

# 98-106 StuCo: Intuitive Quantum Computing Midterm Project – Implementing BB84

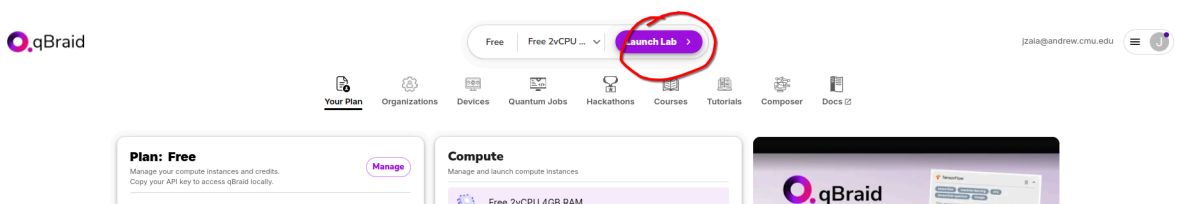
## Introduction

The midterm project for this class involves programming an actual quantum algorithm in Qiskit to run on a simulator using Jupyter notebooks. Namely, you will be implementing one half of the BB84 Quantum Key Distribution protocol. The project is worth 20% of your grade and is graded on correctness, with partial credit for mostly correct solutions.

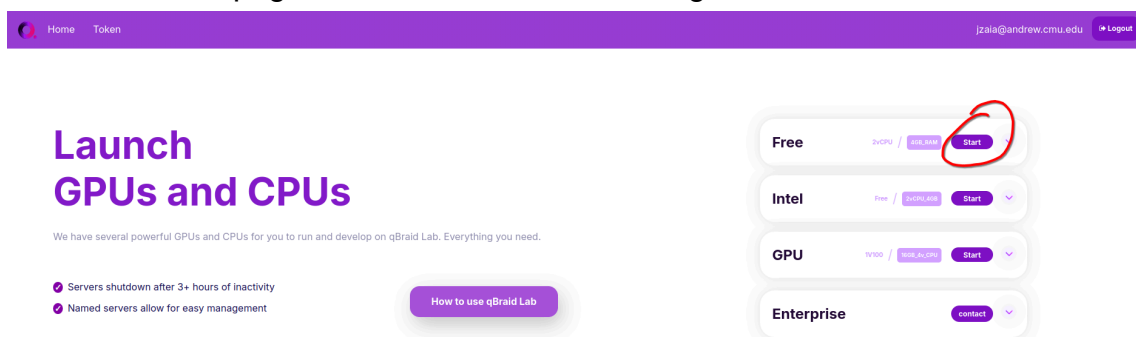
## Setting Up a Jupyter Environment

To run this project, you will need access to Jupyter notebooks which can install the Qiskit package for Python. I recommend using qBraid Labs for this purpose, but you could also run Jupyter locally if you prefer. You may have used Google Colab before but I would **not** recommend it for this project since it does not allow for files to be easily shared between different notebooks. Click the following link to access [qBraid Labs](#). Sign up for an account using your CMU email. The free tier account is more than enough for anything we will do in this class (if qBraid ever asks you to purchase credits, select no).

