CMPT981[4] - Final Project Proposal
Ashish G(akg42@sfu.ca)

A Report on Quantum Approximate Optimization Algorithm [2]

In this project, we aim to answer the following -

- Understanding the basic settings and mathematics behind the QAOA.
- Resource Estimate: Given a 3-regular(or/and 2-regular) graph $G = (V, E)$, $|V| = n$; estimate the number of gates required to implement QAOA on Clifford+T gates(or on Single Qubit Unitaries) with an error parameter ϵ. [3]
- Its performance(0.6924 on 3-regular with parameter 1) on Max Cut as compared to the classical approximation(0.8785 on a generic graph) - Is it intrinsic to the quantum settings? Can we identify the cause for this(limitation)?
- Understanding the application of QAOA on Independent Set (described in [2]). What is the approximation ratio in this case?
- Does the algorithm accepts only specific instances of a problem(like 3-regular in case of Max-Cut) or it accepts all instances? Do we have example NP-Complete problems where QAOA outperforms known classical approximation algorithms?

References

[1] Edward Farhi, Jeffrey Goldstone, Sam Gutmann, and Michael Sipser. Quantum computation by adiabatic evolution, 2000. arXiv:quant-ph/0001106.

[2] Edward Farhi, Jeffrey Goldstone, and Sam Gutmann. A Quantum Approximate Optimization Algorithm, 2014. arXiv:1411.4028 [quant-ph] .

[3] M. Nielsen, and I. Chuang. Quantum Computation and Quantum Information. Cambridge University Press, 2000.

[4] Matt Amy. CMPT 409/981: Quantum Circuits and Compilation, SFU. https://www.cs.sfu.ca/ meamy/f22/cmpt981/