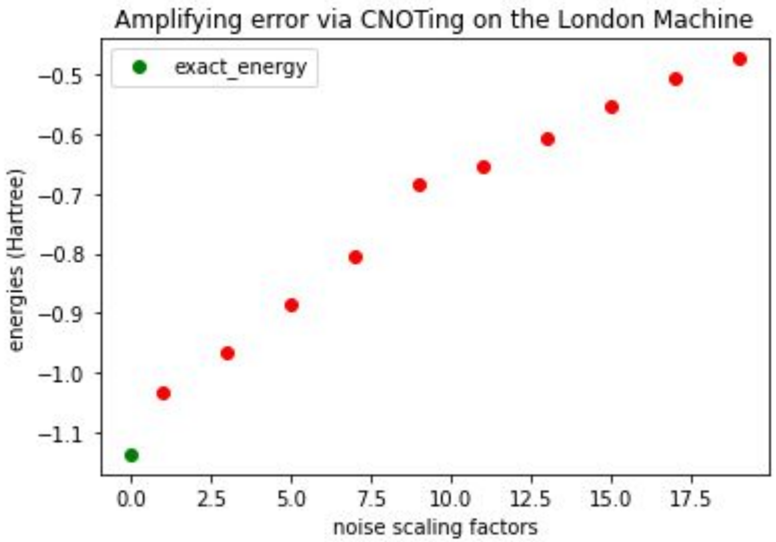
CNOT-ing VQE (1)

Meeting with Professor Schnetzer and Rikab
July 17, 2020

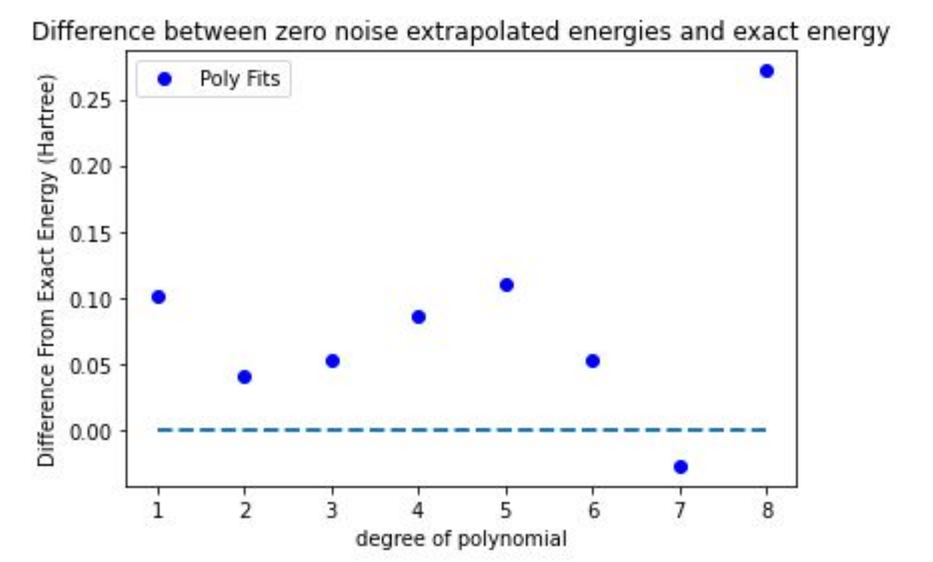
Testing CNOT pairs on a VQE circuit



- For each red point, I had to measure expectation value of 5 circuits (because of 5 local hamiltonians)
- Each of those circuits has 1024 shots
- **Question**: How to calculate uncertainty of the energies (red points)?
- Should I sample more times for each red point (obtain multiple sets of 5 circuits) ?
- There is nothing probabilistic about the CNOT technique compared to twirling. If we sample more times, all the uncertainty will be due to london device.

