

Quantum Computing and Quantum Information Processing

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Assignment #4, submission April 02, 2007

1. Suppose  $U|x\rangle|y\rangle = U|x\rangle|y \oplus f(x)\rangle$ . Define  $\hat{f}(l) = 1/\sqrt{r} \sum_{x=0}^{r-1} e^{-i2\pi xl/r} |f(x)\rangle$ , where  $r$  is the period of  $f(x)$ , for all  $l = 0 \dots r-1$ .  $\hat{f}(l)$  is called the Fourier transform of  $f(x)$ . Show that  $|f(x)\rangle = \sum_{l=0}^{r-1} e^{i2\pi lx/r} |\hat{f}(l)\rangle$ .
2. Exercise 5.20 [Nielsen and Chuang].
3. Exercise 5.21 [Nielsen and Chuang].