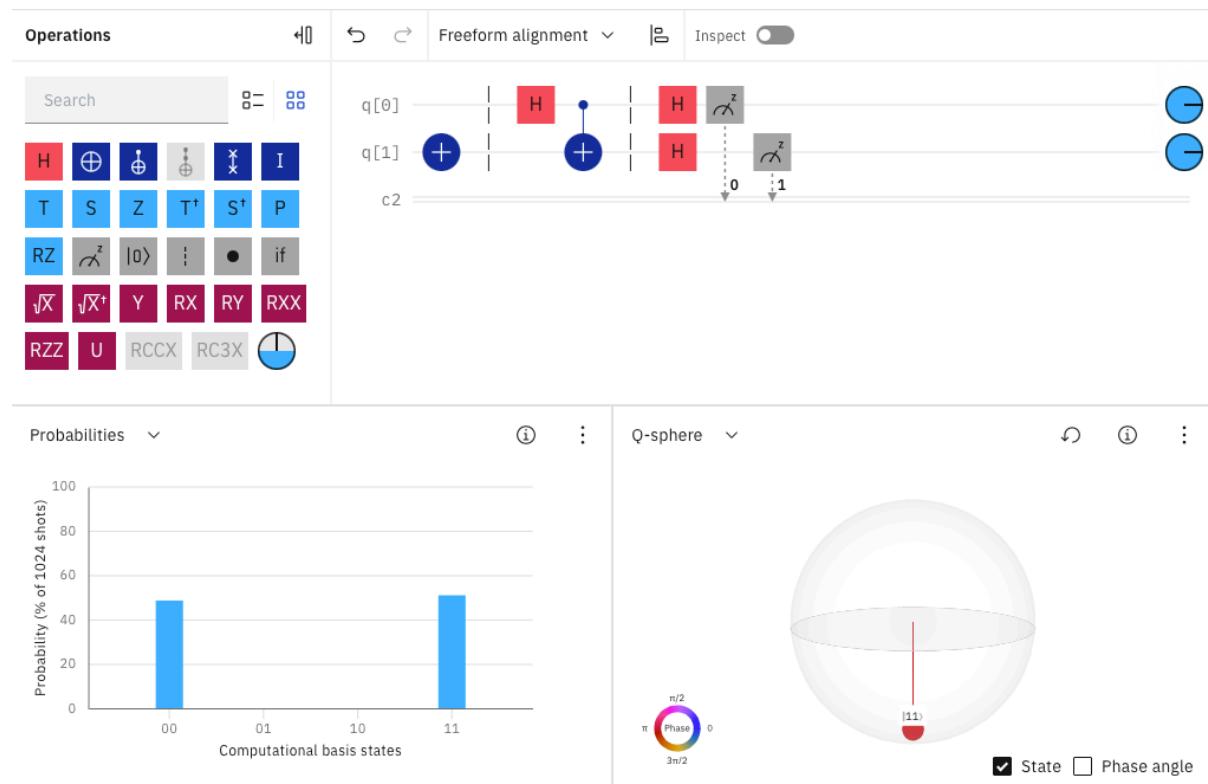
Task 5.1



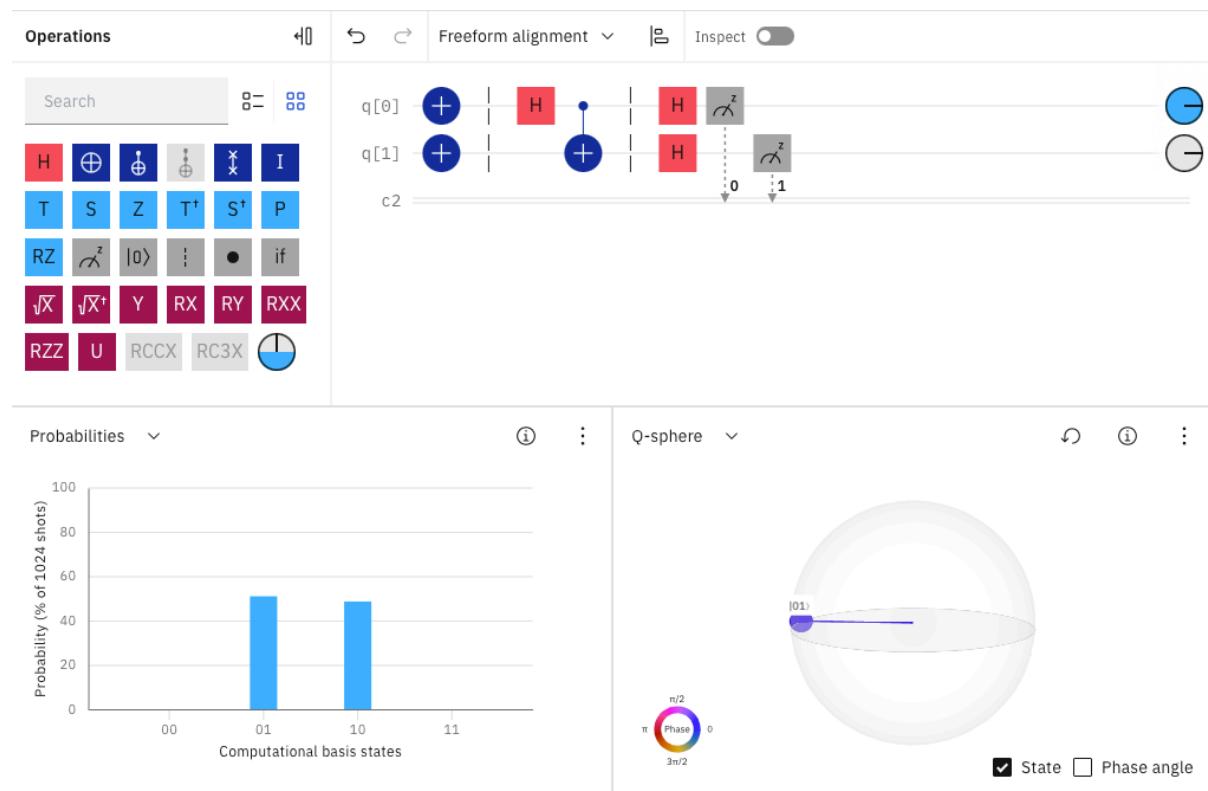
Task 5.2



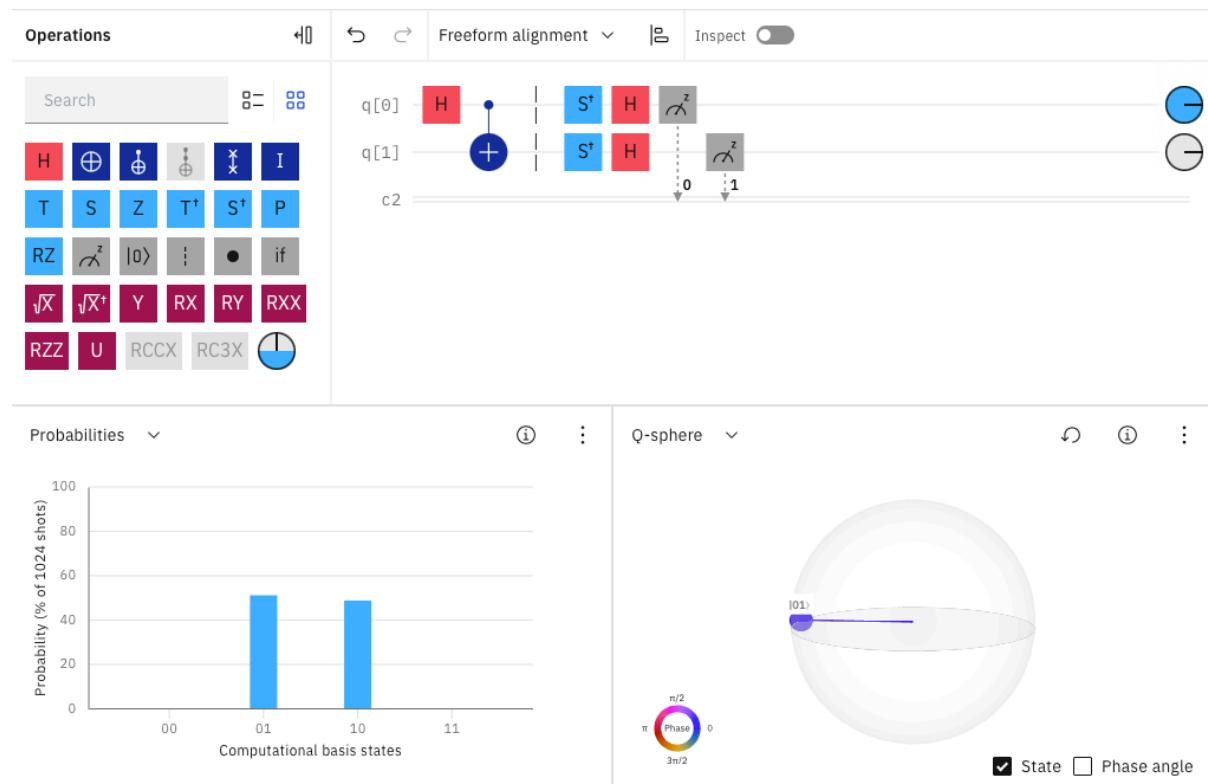
