

Density matrix of a single qubit

$$\rho = \frac{1}{2} (I + \vec{r} \cdot \vec{\sigma})$$

position

vectors

qubit initializes  $|0\rangle$  with a Hadamard gate

our final state

$$|q\rangle = \frac{1}{\sqrt{2}} (|0\rangle + |1\rangle) = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$\rho = \frac{1}{2} (I + \mu_x \sigma_x + \mu_y \sigma_y + \mu_z \sigma_z)$$

$$\sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$$\sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$$

SUNDAY

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$$\sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

and Bloch sphere

$$|\psi\rangle = \alpha |0\rangle + \beta |1\rangle$$

$$|\psi\rangle = \frac{\cos \theta}{2} |0\rangle + \frac{\sin \theta}{2} e^{i\varphi} |1\rangle$$

$$\vec{\rho} = \begin{pmatrix} \cos \theta & \sin \theta \\ \sin \theta & \cos \theta \end{pmatrix}$$



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AUGUST  
MONDAY

2017

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$$\frac{\cos \theta}{2} = \frac{1}{\sqrt{2}}$$

$$\frac{\sin \theta}{2} e^{i\phi} = \frac{1}{\sqrt{2}}$$

$$\frac{\sin \theta}{2} (\cos \phi + i \sin \phi) = \frac{1}{\sqrt{2}}$$

$$\frac{\cos \theta}{2} = \frac{1}{\sqrt{2}}$$

$$\theta = 90^\circ \text{ or } \pi/2$$

$$\frac{\sin \theta}{2} = \frac{1}{\sqrt{2}}$$

$$\cos \phi + i \sin \phi = 1$$

$$\phi = 0^\circ$$

$$\text{Now, } \vec{u} = \begin{pmatrix} \cos \phi \sin \theta \\ \sin \phi \sin \theta \\ \cos \theta \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$

$$P = \frac{1}{2} (I + u_x \sigma_x)$$

$$\frac{1}{2} \left( I + \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \right)$$

$$P = \frac{1}{2} (I_{2 \times 2} + 1 \cdot \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix})$$

2017 AUGUST

	7	14	21	28
1	8	15	22	29
2	9	16	23	30
3	10	17	24	31
4	11	18	25	
5	12	19	26	
6	13	20	27	

Notes

$$\rho = \frac{1}{2} \left( \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} + \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \right)$$

$$\rho = \frac{1}{2} \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$$

the density matrix