aQa Course

Take Home Assignment 2 – Additional clarifications for questions 4-6

In both question 4 and 5 the quantity n refers to the number of qubits in the eigenvector register (i.e., the number of qubits on which the unitary U acts).

There is a possible point of confusion in question 4, which we would like to clarify. Namely, we originally stated that you can include the ctrl-Us in the gate set (i.e., making both its depth and gate complexity equal to 1) and afterwards we stated you can, in the expression for the the total complexity, use abstract functions $(f_d(n), f_g(n))$ to denote the depth and gate complexity of these ctrl-Us.

In other words, you can choose what to do. If you choose to include the ctrl-Us into the gate set, this means you have set $f_d(n) = f_g(n) = 1$. Or you can work out the total complexity as a function of the depth and gate complexity of the ctrl-Us, given abstractly (i.e., $f_d(n)$ and $f_g(n)$ respectively).

To avoid confusion for those who have not yet started solving this assignment, we have rephrased the question a bit. **All reasonable solutions will be fully credited**.

Note that the costs of powers of ctrl-Us are multiples (and not powers) of the functions $f_g(n)$ and $f_d(n)$ – this was a typo fixed in the updated THA2. Whatever you do – make sure you clearly state what you are assuming.

Second, in question 5 and 6 we intend for you to study the circuit of a *single round* of the single qubit QPE, including its depth and gate complexity and the measurement outcome probabilities. That is, as the single-qubit QPE repeats a given circuit multiple times (sometimes with different parameters) we intend for you to study the circuit, its depth and gate complexity and the measurement outcome probabilities of one evaluation of this circuit.

Note that in question 5 we do not give you the option to include the ctrl-Us in your gate set! We state that you can assume black-box access to these ctrl-Us, but not that these black-boxes have a gate and depth complexity of 1. Thus, in question 5 you will have to express the total complexity of the single qubit QPE as a function of the depth and gate complexity of the ctrl-Us, i.e., $f_d(n, t)$ and $f_g(n, t)$ respectively.