Phys 31415 Homework #4

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Please do all the work on your own. Be curious and honest and prosperity shall be yours. If you have any questions seriously email me. Check out this before trying the homework.

1 Get Multiple Controls over Gates

This assignment will be more doing then trying to get results or anything.

1. There are alot of cool gates that do alot of specific things, in the lesson we went over the MCX gate. It is essentially a CNOT gate that takes control from multiple qubits. We used it as an Oracle black box for Grover's search algorithm.

   (a) Write out the code for all possible Black boxes for the target states for Grover's search for N=4 (2 control qubits). Append each to their own circuits and draw them using the draw function. Follow my code for example and practice typing it out and understanding what you are doing. Make sure to label each target state each oracle is looking for and just put the oracle in the circuit, nothing else.

   (b) In the Lesson we only went through one iteration of the search. Make a circuit for any N=4 state you like and write the circuit to go through the search twice. Draw it, what does it look like.

   (c) Get creative, can you make a function or just some code that lets me change the number of times I run through the search in our circuit? Try it out for 4 iterations and draw it!(some physics and coding can do great things!)

2. We pulled the MCX gate from the circuit.library part of Qiskit. Look up a new gate from the circuit library, append it to your own circuit and briefly tell me what it does and what it is doing in your example! I want you to get practive looking up new things and expanding on your knowledge, gaining mastery (control) over multiple gates.

   (a) Print the state vector before and after the circuit.

   (b) Measure the circuit and print out a histogram of the results.

   (c) Draw the circuit using the draw function.

   (d) A brief explanation of what your circuit does and how it compares to what you may have expected.