Calculation **Mudassir Moosa**

The best-known classical algorithm for solving the maximum weight independent set (MWIS) problem has a complexity of $O(1.2^n)$ where n is the number of nodes [1]. We take this complexity as an estimation of the number of flops needed to implement this algorithm. Now let us consider a graph with $n = 250$ nodes. The estimate for the number of operations needed to find MWIS is then $1.2^{250} = 6.2 \times 10^{19}$.

Now we consider a cluster of 3 GPUs. Each GPU is known to operate at a rate of 2.6 Tflops per second, i.e. 2.6×10^{12} flops per second. So a cluster of 3 GPUs can do 7.8×10^{12} flops per second. At this rate, 3 GPUs can find the aforementioned MWIS in approximately 2000 hours.

Moving on, let us consider an HPC that can operate at the rate of 7 Pflops per second, i.e., 7.0×10^{15}. This HPC can solve the MWIS problem with $n = 250$ in approximately 2.5 hours.

Now let us consider a quantum computer (QC). We solve the MWIS problem by implementing the adiabatic evolution on an analog QC. Let us assume that we need 10^5 shots of measurement to extract the desired result. During the Q/A session for the third round of this Hackathon, we learned that each shot of measurement can be done in 1 second. Using the time to do 10^5 measurements as a proxy of the total time taken, we deduce that it will take a QC of around 27 hours to solve the MWIS problem.

We enter the estimates of the time that a GPU, HPC, and QC would take to solve the MWIS problem on the provided excel file.

References

[1] M. Xiao and H. Nagamochi, "Exact Algorithms for Maximum Independent Set," *arXiv e-prints* (Dec., 2013) arXiv:1312.6260, `arXiv:1312.6260 [cs.DS]`.