Simulated Design of Quantum networks

Senior Design team sddec 23-17

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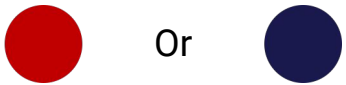
Explanation of Quantum Network

Network that taking leverage of 'nature of quantum'

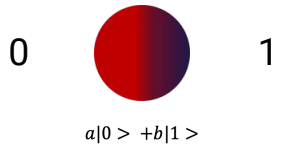
Classical Computers (Digital Computers)

Bits



Quantum Computers

Qbits



(Security) We can communicate secretly by without breaking quantum information.

OR

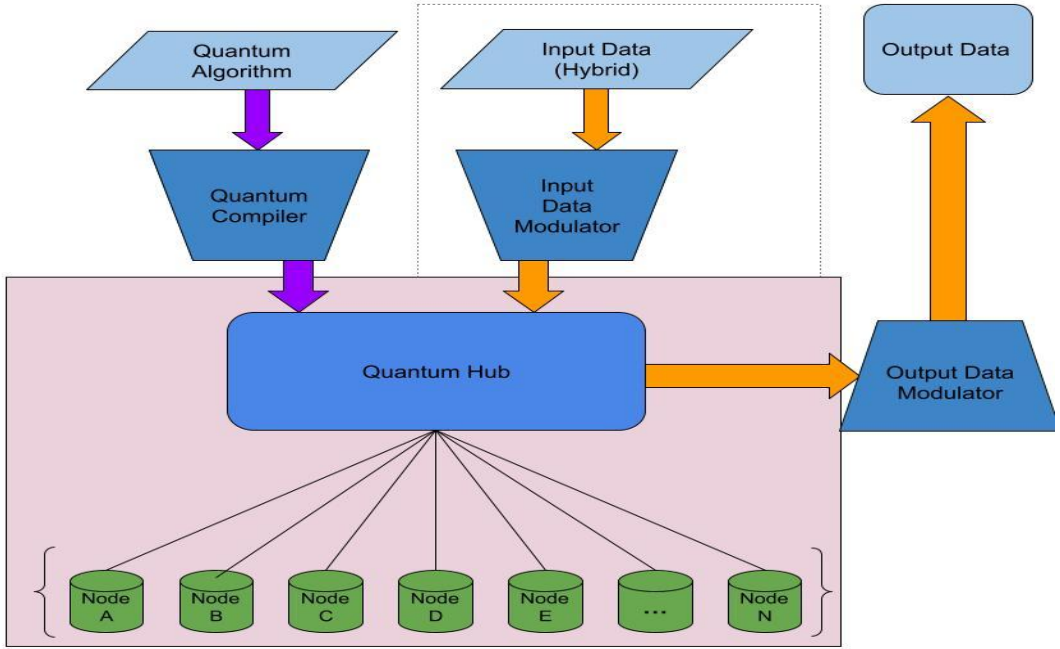
(Condensed communication) we can have a much higher density of information.
N Qbits -> 2^N classical bits

Explanation of Quantum Network

Design Context

- Clients: Dr. Durga and Dr. Smith
  - Doing intensive **researches** regarding quantum computers.
  - Major interest : **Quantum computation** and **Quantum information theory**
    - **They are making Ion trap to hold Q-bits. They want to research quantum cluster computing.**
- Needs
  - Design a quantum network **simulation** to communicate with quantum cluster computers. These computers will have both classical and quantum components.

Explanation of Quantum Network - Network diagram



Quantum network for quantum cluster computing Project Timeline

Phase	Aug	Sept	Oct	Nov	Dec
Quantum communication network phase1	Build 2Qbit communication network				
Quantum router phase 1	Build quantum quantum router (2 nodes)				
Integration phase1		Integrate two rudimentary components	Testing and get feedback		
Improvement			Implement advanced features Enabling N - nodes		
Integration phase2				Integrate two components	Create dummy job for presentation
Documentation					Write technical documents for our clients to make them to use for their research
Research	Research and study quantum computation and cluster networking				

