6. Solve all parts of this problem.

6.a. What is the result of applying Hadamard transform to the state 0.6|0> − 0.8|1>?

6.b. What is the result of applying the quantum version of negation to the state 0.6|0> − 0.8|1>?

6.c. What is the result of applying the quantum version of "or"-operation to the states 0.6|0> − 0.8|1> and 0.8i|0> − 0.6|1>?

\[ H(0.6|0> - 0.8|1>) = H(0.6|0>) - H(0.8|1>) \]

\[ H(0.6|0>) = 0.6 \left( \frac{1}{\sqrt{2}} |0> + \frac{1}{\sqrt{2}} |1> \right) = \frac{3}{\sqrt{2}} |0> + \frac{3}{\sqrt{2}} |1> \]

\[ H(0.8|1>) = 0.8 \left( \frac{1}{\sqrt{2}} |0> - \frac{1}{\sqrt{2}} |1> \right) = \frac{4}{\sqrt{2}} |0> - \frac{4}{\sqrt{2}} |1> \]

Thus,

\[ H(0.6|0> - 0.8|1>) = \frac{3}{\sqrt{2}} |0> + \frac{3}{\sqrt{2}} |1> - \frac{4}{\sqrt{2}} |0> + \frac{4}{\sqrt{2}} |1> = \frac{-1}{\sqrt{2}} |0> + \frac{7}{\sqrt{2}} |1> \]

\[ (0.6|0> - 0.8|1>) \otimes |10> \]

\[ 0.6|100> - 0.8|110> \]

Now we apply \( f(x) = 7x \)

Thus we have,

\[ 0.6|101> - 0.8|110> \]

\[ (0.6|0> - 0.8|1>) \otimes (0.8i|10> - 0.6|1>) \otimes |11> \]

\[ = 0.48i|1001> - 0.36i|1011> - 0.64i|1101> + 0.48i|1111> \]

\[ f(x) = x_1 \text{ or } x_2 \]

\[ |x, x_2, y \rightarrow |x, x_2, y \oplus f(x) \]
\[ \begin{align*}
|001\rangle & \longrightarrow |001\rangle \\
|101\rangle & \longrightarrow |010\rangle \\
|110\rangle & \longrightarrow |100\rangle \\
|111\rangle & \longrightarrow |110\rangle \\
\end{align*} \]

Thus the final result is

\[ 0.48i \: |001\rangle - 0.26 |010\rangle - 0.64i |100\rangle + 0.48 |110\rangle \]
8. Solve only one part of this problem -- corresponding to your UTEP ID.

8.0 What will happen if we apply the function \( f(x) = 1 \) to a general 2-bit state
\[
|00\rangle + b|01\rangle + c|10\rangle + d|11\rangle?
\]

8.1. What will happen if we apply the function \( f(x) = \text{not } x \) to a general 2-bit state
\[
|00\rangle + b|01\rangle + c|10\rangle + d|11\rangle?
\]

8.2. What will happen if we apply the function \( f(x) = x \) to a general 2-bit state
\[
|00\rangle + b|01\rangle + c|10\rangle + d|11\rangle?
\]

8.3. What will happen if we apply the function \( f(x) = 0 \) to a general 2-bit state
\[
|00\rangle + b|01\rangle + c|10\rangle + d|11\rangle?
\]
8. Solve only one part of this problem -- corresponding to your UTEP ID.

8.0 What will happen if we apply the function \( f(x) = 1 \) to a general 2-bit state

\[ a|00\rangle + b|01\rangle + c|10\rangle + d|11\rangle? \]

8.1. What will happen if we apply the function \( f(x) = \text{not } x \) to a general 2-bit state

\[ a|00\rangle + b|01\rangle + c|10\rangle + d|11\rangle? \]

8.2. What will happen if we apply the function \( f(x) = x \) to a general 2-bit state

\[ a|00\rangle + b|01\rangle + c|10\rangle + d|11\rangle? \]

8.3. What will happen if we apply the function \( f(x) = 0 \) to a general 2-bit state

\[ a|00\rangle + b|01\rangle + c|10\rangle + d|11\rangle? \]

\[ |00\rangle \rightarrow |0\rangle, \quad |00\rangle \oplus |0\rangle = |00\rangle \]

\[ |01\rangle \rightarrow |0\rangle, \quad |01\rangle \oplus |0\rangle = |01\rangle \]

\[ |10\rangle \rightarrow |1\rangle, \quad |10\rangle \oplus |0\rangle = |11\rangle \]

\[ |11\rangle \rightarrow |1\rangle, \quad |11\rangle \oplus |0\rangle = |10\rangle \]

The result is

\[ a|00\rangle + b|01\rangle + c|11\rangle + d|10\rangle \]
8. Solve only one part of this problem -- corresponding to your UTEP ID.

8.0 What will happen if we apply the function \( f(x) = 1 \) to a general 2-bit state

\[ a|00> + b|01> + c|10> + d|11> \]

8.1. What will happen if we apply the function \( f(x) = \text{not} \) to a general 2-bit state

\[ a|00> + b|01> + c|10> + d|11> \]

8.2. What will happen if we apply the function \( f(x) = x \) to a general 2-bit state

\[ a|00> + b|01> + c|10> + d|11> \]

8.3. What will happen if we apply the function \( f(x) = 0 \) to a general 2-bit state

\[ a|00> + b|01> + c|10> + d|11> \]

8.3) if we apply \( f(x) = 0 \) to

\[ a|00> + b|10> + c|10> + d|11> \]

we get the same state since \( 0 \oplus 0 = 0 \)