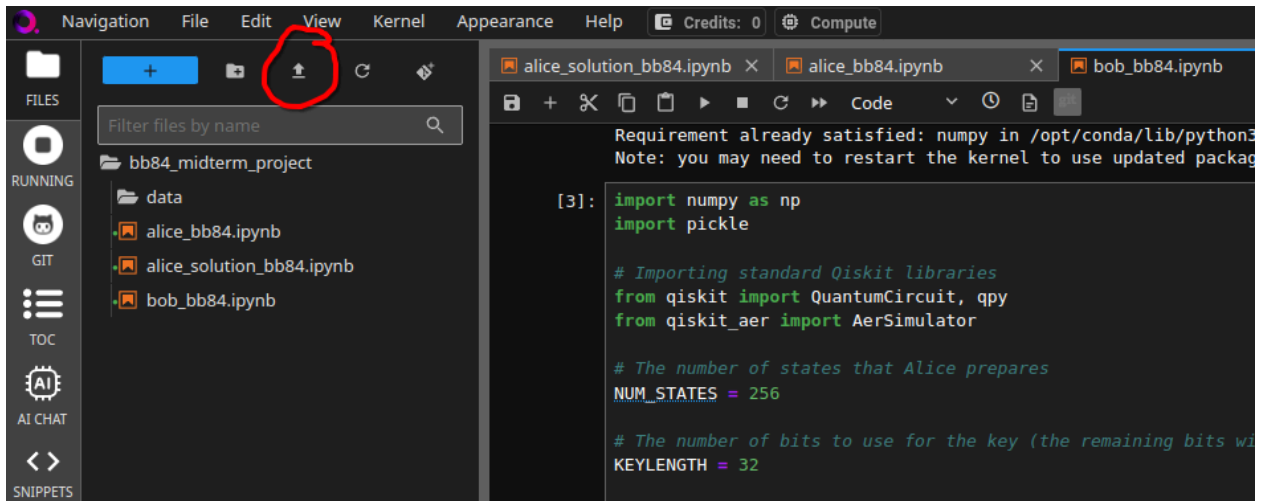
After you sign up, you may be redirected to a homepage. If this happens, press the button that says “Launch Lab”:



From the Lab homepage, select the “Free” tier to begin:



Once you are in qBraid Labs, you will be placed into a Jupyter notebook interface. You can upload the files `alice_bb84.ipynb` and `bob_bb84.ipynb` using the import files feature:



The files have further instructions on what the code within does, and the correct way to go about executing them.

## Project Files

The project files can be found [here](#). There are 2 files in this project: `alice_bb84.ipynb` and `bob_bb84.ipynb`. These notebooks represent the actions taken by Alice and Bob during the BB84 quantum key distribution protocol. To represent communication between the parties of Alice and Bob, data files are read/written to a place accessible to both notebooks. Bob's notebook has been completed for you, so **all of your work will be done in Alice's notebook**.

## Resources & Collaboration

You are free to use any resources available to you to complete this assignment, both from the course and on the internet. However you **may not directly share code with anyone in the class (or anyone else)**. Feel free to make use of the Qiskit documentation, qBraid documentation, course Piazza, ChatGPT (without giving it your code), Google, the quantum stack exchange, Wikipedia or any other tools you need. **Collaboration is encouraged**, and you can speak about any specifics of this assignment in as much detail with one another as you like. The only thing you may not do is share your code or view another student's code. **If you worked with someone else, please write this somewhere in your submission.**

## Useful Links

Links to some useful resources are below:

- The Course Piazza: <https://piazza.com/cmu/fall2024/98106>
- The Qiskit documentation: <https://docs.quantum.ibm.com/api/qiskit>
- The qBraid Labs documentation: <https://docs.qbraid.com/lab/user-guide/overview>
- The slides from the BB84 lecture:  
[https://docs.google.com/presentation/d/18VddEUVildaBNH0EZfdWYDTocSdKORDHvI\\_Us2tEg4Y/edit?usp=drive\\_link](https://docs.google.com/presentation/d/18VddEUVildaBNH0EZfdWYDTocSdKORDHvI_Us2tEg4Y/edit?usp=drive_link)

It bears saying again: **this course has a Piazza**, where myself and your fellow classmates can answer any questions you're having. **If you get stuck, post there first!** If you email me with a question about the notebook contents, I will tell you to make a Piazza post so other people can benefit from the answer to your question.

## Submission & Grading

### Submitting to Canvas

Submit Alice's notebook on Canvas to the assignment labeled "Midterm Project" under the Assignments tab. The submission is due Nov 12th, but you may also work on this project late for full credit. Past the submission deadline, I may not be as quick to respond to questions you may have about completing the assignment (this is your incentive to complete it on time).

### Grading

Each section marked "TODO" within the code is weighted equally. Each section is graded on its correctness, with partial credit for a mostly correct answer. Note that there are many equally correct ways to fill in the "TODO" sections. Ensure that you **do not modify Bob's notebook**, since I will only be grading your changes to Alice's notebook, which must communicate with Bob's notebook correctly as-is.