Task 5.3



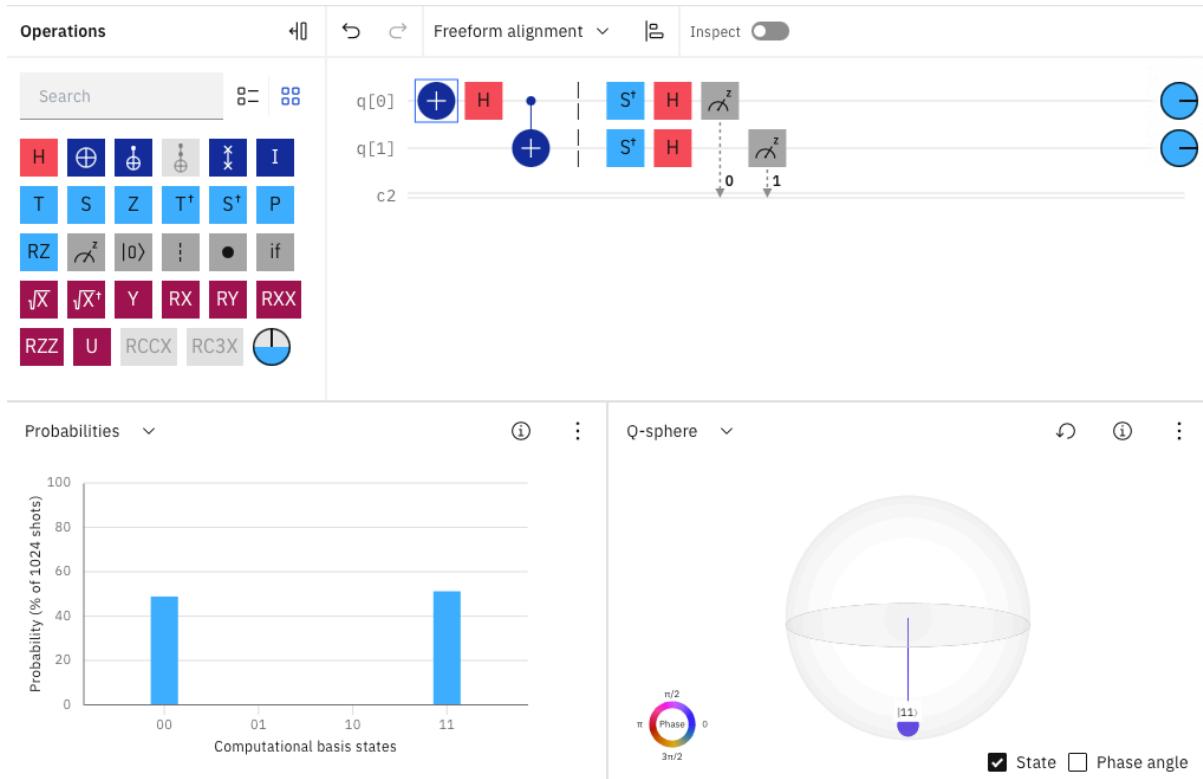
Task 5.4



