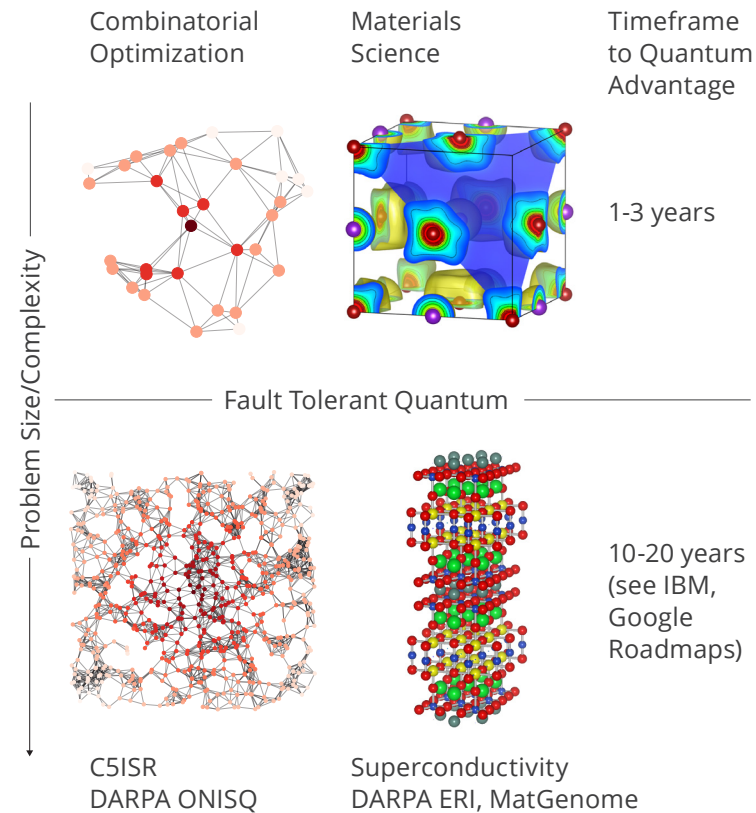


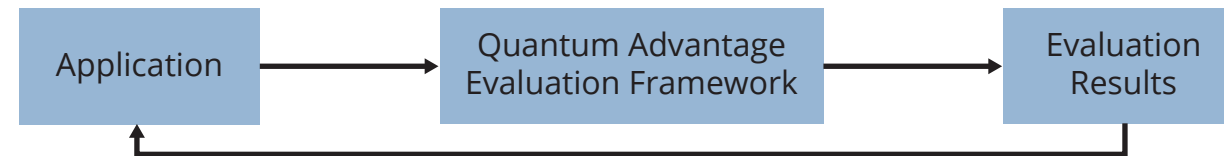
Quantum Advantage Evaluation Framework

Problem

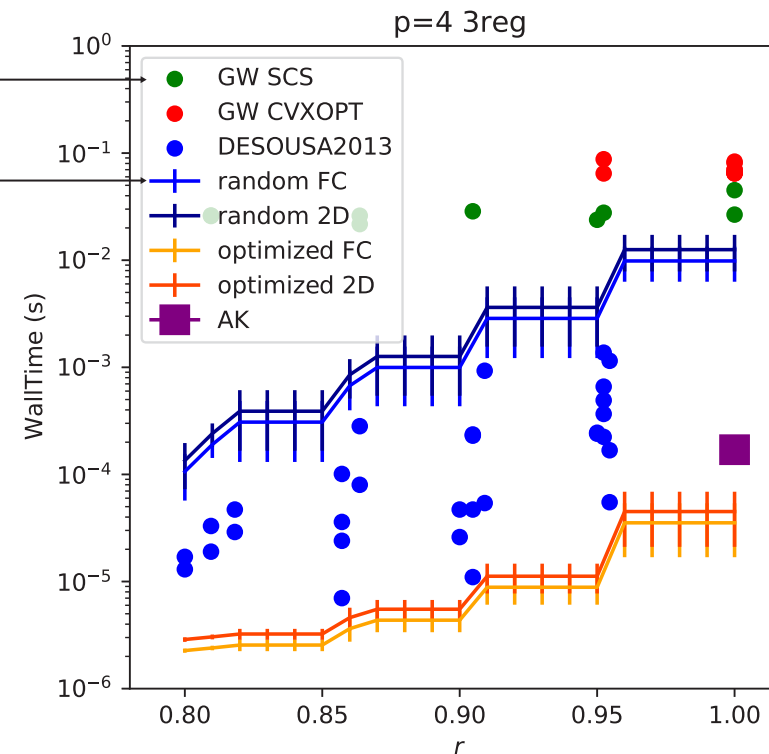
When and where can the DoD benefit from investing in quantum computing technology? To answer this question, we are working with noisy intermediate scale quantum (NISQ) computers, but we're also thinking ahead to fault-tolerant quantum error corrected computation. In particular, we want to determine when and where quantum advantage will exist for the following important DoD applications:



Framework to evaluate current and **projected quantum computing advantage.**



Classical State of the Art: PSC
 Quantum Computers (simulated)



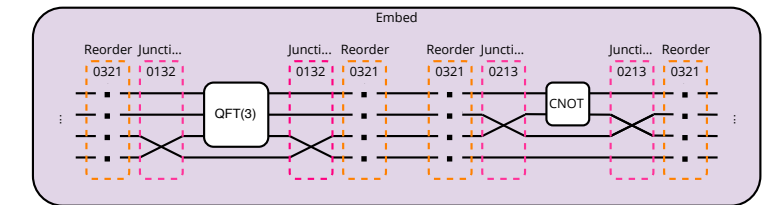
Where: to determine quantum advantage, benchmarks on specific problem instances must be performed on "real world" scales (O(100-1000+ nodes) (estimated 3 years IBM, Google)

<https://arxiv.org/abs/2006.04831>
 "Assessment of Alternative Objective Functions for Quantum Variational Combinatorial Optimization," M. Jonsson, et al, IEEE QCE Quantum Week 2020

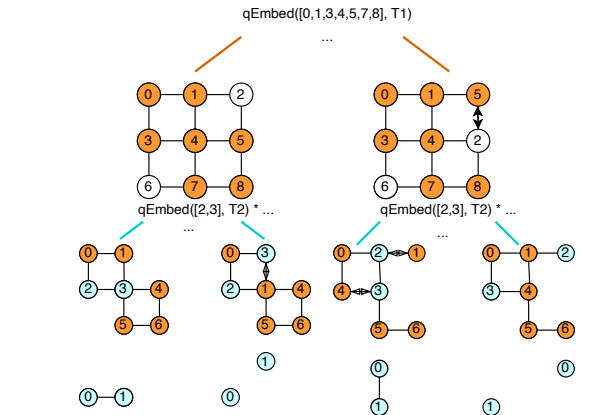
SEI Collaboration with Carnegie Mellon University

Quantum algorithm performance depends critically on quantum circuit optimization. We are working with CMU ECE Franz Franchetti's group to adapt their well-known classical computing optimization tool, SPIRAL.

Quantum Circuit Optimization in SPIRAL



Scheduling to Quantum "Baremetal"



<http://spiral.net/>
<https://github.com/spiralgen/spiral-package-quantum>
 "Quantum Circuit Optimization with SPIRAL: A First Look," S Mionis, et al, Supercomputing 2020

QAEF Output: When and where can you leverage quantum computing to achieve advantage in solving your organization's problems?

- Input: the applications that have most potential for quantum advantage. It is critical to identify "real world" problem instances.
- Output: when and where will quantum advantage exist? Establish timeframe for Quantum Advantage Readiness.

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