exercise 1

• | Yto>=|o> 
$$\otimes$$
 |o> =  $\begin{pmatrix} 1 \\ 0 \end{pmatrix} \otimes \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$ 

$$G_1 = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} \otimes \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$$

 $G_{2} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix}$ 

G3 = 61

•  $|\psi_{t1}\rangle = 61 |\psi_{t0}\rangle = \frac{1}{2} \begin{pmatrix} 1 & 1 & 11 \\ 1-1 & 1-1 \\ 11 & -1-1 \\ 1-1 & -11 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$ 

•  $| \psi_{t_2} \rangle = 62 | \psi_{t_1} \rangle = \frac{1}{2} \begin{pmatrix} 1000 \\ 0100 \\ 000-1 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} = \frac{1}{2} \begin{pmatrix} 1 \\ 1 \\ 1 \\ -1 \end{pmatrix}$ 

 $=\frac{1}{2}\left(\begin{array}{c}1\\1\\1\end{array}\right)=|++\rangle$ 

• 
$$|\psi_{t_3}\rangle = 63 |\psi_{t_2}\rangle = \frac{1}{h} \begin{pmatrix} 11 & 11 \\ 1-1 & 1-1 \\ 14-1-1 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \\ 1 \\ -1 \end{pmatrix}$$

$$= \frac{1}{h} \begin{pmatrix} \frac{2}{2} \\ \frac{1}{2} \\ -2 \end{pmatrix} = \frac{1}{2} \begin{pmatrix} 1 \\ 1 \\ \frac{1}{2} \\ -1 \end{pmatrix}$$

$$64 = X \otimes X = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \otimes \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 40 \\ 0 & 1 & 00 \\ 10 & 00 \end{pmatrix}$$

$$65 = 6z = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix}$$

$$| 4 + 5 \rangle = 65 | 4 + 4 \rangle = \frac{1}{2} \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & -1 \end{pmatrix} \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & -1 \\ 1 & 1 & -1 \end{pmatrix}$$

$$G_{6} = G_{4} = \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix}$$

$$| V_{46} \rangle = G_{6} | V_{45} \rangle = \frac{1}{2} \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix} \begin{pmatrix} -1 \\ 1 \\ 1 \\ -1 \end{pmatrix} = \frac{1}{2} \begin{pmatrix} -1 \\ 1 \\ 1 \\ -1 \end{pmatrix}$$

$$| V_{46} \rangle = G_{6} | V_{45} \rangle = \frac{1}{2} \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 10 & 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} -1 \\ 1 \\ 1 \\ -1 \end{pmatrix} = \frac{1}{2} \begin{pmatrix} -1 \\ 1 \\ 1 \\ -1 \end{pmatrix}$$

$$\begin{array}{c} (1000) \\ (100)$$

$$|Y_{t6}\rangle = G_6 |Y_{t5}\rangle = \frac{1}{2} |$$

$$G_7 = G_1 = \frac{1}{2} \begin{pmatrix} \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \end{pmatrix}$$

final result

14t=> = -111>

$$\frac{1}{2}\begin{pmatrix} 1-1\\ 11\\ 1-1 \end{pmatrix}$$

• 
$$| \psi_{t_7} \rangle = G_7 | \psi_{t_6} \rangle = \frac{1}{4} \begin{pmatrix} 11 & 11 \\ 1-1 & 1-1 \\ 1 & 1-1-1 \\ 1-1-1 & 1 \end{pmatrix} \begin{pmatrix} -1 \\ 1 \\ 1 \\ -1 \end{pmatrix}$$

 $=\frac{1}{4}\begin{pmatrix}0\\0\\0\\-2\end{pmatrix}=\frac{1}{2}\begin{pmatrix}0\\0\\1\end{pmatrix}$