## Homework 2

Due at 5pm, Oct 25. Give your answer sheet to TA (Liu Yang, yliu@cse).

1. Consider two sets of quantum pure states and . Prove that there is a unitary operation s.t. for all if and only if for all ..
2. Prove that for any two matrices , . Recall that , the operator norm is the largest singular value of , and the trace norm is the summation of all singular values of .
3. What is the bounded-error quantum query complexity of the function of AND-of-OR? Here the function is defined as follows. It has variables, divided into blocks , with variables in each block . The function if for all , contains at least one variable being 1. (Otherwise .) In other words, the function is the AND of the blocks, and each block is the OR function on its variables.   
   Note that to get the quantum query complexity, you need to prove both the upper and lower bounds, and hopefully they match (up to a constant factor).