Programming frameworks 1: Cirq

Monday, September 28, 2020
Rutgers University
Yipeng Huang
Seminar schedule will be released very soon
Class grading rubric will be as follows:

• 2 × 25 points on the presentations

• 2 × 25 points on the programming exercises

• Week-to-week, I may have 5-point assignments to encourage engagement and to spur discussion about the papers.
Seminar presentation grading rubric

15 points: Content
• 5 points: Breadth
• 5 points: Depth
• 5 points: Evaluation and analysis

10 points: Quality of seminar presentation
• 4 points: Structure
• 3 points: Professional preparation and delivery
• 3 points: Timing
Seminar presentation grading rubric: Content (15 points)

5 points: Breadth

*Overall, what is this article about?*

- Give a high-level overview of the article's background, problem statement, methodology, and major results.

5 points: Depth

*After giving an overview of the paper, in the time that you have, dive deep and teach your classmates about a specific detail.*

- This may be a specific algorithm, equation, table, or graph.

5 points: Evaluation and analysis

*Demonstrate thoughtful evaluation and analysis of the article, which may include:*

- What are its impacts on the research field and on society as a whole?
- Who should care about this article, and what might be its long-term impacts?
- What is the deeper insight of why this article is important?
- Is the article believable? What are potential limitations?
Seminar presentation grading rubric:
Quality of seminar presentation (10 points)

4 points: Structure
• Do you provide adequate summaries of the whole talk and each section, before going into details?
• Do you outline the content of your talk, so listeners know where you are going?

3 points: Professional preparation and delivery
• Is the presentation speech well rehearsed?
• Are the slides well organized and clear?

3 points: Timing
• Does the talk fit properly in the 30 minutes for the presentation, plus 10 minutes for questions?
Programming lab assignment: QAOA on Cirq
Due Friday, October 30 (then, VQE on Qiskit)

Source: Quantum Approximate Optimization of Non-Planar Graph Problems on a Planar Superconducting Processor. Arute et al.
For full marks, replicate parts of this experiment in simulation.

Source: Quantum Approximate Optimization of Non-Planar Graph Problems on a Planar Superconducting Processor. Arute et al.
Accessing Rutgers Computer Science iLab

https://resources.cs.rutgers.edu/docs/new-users/getting-started/

ssh netid@ilab1.cs.rutgers.edu
ssh netid@ilab2.cs.rutgers.edu
ssh netid@ilab3.cs.rutgers.edu

Beware of ilab4, seems like it is currently missing packages.
You probably want to do work from this directory:

cd /common/users/netid/

See https://resources.cs.rutgers.edu/docs/file-storage/storage-technology-options/
Cloning Google Cirq

https://github.com/quantumlib/Cirq

Optional: fork if you want to hack and contribute to Cirq:
https://docs.github.com/en/free-pro-team@latest/github/getting-started-with-github/fork-a-repo

git clone git@github.com:quantumlib/Cirq.git
cd Cirq
Create a Python virtual environment and install Google Cirq


```
python3 -m venv ./env
source env/bin/activate
which python3
python -m pip install --upgrade pip
python -m pip install cirq
```
(Optional) Install it as a development environment so you can modify Cirq source code


```bash
python -m pip install -e .[dev_env]
python -m pip install -r dev_tools/conf/pip-list-dev-tools.txt
pytest .
```
Great! Now we can simulate quantum circuits

cd examples/
python hello_qubit.py

See effect of single H|1>
See effect of HH|1>
See effect of Bell state entanglement circuit
Next, let’s try a minimal QAOA example

wget
https://raw.githubusercontent.com/yipenghuang0302/Cirq/master/examples/2020_672_qaoa.py

First, create our example graph
Next, let’s try a minimal QAOA example

Walk through the QAOA algorithm again, this time with code: