

COT 6600: Quantum Computing

Assignment 3

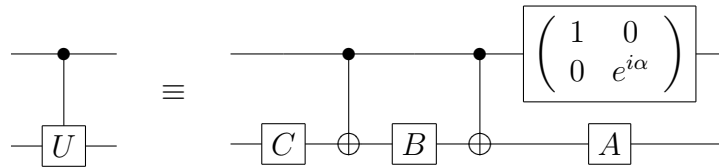
Out: 10/19/2007 Due: 10/30/2007

1. (5 points) Show that

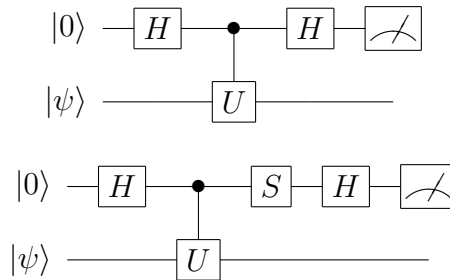


which $X = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ and $Z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ are the Pauli matrices.

2. (10 points) Assume that A, B and C are single qubit gates that satisfy $ABC = I$ and $U = \exp(i\alpha)AXBXC$. Show the following:



3. (20 points) Compute the probabilities of obtaining 0 and 1 on the first qubit in the following quantum circuits and show how we can use these quantum circuits to estimate $\text{Re} \langle \psi | U | \psi \rangle$ and $\text{Im} \langle \psi | U | \psi \rangle$.



(U and $|\psi\rangle$ are arbitrary and $S = \begin{pmatrix} 1 & 0 \\ 0 & i \end{pmatrix}$ is the *Phase* gate).

4. (10 points) Do Exercise 6.4.1
5. (10 points) Do Exercise 6.5.1
6. (15 points) Do Exercise 6.5.2 (a) (b)
7. (Bonus) Do Exercise 7.1.1