Working strategy / Meeting schedules

- Two meetings a week
  - One with advisor
  - One with just students

- Irretive design philosophy

- 1 to 1, 1 to n, n to n

1st iteration plan

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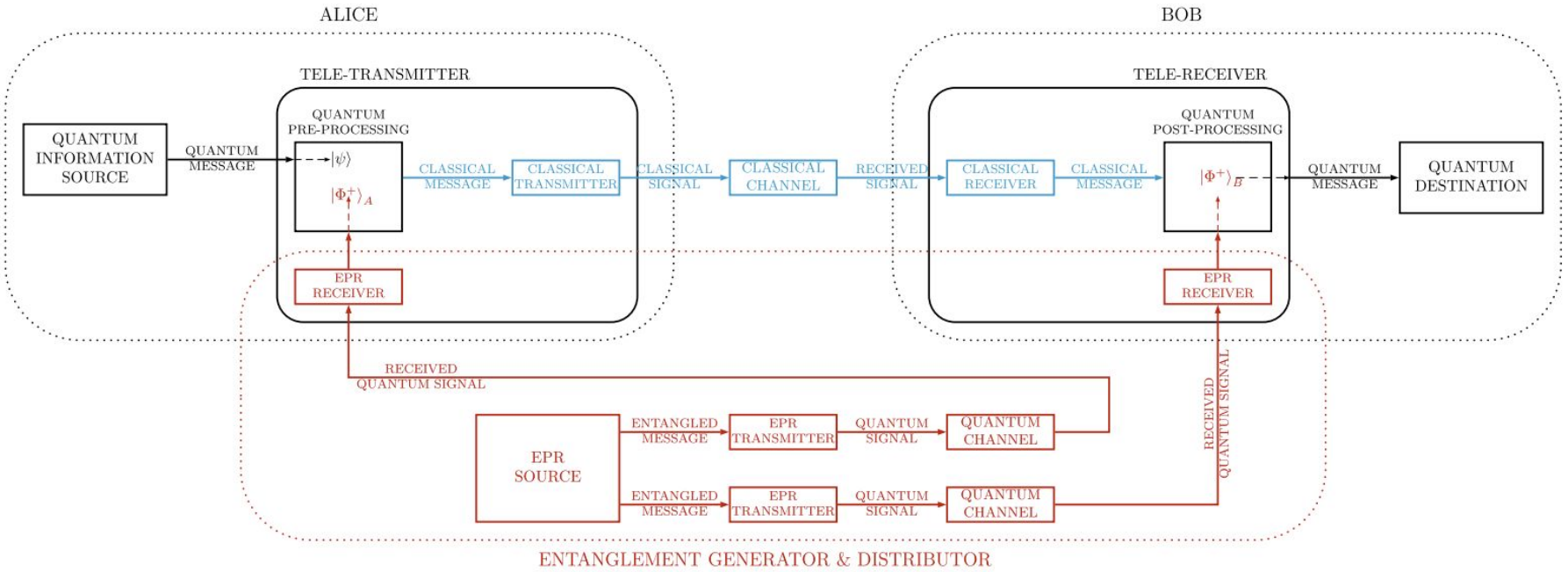
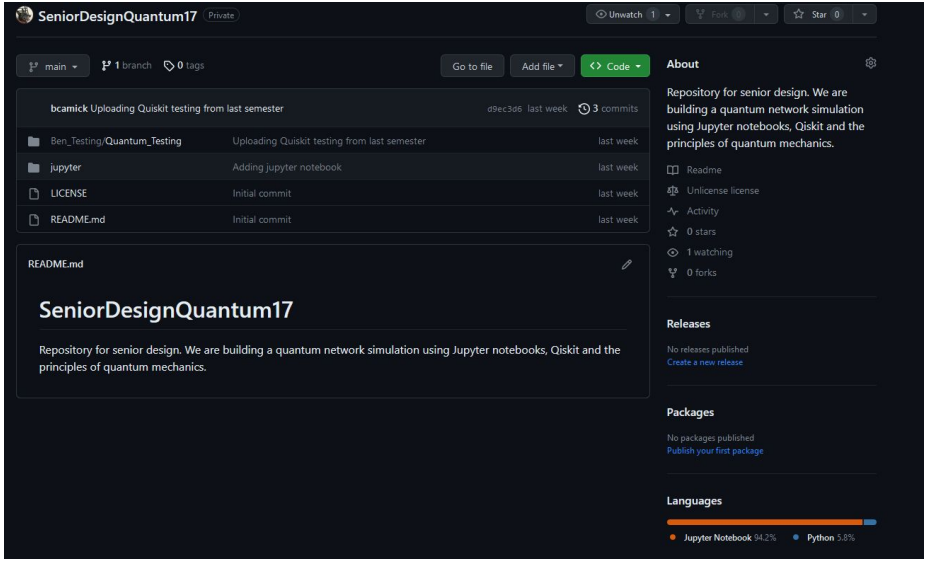