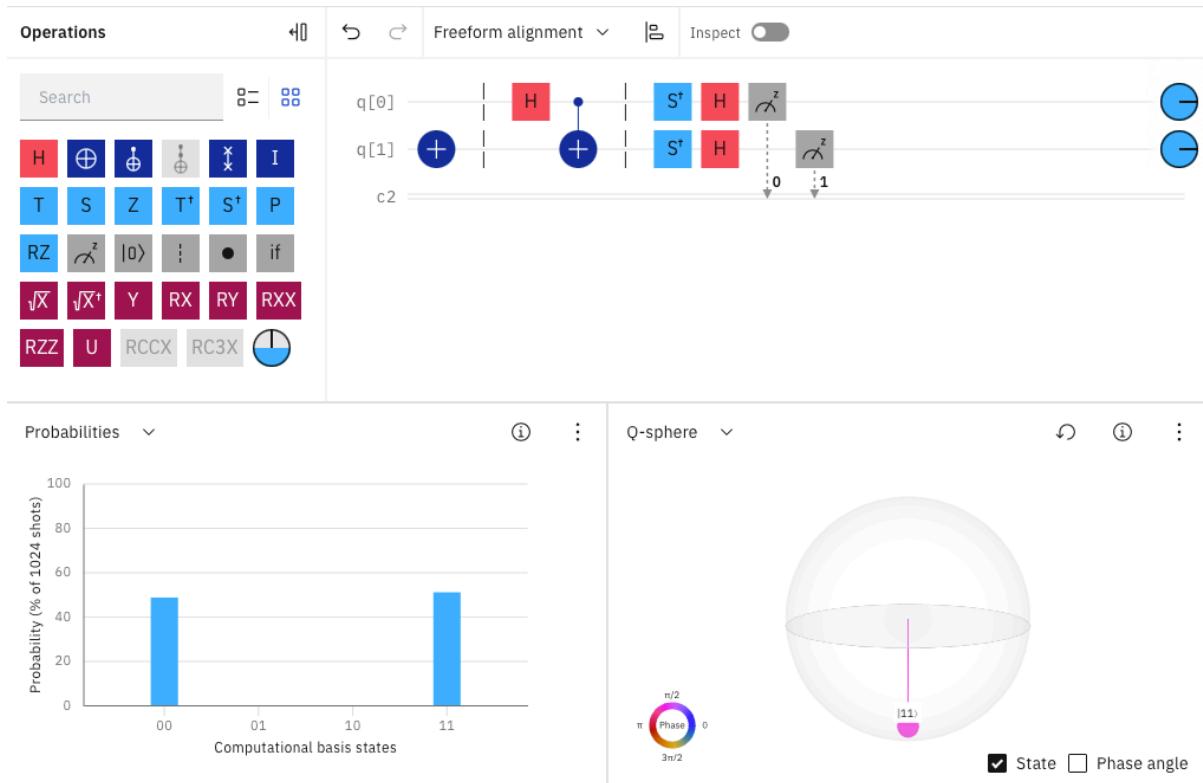
Task 6.1



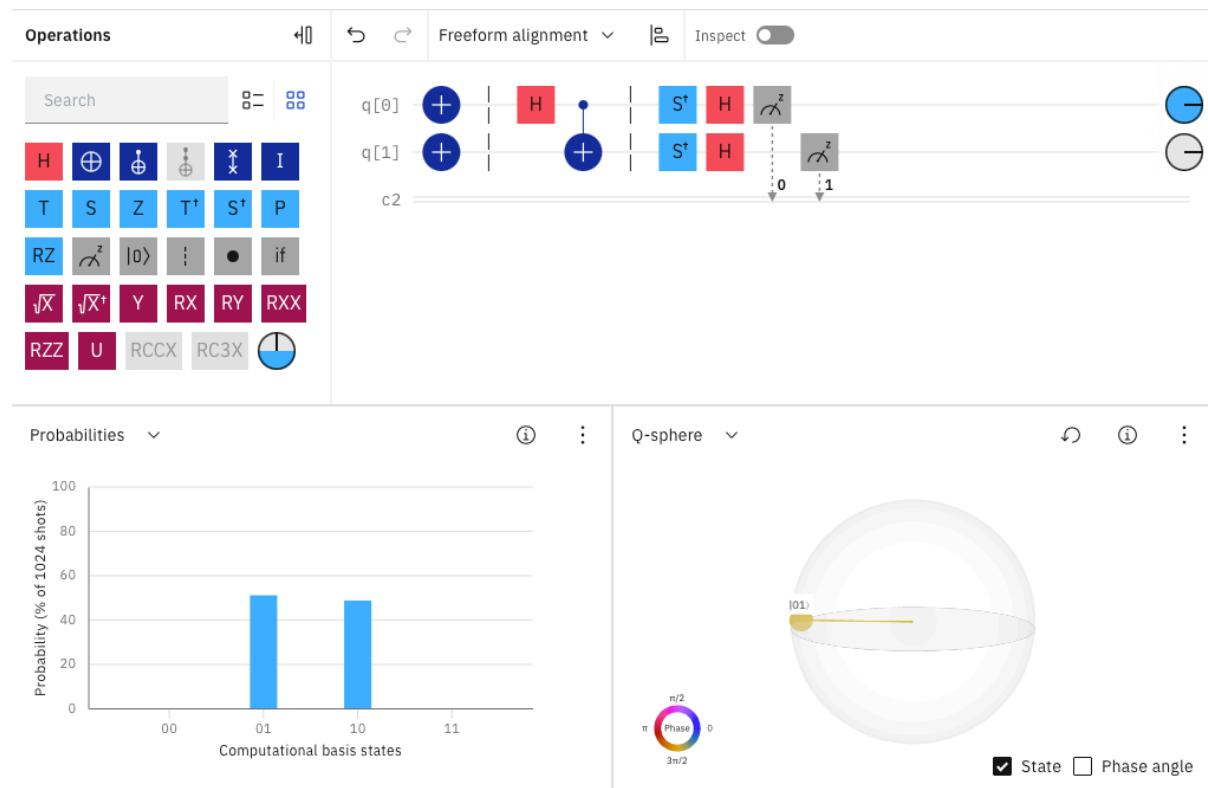
