Problem Set 2
CPSC 629 Analysis of Algorithms
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The assignment is due next Wednesday, before class.

Solve exercises 2.14 – 2.27 given in the lecture notes. Give concise and clear answers. Give complete proofs.

Read pages 1–28 in Nielsen and Chuang. Pages 13–28 are important; pages 1–12 make good beadtime reading. If you need further motivation: These pages contain the anwer to at least one homework question!

Common problems in the previous homework:

- If ϕ is a real number, then $e^{i\phi} = \cos\phi + i\sin\phi$. Any such number satisfies $|e^{i\phi}|^2 = 1$.

- A matrix U is unitary if and only if $\langle Ux|Uy\rangle = \langle x|y\rangle$ for *all* $x, y \in \mathbf{C}^m$. *It is not sufficient to check this just for a special case, such as $y = x$, unless you prove that.*

- Make sure that you know what you want to prove! Learn and understand the definitions first, then try to prove the result.

- Do not write excessively long answers! Keep it succinct and clear.

Please note the following correction:

Exercise 2.27 Design a quantum circuit that implements the parity function $f(x_2, x_1, x_0) = x_2 \oplus x_1 \oplus x_0$. Show how this circuit can be used to generate the state

$$\frac{1}{2}\left(|0000\rangle + |1010\rangle + |1100\rangle + |0110\rangle\right).$$

Assume that the input is $|0000\rangle$. You can use additional single qubit gates to obtain this result.