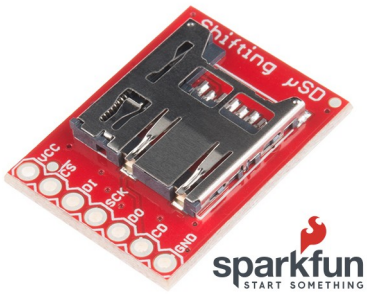
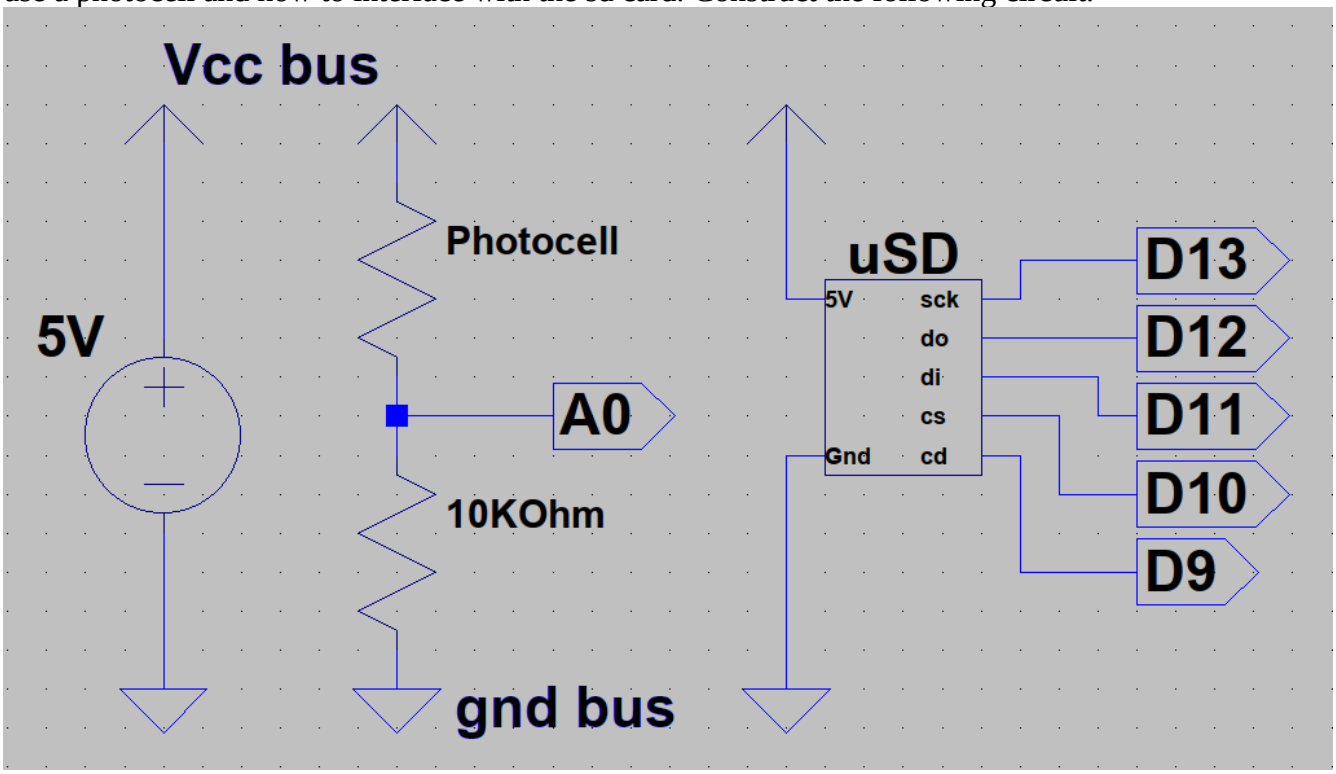
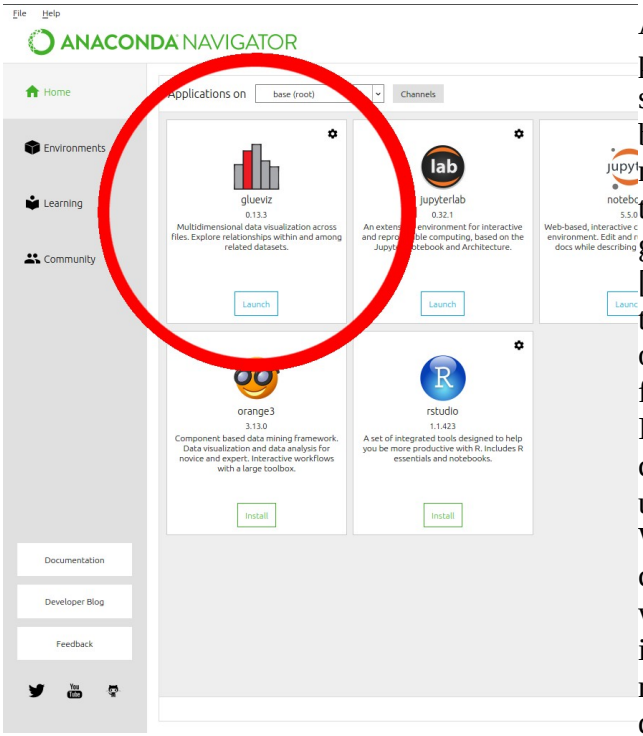