Iteration plan - details

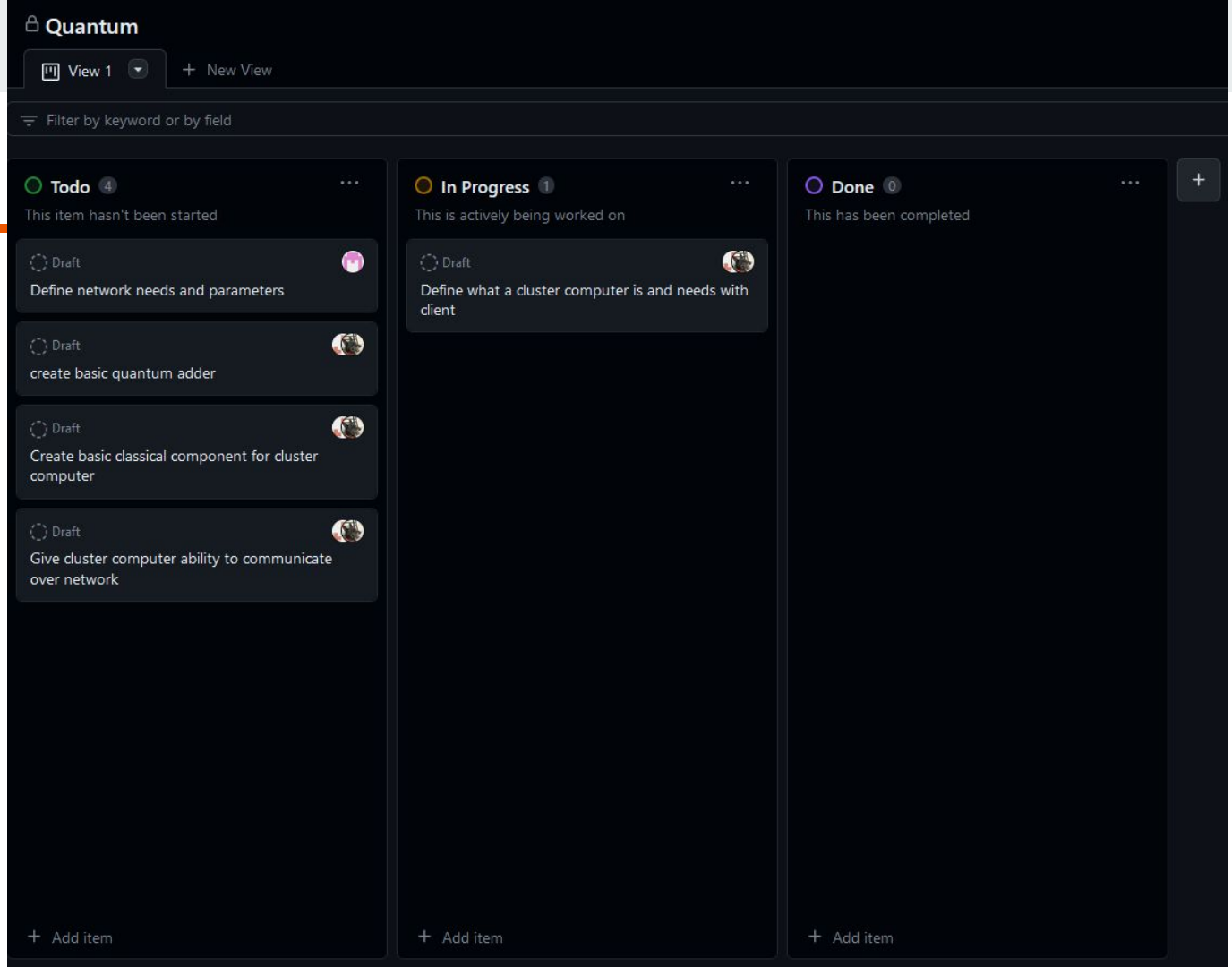


The environment we are using will be Jupyter notebook and our version control will be done using git.

We are using a github board to manage and assign tasks to individuals.

