Instructions to run codes

Project 1:

The vector psi can be initialized in 3 different states. (a) Computational Basis State. (b) Equal Superposition. (c) Cat state. These are commented using '''. Uncomment whichever one is required. Also, the number of qubits N and the number of times the measurement is performed ('repeat') can be changed.

Project 2 and 4:

There are 4 circuits here. All are again commented. Whichever is to be computed can be uncommented. 'N' should not be changed here as these are specific circuits. 'repeat' can be changed.

Project 3 and 5:

The number of qubits N can be changed. On line 21, the variable 'ans' can be set to whichever index you want to be the correct answer. It must be less than $2^N - 1$. In line 29, the number of iterations can be changed from optimal. By default, it has been set to Q + 0 i.e., optimal. 0 can be replaced with other integers which will result in low success rate. (Keep N < 11 for reasonable time computation.) 'repeat' can be changed. For large N, 'repeat' should be set to 1 to get the computation to complete sooner. **Depending on the device increasing N can overwhelm the RAM and might cause the device to hang.**

Project 6:

By default, 'repeat' has been set to 1. You can change N and increase it to 15. It can be increased further at the cost of time consumed. 'ans' can be changed on line 20.

Project 7:

This simply gives factors of C = 15. Change nothing.

Project 8:

It will ask you which number you want to factor. Input any number less than 100. Lower numbers will perform better as 'l' has been set to 6 by default in line 20. To improve success rate, increase 'l' but it will increase the time it takes to complete the computation. Nothing else should be changed.

Project 9:

Simply run the code. Both output matrices should be 0 everywhere except for very small variations.

Project 10 and 11:

Simply run the code. Output from all circuits is displayed.

Project 12:

You can add errors by replacing 'I' with [X or Z] from lines 109 and 114. One X will be corrected. No Z will get corrected. By default, there is no error. You can also change the qubit number

from these lines from multi_gate(I,2). Replace 2 with 1 or 3. Only change qubit number of error gates!

Project 13:

Like the previous project. Add errors in line 128. No error by default.

Project 14:

This is quantum error correction. Maximum possible 3 bit-flip errors have been added already on lines 156, 193, 230. You can change qubit of the error to 1, 2 or 3.

Project 15:

Surface Code Computing from here on.

Errors already inserted on lines 260 and 261. It can detect single errors most of the times depending on the syndrome. You can change the error type [X, Y or Z] and the qubit number (must be the data qubits 1,3,5,7,9,11,13,15). Output should tell you which error you added. Will detect incorrect error sometimes.

Project 16:

Computation to be performed can be changed from line 455. Errors have been turned on by default. New computations can be done if given in the correct format and gates chosen from the available gates given in line 394. Theoretical results from the given circuits are mentioned in the report.

Project 16_17 qubit:

This is for comparison between the 15 qubit and 17 qubit circuit designs. By default, 'repeat' has been set to 10. For comparison it was set to 1000. Computation which was compared is ['H', 'H', 'H', 'H, 'I', 'H', 'H', 'H', 'H']. Errors are turned on by default.

Project 17:

Like previous projects, computation can be changed from line 369. This is a different kind of SCC using defect qubits. No error detection or correction is done here.