We're going to log our sensor data to an sd card, there are many other options for this, but I chose this particular one because its very cheap and the easiest one to use in my opinion. This one is called a "shifting" sd card breakout so that it can safely be used with either 3V or 5V devices. Lower voltage, means lower power consumed for all of the same operations, but not all devices are made the same voltage, and a digital output of a 5V device would be too much for a 3V pin to handle. So there's a chip on this board to handle the change safely. As a consequence this is also cross compatible with both power level devices.

Just to start off logging, lets record light changes over time. We'll use this example to explore how to use a photocell and how to interface with the sd card. Construct the following circuit.



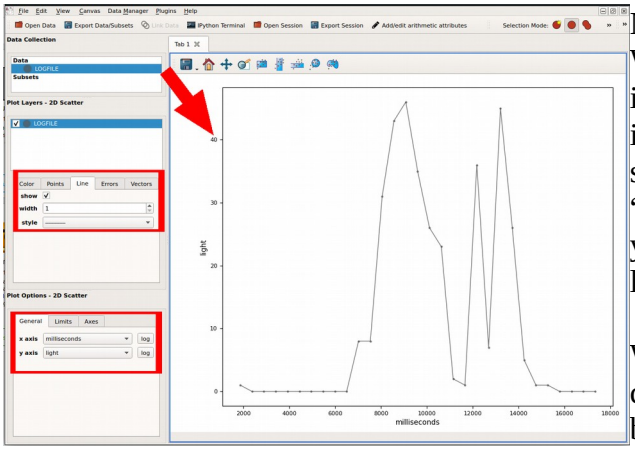
The photocell is a light dependent resistor, and when illuminated, it will act like a low resistance. Here we have it and a 10kOhm resistor creating a voltage divider, so a bright status would have a low resistance or direct connection to 5V. The micro sd card has power pins, and 5 pins for interfacing. These signals are digital like our led and button example, but here the arduino sends out high speed digital signals to write to a text file. Digital pins 13 to 10 are using a communication type called SPI. Sck is serial clock, DO is the sd card data output, DI is the data input, and cs is chip select. Many SPI devices can have the same sck, do, and di pins and the chip select pin is used to choose which one is active. Here we only have one SPI device, so that won't be an issue. The CD pin is a switch detecting whether or not a card is actually in, or card detect.



After the circuit is constructed, upload the sd.ino program to the arduino and open the serial port, it should indicate that the system is waiting for a card to be inserted. While waiting, open up the anaconda navigator and open glue, sometimes it can take time to open, so we'll open it here to be ready for graphing.

[Sd cards are not included in our kit, so we may have to pass around a couple of sd cards for people to use once they've finished building the circuit. When finished building, raise your hand for an sd card test. If we don't have a few sd cards to pass around, our sd card file section has an example logfile produced using the same program.]

With a complete circuit, insert a FAT16 formatted sd card into the card holder, and when clicked all the way in, the arduino will detect the pin has been inserted and will initialize the card and start recording. While the system is recording photocell data, tilt the photocell around relative to light sources or cover it with a hand to vary its input. Do this for a few seconds ensuring a wide range of inputs are applied, and then press the sd card to click it out of its holder. Copy your log file to your computer and delete the file from the sd card to ensure old data isn't used.



Now that the file is recorded, lets look at its contents. With Glue open, drag the logfile from a file browser into anywhere in glue, and then drag from the sidebar into the main area of the program and it will open a scatter plot of the data. Change the axis so that "milliseconds" is on the x axis and light level is on the y axis. To make curve shape more visible, make the line visible on the plot.

We should be able to see in the plot low values corresponding to dark levels and high values represent bright levels, with middle range values representing uncovered but pointing away from a light source. In a launch, the most prominent light source will be the sun from above, so we might expect that steady values mean the system isn't moving, where jittering signals are from a system moving, with a dark value probably meaning the sensor is facing upside down. The shape of the light curve can be examined using Glue's magnifying glass tool. Zooming in closely on the curve will reveal the sensor's stepsize, the sensor cannot measure variations smaller than this for any given sensor. Sections of data can be grouped together and colored to highlight certain interesting events in the data, but we'll save the fancier analysis for later on.