Task 6.2



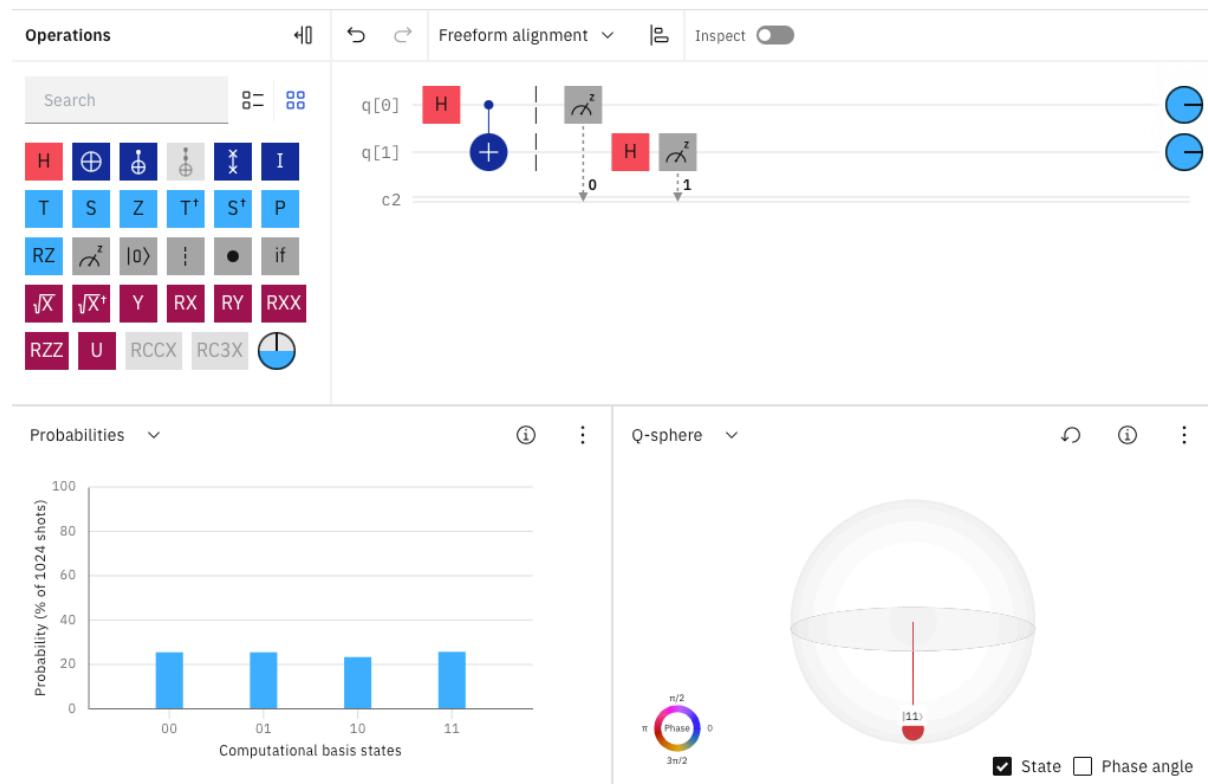
