Lab 1: Intro to DAQ

1 Introduction

During this term, you and your teammates will gain an experimental understanding of physics concepts using devices typically employed in engineering applications. You and your team will have to find your own solution to specific problems formulated in the context of engineering projects. The solution to these projects will require a clear understanding of the underlying physics concepts as well as skills in the engineering implementation of such solutions.

2 Assignment

Data acquisition is the process of taking physical qualities (e.g., voltage, current, sound pressure) and converting them to digital data that a computer can work with. The Visualisation Studio machine at your lab station is equipped with a data acquisition unit (or DAQ, for short) that is capable of measuring voltage. Your team is tasked with:

1. characterizing the DAQ. You will measure a known voltage many times with the DAQ and assess the measurement uncertainty of the device (see section 4.1).
2. using the DAQ to measure some unknown voltage (see section 4.3).

3 Deliverables

Your team is to submit a lab report presenting your findings. 10% of your lab report grade will be based on following the guidelines in the lab report template. Another 10% of the lab report grade will be for the report's Abstract and Introduction. The remaining 80% will be determined by including the following content in your report:

- for assignment 1:
    1. *[12.5%]* a plot showing how the number of samples (N) affects the average voltage read from the DAQ (V_{avg})
    2. *[12.5%]* a plot showing how the number of samples (N) affects the uncertainty in the average voltage read from the DAQ (σ_V)
- for assignment 2:
    4. *[10%]* a discussion of the process your team used to measure this voltage
    5. *[15%]* your team's measurement of the power supply output when running the `mystery_voltage.py` script, as well as the uncertainty associated with your measurement
    6. *[15%]* a plot (e.g., time series, histogram) showing the data your team took for this measurement
    7. *[15%]* a discussion of how the uncertainty in the measurement of this unknown voltage relates to the uncertainty associated with the DAQ, as determined for assignment 1

4 Technical Information

4.1 Using the DAQ

There are eight channels on the DAQ. Channels 0-3 are grounded and measure voltages up to 10 V. Channels 4-7 measure voltages up to 10 mV. To take a reading from the DAQ, you can perform the following in a Python session:

```
from lab.daq import DAQ
daq = DAQ()
daq.readChannel(0)
```

where the argument to `readChannel()` is the channel you are reading from. There are also several prepared scripts in the `examples` directory that you may use. The `daq_to_csv.py` script may be of particular use for this lab. If you choose to use these scripts, read through the code and ensure you understand what the program is doing.

4.2 Using the power supply

The power supplies can operate in either constant current (CC) or constant voltage (CV) mode, depending on which variable is the limiting factor. The 'SET' values refer to caps on the maximum value for current and voltage, not what is actually being output. The values above these reflect what is actually being output, so be mindful of this when making measurements. It should also be noted that each channel can be turned on or off independently with the colored buttons on the front of the supply.

4.3 Generating an unknown voltage

There is a program that your team will use to generate the unknown voltage you are to measure. This program will connect to the DC power supply and control its output. In the terminal, run the command:

```
python3 -m lab.mystery_voltage
```

When running the script, you will be asked to select an instrument to connect to. Select whichever begins with 'USB'. To prevent errors, you should not touch the power supply while the script is running. In order to run this script and also take DAQ readings at the same time, you may wan to open two terminals.

5 Hazard Assessment

- Your team will be using a DC power supply in this lab. Always ensure the supply is **off** when plugging into or unplugging from the supply. The current output from the supply should not be over **0.1 A** during this lab.