Developing Python Programs for Data Collection and Analyzation

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Introduction

During the fall and spring semester, I worked at the Joint Quantum Institute with graduate researcher Jonathan Vannucci. I worked to develop Python data collection programs to collect data from cameras that measured light from a laser being shone on a 2D material at cryogenic temperatures.
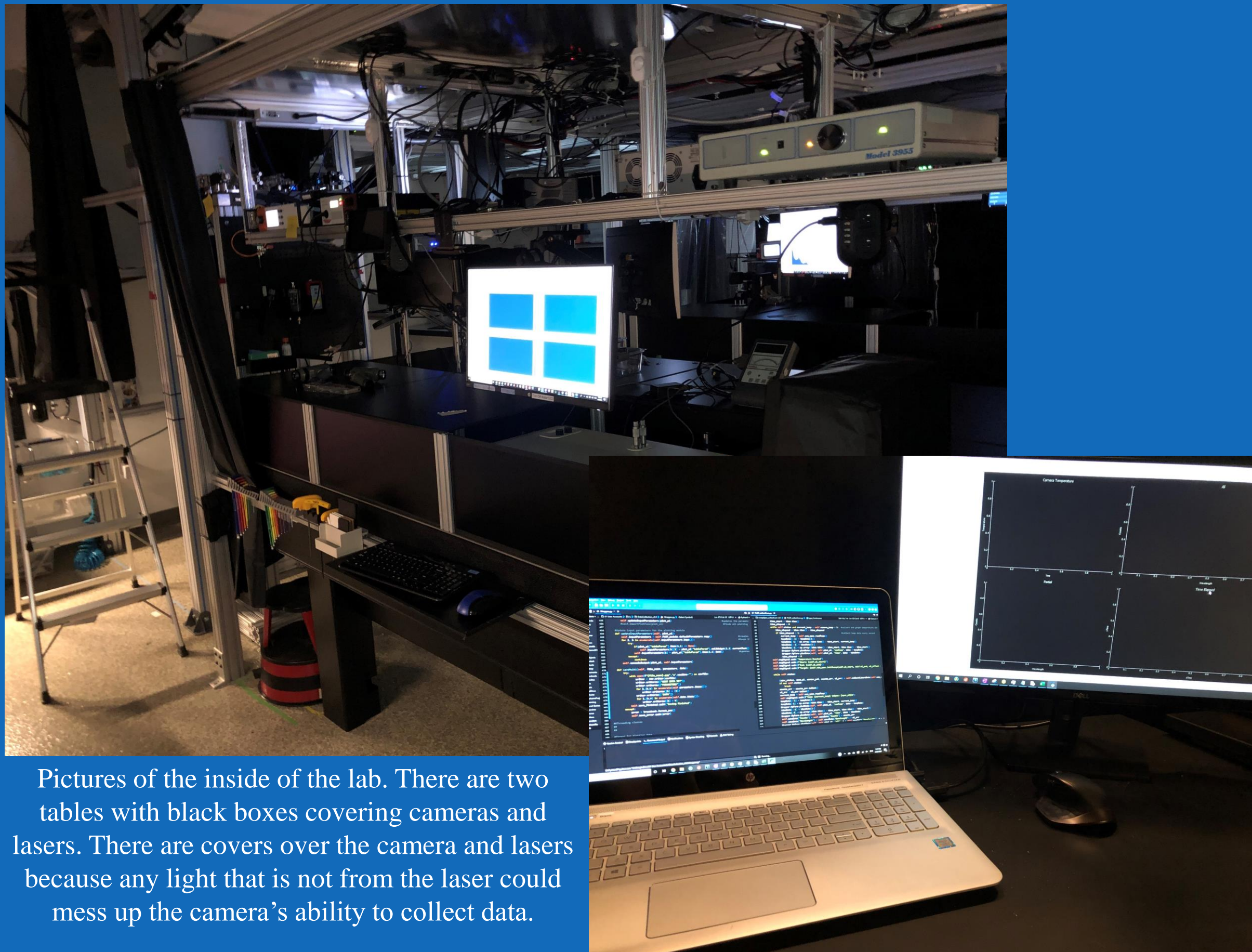
Pictures of the inside of the lab. There are two tables with black boxes covering cameras and lasers. There are covers over the camera and lasers because any light that is not from the laser could mess up the camera's ability to collect data.
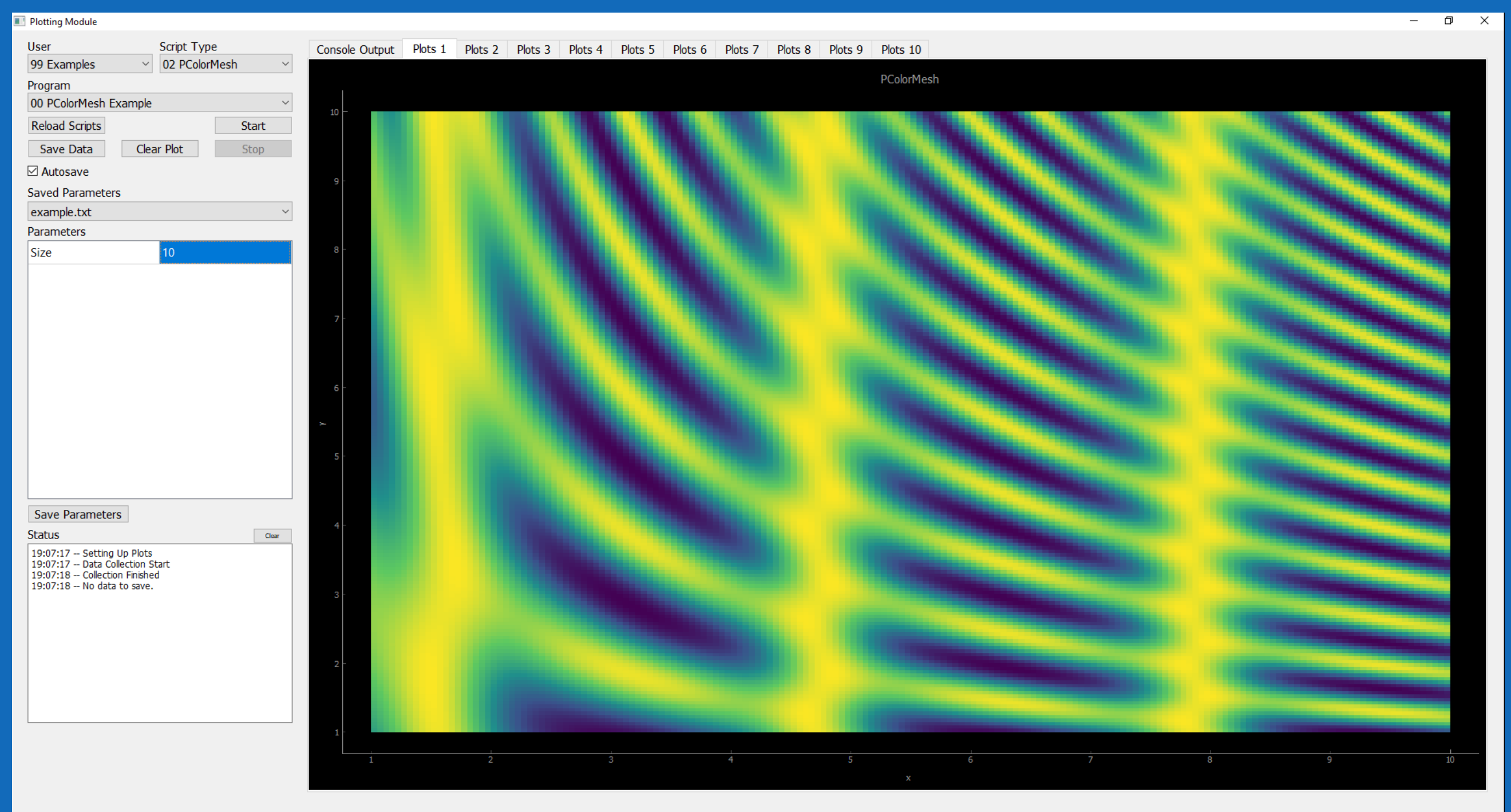
Picture of the setup I had in the lab to develop programs