Task 6.3



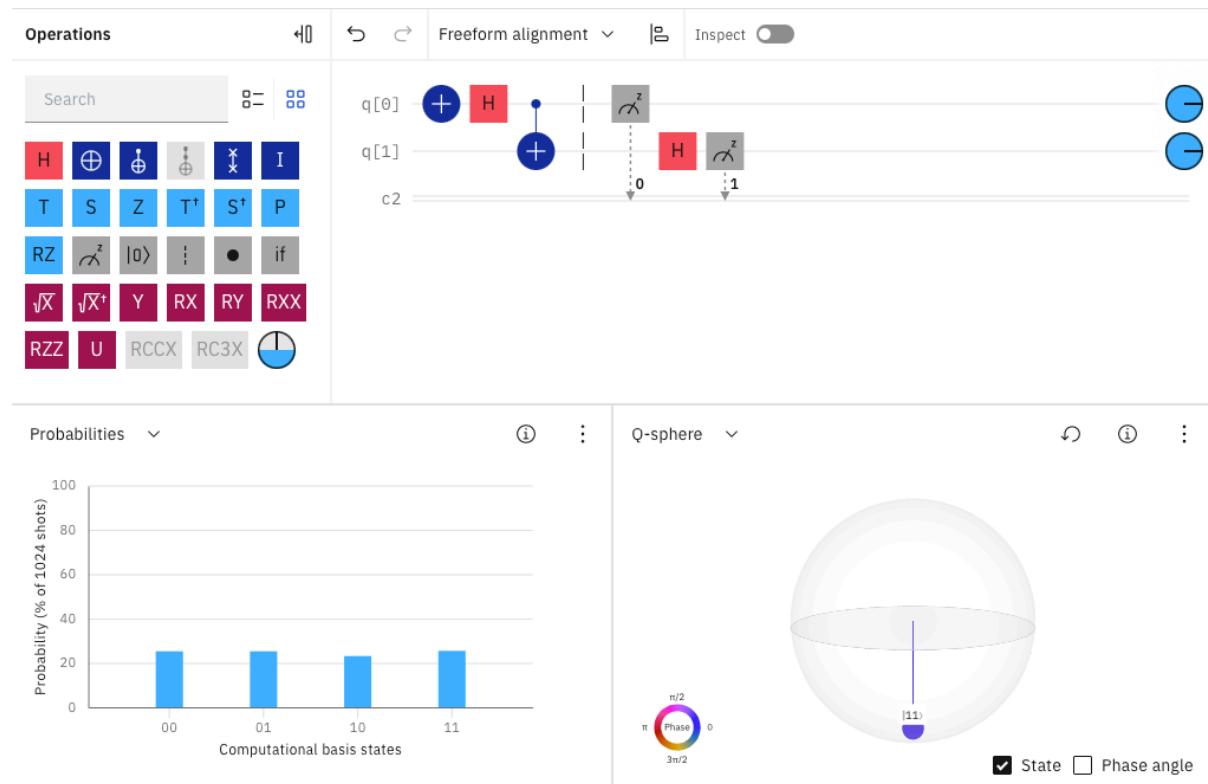
Task 6.4