Testing CNOTing on a VQE circuit

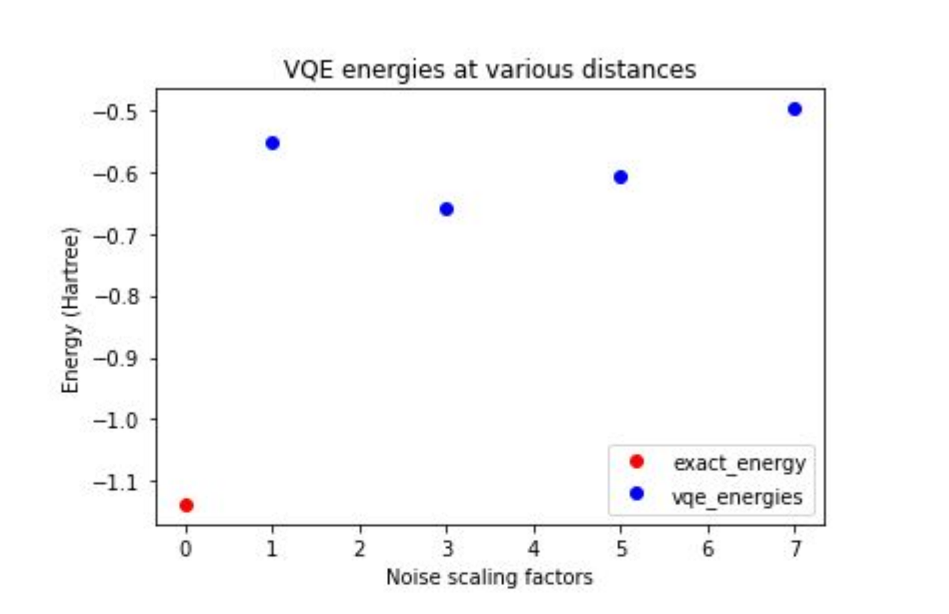
Zero noise extrapolation (Only 1 sample of energy for each noise scaling so didn't put in error bars)



Integrating CNOT-ing into VQE

Not Good!

Same trend as when I integrated twirling into VQE: regardless of how much I scale the noise, VQE energies remain constant (as if I didn't scale noise at all)



Done on the Burlington Machine

Power Function

f(x) = a*x^b + c

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a = 0.05382923111672574
b = 0.789242945508109З
c = -1.1450493294612722
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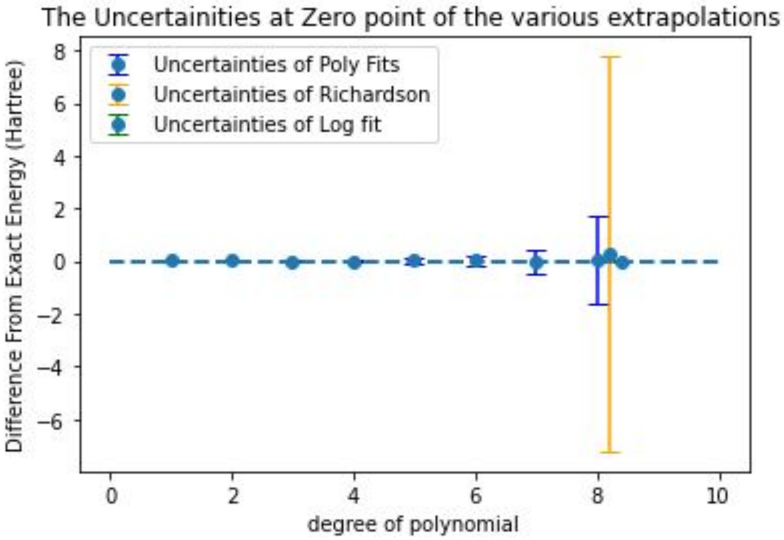
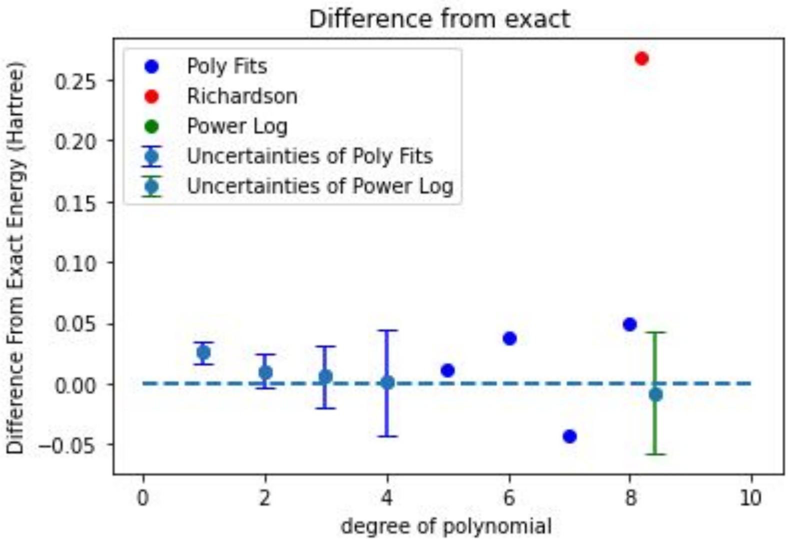
- Looks like we have to try square root -type functions
- Uncertainty of this function similar to 3rd, 4th degree polynomial functions.

Power Function

Zero Noise Extrapolation





Monte Carlo vs Covariance Issue

Resolved: Covariance method is not taking statistical uncertainties of the computed energies (at diff noise levels) into account.

Thanks to Rikab!

- Then we can make the claim that polynomial fitting is better than Richardson, at least for circuits, not VQE
- Can't make the claim for VQE because noise amplification schemes are not working!
- Will double check the code if there is a bug but I don't think that's the issue.