

Consider the quantum state: $\frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$

100 qubits are prepared in this quantum state and measured.

In those 100 measurements:

1. How many times would you expect to measure a $|0\rangle$? 50 times

2. How many times would you expect to measure a $|1\rangle$? 50 times

Consider the quantum state: $|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$

3. Select values for α and β such that it is more likely that a $|0\rangle$ will be measured than $|1\rangle$.

$a.\quad \alpha = \frac{1}{\sqrt{5}},\ \beta = \frac{2}{\sqrt{5}}$

$b.\quad \alpha = \frac{2}{\sqrt{5}},\ \beta = \frac{1}{\sqrt{5}}$

$c.\quad \alpha = \frac{1}{\sqrt{5}},\ \beta = \frac{4}{\sqrt{5}}$

$d.\quad \alpha = \frac{3}{\sqrt{5}},\ \beta = \frac{2}{\sqrt{5}}$

Consider the quantum state : $\frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$

4. What is the probability of measuring a $|1\rangle$?

$a.\ \frac{1}{2}$ $b.\ \frac{1}{4}$ $c.\ \frac{1}{5}$ $d.\ \frac{1}{8}$

5. The notation used to describe the quantum state above is called ____________ .

$a.$ vector notation $b.$ bra-ket notation $c.$ standard basis notation $d.$ none of the above

6. Which of the following describes the same quantum state?

$a.\ \begin{bmatrix} \frac{1}{4} \\ \frac{1}{4} \end{bmatrix}$ $b.\ \begin{bmatrix} \frac{1}{2} \\ \frac{1}{2} \end{bmatrix}$ $c.\ \frac{1}{\sqrt{2}}\begin{bmatrix} 1 \\ 1 \end{bmatrix}$ $d.\ \begin{bmatrix} 1 \\ \frac{1}{2} \end{bmatrix}$

Consider the quantum state : $\frac{1}{2}|0\rangle + \frac{\sqrt{3}}{2}|1\rangle$

7. What is the probability of measuring a |0⟩?

$a.\ \frac{1}{2}$ $b.\ \frac{1}{4}$ $c.\ \frac{3}{4}$ $d.\ \frac{\sqrt{3}}{4}$

8. What is the probability of measuring a |1⟩?

$a.\ \frac{1}{2}$ $b.\ \frac{1}{4}$ $c.\ \frac{3}{4}$ $d.\ \frac{\sqrt{3}}{4}$

9. Which of the following describes the same quantum state?

$a.\ \frac{1}{2}\begin{bmatrix} 1 \\ \sqrt{3} \end{bmatrix}$ $b.\ \begin{bmatrix} \frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{bmatrix}$ $c.\ \frac{1}{\sqrt{2}}\begin{bmatrix} 1 \\ 1 \end{bmatrix}$ $d.\ \begin{bmatrix} \frac{1}{\sqrt{5}} \\ \frac{2}{\sqrt{5}} \end{bmatrix}$

Consider the quantum state : $\begin{bmatrix} \frac{2}{\sqrt{5}} \\ \frac{1}{\sqrt{5}} \end{bmatrix}$

10. What is the probability of measuring a |0⟩?

$a.\ \frac{1}{\sqrt{5}}$ $\quad b.\ \frac{4}{5}$ $\quad c.\ 0.2$ $\quad d.\ 0.4$

11. What is the probability of measuring a |1⟩?

$a.\ \frac{1}{\sqrt{5}}$ $\quad b.\ \frac{4}{5}$ $\quad c.\ 0.2$ $\quad d.\ 0.4$

12. Which of the following describes the same quantum state?

$a.\ \frac{\mathbf{1}}{\sqrt{\mathbf{5}}}|0\rangle + \frac{\mathbf{2}}{\sqrt{\mathbf{5}}}|1\rangle$ $\quad b.\ 0.8|0\rangle + 0.2|1\rangle$ $\quad c.\ \frac{1}{\sqrt{5}}\begin{bmatrix} 2 \\ 1 \end{bmatrix}$ $\quad d.\ \frac{1}{2}|0\rangle + \frac{\sqrt{3}}{2}|1\rangle$

Consider the quantum state : $\begin{bmatrix} \frac{\sqrt{2}}{\sqrt{3}} \\ \frac{1}{\sqrt{3}} \end{bmatrix}$

13. What is the probability of measuring a |0⟩?

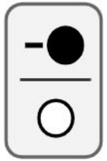
$a.\ \frac{1}{3}$ $b.\ \frac{1}{\sqrt{3}}$ $c.\ \frac{2}{3}$ $d.\ 0.4$ $e.\ \sqrt{3}$

14. What is the probability of measuring a |1⟩?

$a.\ \frac{1}{3}$ $b.\ \frac{1}{\sqrt{3}}$ $c.\ \frac{2}{3}$ $d.\ 0.4$ $e.\ \sqrt{3}$

