The application of quantum computing to the optimal design of open-pit mines (v2.0)

1. Overview

The optimal design of open-pit mines is an ongoing optimization problem in the mining industry since the 1960's, where incremental improvements through new algorithms and/or better heuristics result in greater economic value, environmental value, and safety.

2. Detailed Objective

As a background, briefly read these two papers to develop an understanding of the problem: the original problem statement and algorithm, *Lerchs-Grossman (L-G)*, and today's best-known heuristic, *Pseudoflow*. From there, you can get up to speed on where last year's CS210 class took this project via your TA, who was a member of the project and one of the co-authors of the code, scientific paper, and patent (you can also read up on a technique related to the one conceived by last year's CS210 class, https://arxiv.org/pdf/2007.10917.pdf).

> This year's main objective is to test 3 different quantum algorithms—adiabatic state preparation, QAOA, and QITE—to see if they perform better or worse than the VQE-based algorithm previously explored.

You will get access to the existing github repo, slack channel, and other shared resources from last year's project.

3. Requirements

The stated objective is challenging, yet feasible, in terms of understanding the state-of-the-art and exploring 3 different and interesting paths forward, all under the guidance of a leading expert in the field of quantum information science.

At the same time, connecting theory and experiments to real-world practice is a requirement, and the team will also need to understand how a quantum computing solution to the problem would fit into the business processes and workflows of the realities of open-pit design today. IBM would need to connect the team to an industry partner in this field, e.g., to provide business insights and data.

4. Project Success Criteria

The delivery of 3 quantum algorithms and a scientific paper exploring the optimization problem of the design of open-pit mines.

5. Points of Contact

Mario Motta will be the IBM technical lead. Joe Latone will be the business strategy lead.