Site Information:

Joint Quantum Institute

Address: 4296 Stadium Dr, College Park, MD, 20742

Site Supervisor: Mohammad Hafezi

Site Mission: Designs, fabricates, and collect measurements of 2D material device structures that exhibit unique electrical and optical responses at cryogenic temperatures.

Issues Confronting Site:

The lab needed to develop a new program in Python that could collect data for their instruments since the old program they were using was not able to be updated. Also, I would need to redevelop existing data collection modules to work with the new program.
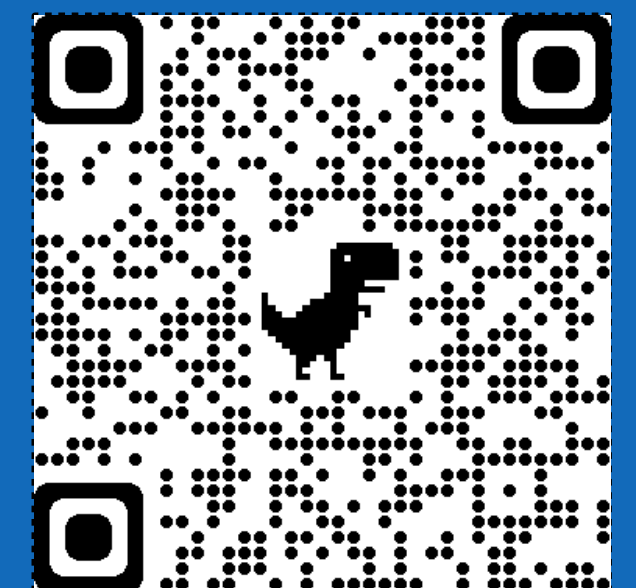
Future Work:

As of now, the main program is functional and is able to collect data from some instruments. In the future, I will continue to update and refine the program and develop more modules for the instruments in the lab.

Activities:

I developed a Python program that could take scripts for a variety of instruments in order to collect and display the data that was collected. I needed to develop the program so that it displayed the data being collected in real time. This was done using multithreading with the GUI running in the main thread and the data collection being ran in another. I also learned more about Python and it's libraries like NumPy and PyQtGraph for displaying data and PyQt5 to develop GUIs for the program.

Impact:

The program that I have developed will help make it easier to collect data in the lab since I have improved on a previous programs features. Also, the program that I have created is modular so in theory, it will work with any new modules that are developed to collect data from new machines. This project helped me get better at coding and developing programs in Python and helped me understand more about how Python works.

Screenshot of the program running an example program. The example program is creating values for a contour map from example functions and plotting it onto the main GUI.

Discussion:

In the beginning, I knew very little about developing programs in Python and I started out making a simple program to collect data from an oscilloscope. However, the program that I had developed freezes whenever data was being collected. This was an obvious problem since the instruments that I develop programs for will sometimes be running for long periods of time, where the data needed to be monitored as it was collected. This meant that I needed to learn how to use threading in Python in order to keep the GUI running and display the data being collected in real time. After I finished the simple program, I created a main program that could take another Python script that collects data, and the main program would display the data being collected in real time. This one was the most challenging since I needed to create the program so that it could take any Python script that I create, send instructions to the instruments, plot the data being collected in real time, and be able to save the data after it was finished. I eventually finished the program and it can collect thousands of datapoints a second without slowing down or freezing.

Acknowledgments:

I would like to thank my site supervisor Mohammad Hafezi for giving me this opportunity and Jonathan Vannucci for overseeing me and help me understand what I needed to make. I would also like to thank Dr. Holtz and Dr. Merck for all their help and knowledge throughout my first two years in college.