15. Which of the following describes the same quantum state?

$a.\ \frac{\sqrt{2}}{\sqrt{3}}|0\rangle + \frac{1}{3}|1\rangle$ $b.\ \frac{1}{\sqrt{3}}\begin{bmatrix} \sqrt{2} \\ 1 \end{bmatrix}$ $c.\ \frac{1}{\sqrt{3}}|0\rangle + \frac{\sqrt{2}}{\sqrt{3}}|1\rangle$ $d.\ \begin{bmatrix} \frac{1}{\sqrt{3}} \\ \frac{\sqrt{2}}{\sqrt{3}} \end{bmatrix}$

Consider the quantum state : 

16. What is this state in bra-ket notation?

$a.\ -\frac{1}{2}|0\rangle + \frac{1}{2}|1\rangle$ $b.\ \frac{1}{2}|0\rangle - \frac{1}{2}|1\rangle$ $c.\ \frac{1}{\sqrt{2}}|0\rangle - \frac{1}{\sqrt{2}}|1\rangle$ $d.\ -\frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$ $e.\ -\frac{1}{\sqrt{2}}|0\rangle - \frac{1}{\sqrt{2}}|1\rangle$

17. What is this state in vector notation?

$a.\ \begin{bmatrix} \frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} \end{bmatrix}$ $b.\ \begin{bmatrix} -\frac{1}{2} \\ \frac{1}{2} \end{bmatrix}$ $c.\ \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ $d.\ \begin{bmatrix} -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{bmatrix}$ $e.\ \begin{bmatrix} \frac{1}{2} \\ -\frac{1}{2} \end{bmatrix}$

18. What is the probability of measuring $|1\rangle$?

$a.$ 25% $b.$ 50% $c.$ 0% $d.$ 100%

(Questions 16 - 18)

Consider a quantum state in which the probability of measuring a |0⟩ is 10%.

16. What is the probability of measuring a |1⟩?

$a.\ \frac{1}{\sqrt{10}}$ $b.\ \frac{9}{10}$ $c.\ \frac{3}{\sqrt{10}}$ $d.\ \frac{1}{10}$

Given that $\alpha|0\rangle + \beta|1\rangle$ and the probability above, what is the value of α?

$a.\ \frac{9}{10}$ $b.\ \frac{1}{\sqrt{10}}$ $c.\ \frac{3}{\sqrt{10}}$ $d.\ \frac{1}{10}$

Given that $\alpha|0\rangle + \beta|1\rangle$ and the probability above, what is the value of β?

$a.\ \frac{3}{\sqrt{10}}$ $b.\ \frac{\sqrt{3}}{4}$ $c.\ \frac{9}{10}$ $d.\ \frac{1}{\sqrt{10}}$

19. (True / False) $0.5|0\rangle + .5|1\rangle$ is a valid possible quantum state.

20. (True / False) $0.9|0\rangle + .1|1\rangle$ is a valid possible quantum state.

21. (True / False) $\frac{1}{2}|0\rangle + \frac{\sqrt{3}}{2}|1\rangle$ is not a valid possible quantum state.

22. (True / False) $\frac{1}{2}\begin{bmatrix} 1 \\ \sqrt{3} \end{bmatrix}$ is a valid possible quantum state.

23. (True / False) $\begin{bmatrix} 0.25 \\ 0.75 \end{bmatrix}$ is not a valid possible quantum state.

24. (True / False) $\begin{bmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{bmatrix}$ and $\frac{1}{2}\begin{bmatrix} 1 \\ \sqrt{3} \end{bmatrix}$ describe the same quantum state.

Choose the correct result vector for the matrix multiplication problem.

$$\begin{bmatrix} 1 & 3 \\ 5 & 7 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

a. $\begin{bmatrix} 7 \\ 19 \end{bmatrix}$ b. $\begin{bmatrix} 4 \\ 24 \end{bmatrix}$ c. $\begin{bmatrix} 5 \\ 14 \end{bmatrix}$ d. $\begin{bmatrix} 3 \\ 70 \end{bmatrix}$

Choose the correct result vector for the matrix multiplication problem.

$$\begin{bmatrix} 1 & 3 \\ 5 & 7 \end{bmatrix} \begin{bmatrix} 2 \\ 1 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

a. $\begin{bmatrix} 8 \\ 12 \end{bmatrix}$ b. $\begin{bmatrix} 6 \\ 13 \end{bmatrix}$ c. $\begin{bmatrix} 6 \\ 35 \end{bmatrix}$ d. $\begin{bmatrix} 5 \\ 17 \end{bmatrix}$

Choose the correct result vector for the matrix multiplication problem.

$$\begin{bmatrix} 4 & 5 \\ 6 & 7 \end{bmatrix} \begin{bmatrix} 2 \\ 3 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