Our plan is to create a basic cluster computer (in code) that has the ability to communicate with our network and can select and perform different quantum computational tasks and return the result.

AGILE- We want to work in two week sprints and are working in teams of two.


Quantum
View 1
New View
Filter by keyword or by field
Todo 4
This item hasn't been started
Draft
Define network needs and parameters
Draft
create basic quantum adder
Draft
Create basic classical component for cluster computer
Draft
Give cluster computer ability to communicate over network
Add item
In Progress 1
This is actively being worked on
Draft
Define what a cluster computer is and needs with client
Add item
Done 0
This has been completed
Add item

jupyter quantum Last Checkpoint: 9 days ago

File Edit View Run Kernel Settings Help Trusted

Code JupyterLab Python 3 (ipykernel)

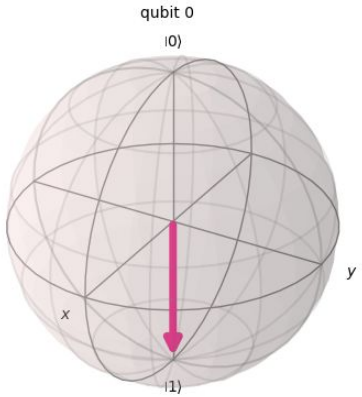
[2]:
```
!pip install qiskit
```

```
Requirement already satisfied: qiskit in c:\python311\lib\site-packages (0.44.1)
Requirement already satisfied: qiskit-terra==0.25.1 in c:\python311\lib\site-packages (from qiskit) (0.25.1)
Requirement already satisfied: rustworkx>=0.13.0 in c:\python311\lib\site-packages (from qiskit-terra==0.25.1->qiskit) (0.13.1)
Requirement already satisfied: numpy>=1.17 in c:\python311\lib\site-packages (from qiskit-terra==0.25.1->qiskit) (1.23.5)
Requirement already satisfied: ply>=3.10 in c:\python311\lib\site-packages (from qiskit-terra==0.25.1->qiskit) (3.11)
Requirement already satisfied: psutil>=5 in c:\python311\lib\site-packages (from qiskit-terra==0.25.1->qiskit) (5.9.5)
Requirement already satisfied: scipy>=1.5 in c:\python311\lib\site-packages (from qiskit-terra==0.25.1->qiskit) (1.10.1)
Requirement already satisfied: sympy>=1.3 in c:\python311\lib\site-packages (from qiskit-terra==0.25.1->qiskit) (1.12)
Requirement already satisfied: dill>=0.3 in c:\python311\lib\site-packages (from qiskit-terra==0.25.1->qiskit) (0.3.7)
Requirement already satisfied: python-dateutil>=2.8.0 in c:\python311\lib\site-packages (from qiskit-terra==0.25.1->qiskit) (2.8.2)
Requirement already satisfied: stevedore>=3.0.0 in c:\python311\lib\site-packages (from qiskit-terra==0.25.1->qiskit) (5.1.0)
Requirement already satisfied: six>=1.5 in c:\python311\lib\site-packages (from python-dateutil>=2.8.0->qiskit-terra==0.25.1->qiskit) (1.16.0)
Requirement already satisfied: pbr!=2.1.0,>=2.0.0 in c:\python311\lib\site-packages (from stevedore>=3.0.0->qiskit-terra==0.25.1->qiskit) (5.11.1)
Requirement already satisfied: mpmath>=0.19 in c:\python311\lib\site-packages (from sympy>=1.3->qiskit-terra==0.25.1->qiskit) (1.3.0)
DEPRECATION: Loading egg at c:\python311\lib\site-packages\vboxapi-1.0-py3.11.egg is deprecated. pip 23.3 will enforce this behaviour change. A possible replacement is to use pip for package installation..
```

[3]:
```
from qiskit.visualization import plot_bloch_multivector as pbm
```

[4]:
```
state=[0,1]
pbm(state)
```

[4]:



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Technical difficulties

Quantum

- We don’t have a quantum computer to use, we will need to rely on simulations
- Quantum information is very easy to break

Classical

- Every Quantum device needs an underlying classical network
- Interaction between quantum and classical is very hard to do
- The classical network will need to be able to keep up with the quantum network

Goals for this semester

1. One to One quantum communication
2. One to many quantum communication
3. Modularize the quantum nodes
4. Error correction
5. Testing with many (100+) quantum nodes

Thank you !