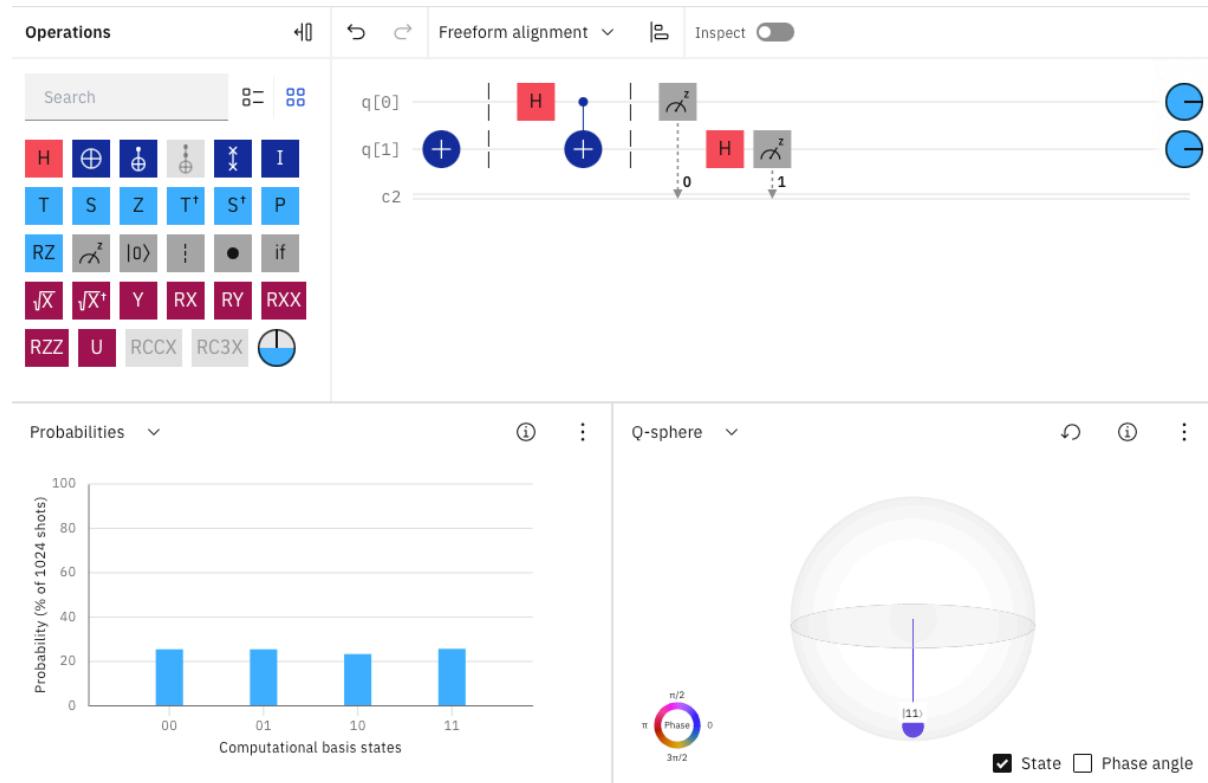
Task 7.1



Task 7.2



Task 7.3



Task 7.4