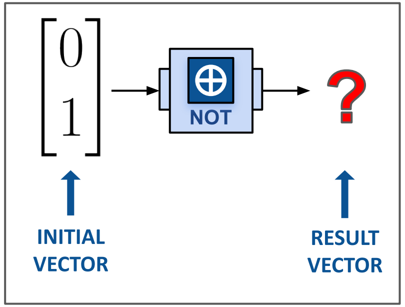
a. $\begin{bmatrix} 40 \\ 126 \end{bmatrix}$ b. $\begin{bmatrix} 23 \\ 33 \end{bmatrix}$ c. $\begin{bmatrix} 18 \\ 39 \end{bmatrix}$ d. $\begin{bmatrix} 11 \\ 16 \end{bmatrix}$

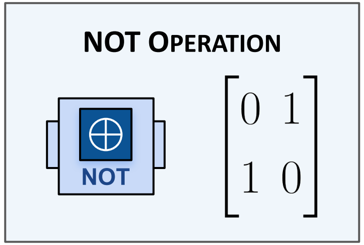
Choose the correct result vector for the matrix multiplication problem.

$$\begin{bmatrix} 1 & 3 \\ 4 & 2 \end{bmatrix} \begin{bmatrix} 6 \\ 5 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

a. $\begin{bmatrix} 24 \\ 30 \end{bmatrix}$ b. $\begin{bmatrix} 10 \\ 11 \end{bmatrix}$ c. $\begin{bmatrix} 18 \\ 40 \end{bmatrix}$ d. $\begin{bmatrix} 21 \\ 34 \end{bmatrix}$

The NOT Operator is applied to an initial vector: $\begin{bmatrix} 0 \\ 1 \end{bmatrix}$





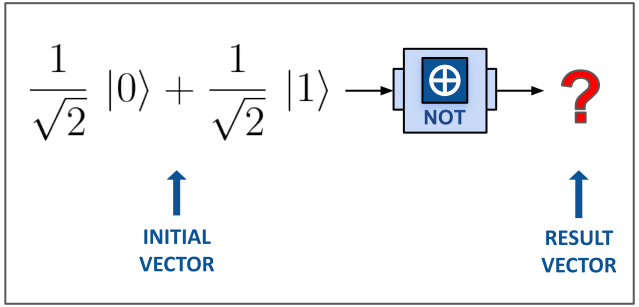
What will the result be in vector notation?

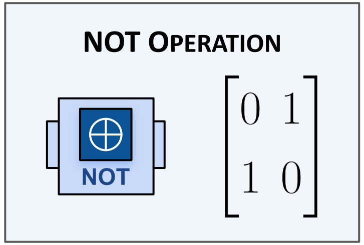
$a.\ \begin{bmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{bmatrix}$ $b.\ \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ $c.\ \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ $d.$ Cannot be determined

What will the result be in bra-ket notation?

$a.\ |0\rangle$ $b.\ |1\rangle$ $c.\ \frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$ $d.$ Cannot be determined

The NOT Operator is applied to an initial vector: $\frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$.





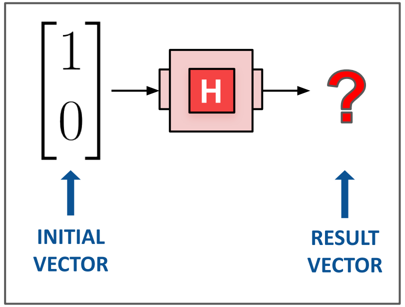
What will the result be in bra-ket notation?

$a.\ \frac{\sqrt{3}}{2}|0\rangle + \frac{1}{2}|1\rangle$ $b.\ \frac{1}{2}|0\rangle + \frac{\sqrt{3}}{2}|1\rangle$ $c.\ \frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$ $d.$ Cannot be determined

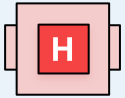
What will the result be in vector notation?

$a.\ \begin{bmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{bmatrix}$ $b.\ \begin{bmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{bmatrix}$ $c.\ \begin{bmatrix} \frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{bmatrix}$ $d.$ Cannot be determined

The H operation is applied to an initial vector: $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$.



H OPERATION



$$\frac{\mathbf{1}}{\sqrt{\mathbf{2}}}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$

What will the result be in vector notation?

$a.\ \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ $\quad b.\ \frac{1}{\sqrt{2}}\begin{bmatrix} 1 \\ -1 \end{bmatrix}$ $\quad c.\ \frac{1}{\sqrt{2}}\begin{bmatrix} 1 \\ 1 \end{bmatrix}$ $\quad d.\ \begin{bmatrix} \frac{1}{\sqrt{2}} \\ \frac{-1}{\sqrt{2}} \end{bmatrix}$

What will the result be in bra-ket notation?

$a.\ \frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$ $\quad b.\ \frac{\mathbf{2}}{\sqrt{\mathbf{5}}}|0\rangle + \frac{\mathbf{1}}{\sqrt{\mathbf{5}}}|1\rangle$ $\quad c.\ \frac{1}{2}|0\rangle + \frac{\sqrt{3}}{2}|1\rangle$ $\quad d.\ \frac{1}{\sqrt{2}}|0\rangle - \frac{1}{\sqrt{2}}|1\rangle$