Abstract

Quantum software tends to lag behind the development of quantum hardware, and mixed incentives between competing manufacturers prevent the architects from cooperating on a unified interface. This leads to a fragmented ecosystem where the fruits of individual researchers' labor are sequestered behind trade secrets or exorbitant licenses, and individual architectures with varying maturity cannot always benefit from the state of the art.

Further, this fragmentation prevents prospective consumers of quantum computation from easily accessing samples relevant to their target domain, requiring lengthy consulting processes to determine a mapping between the unique shape of the customer's problem and the limitations of the provider's hardware. Similarly, because consumers have a difficult time formatting their queries for any one platform, the operators cannot fill their inventory and face difficulties maximizing their utilization on supercooled machines which are expensive to shut down.

Even if these consumers could easily access these quantum computers, a challenge remains in validating the outputs of these jobs—those that can be validated often have efficient classical algorithms that call into question the utility of the quantum computer, and the jobs that cannot be validated have no third-party benchmarks by which to measure their correctness.

To resolve these tensions and realign stakeholder incentives, we propose a decentralized quantum computing marketplace, the Quip Network. The stakeholders forming this network are quantum algorithm designers, quantum computer operators, quantum compute consumers, and classical computer operators.

Quantum algorithm designers propose subnets dedicated to running a specific quantum algorithm and publish the code in return for a royalty each time the code runs. Quantum computer operators select the subnets befitting their architecture and accept jobs where bids are sufficiently enticing or excess machine capacity is available. Quantum compute consumers bid QUIP tokens to have their jobs filled on any subnet by an interested miner. Classical computer operators then compare the quantum outputs and verify the results before the rewards are distributed to the relevant participants with valid and optimal solutions.

Using this framework, we provide a blueprint for the first subnet which uses D-Wave quantum annealing computers to execute numerous fast optimization problems where solutions meet a minimum diversity and energy threshold. We further propose several future subnets supporting known quantum algorithms. We then analyze the security properties of this network and suggest future research directions.