



$$F_{\ell,U}|x\rangle|\phi\rangle = \begin{cases} |x\rangle U|\phi\rangle & \text{If } f_\ell(x) = 1 \\ |x\rangle|\phi\rangle & \text{If } f_\ell(x) = 0 \end{cases}$$

$$f_\ell(x) = \bigwedge_{i=1}^{\ell-1} (x_{2i-1} = x_{2i}) \wedge (x_{2\ell-1} \neq x_{2\ell})$$

$$g_\ell(x) = \bigvee_{i=1}^{\ell} (x_{2i-1} \neq x_{2i})$$