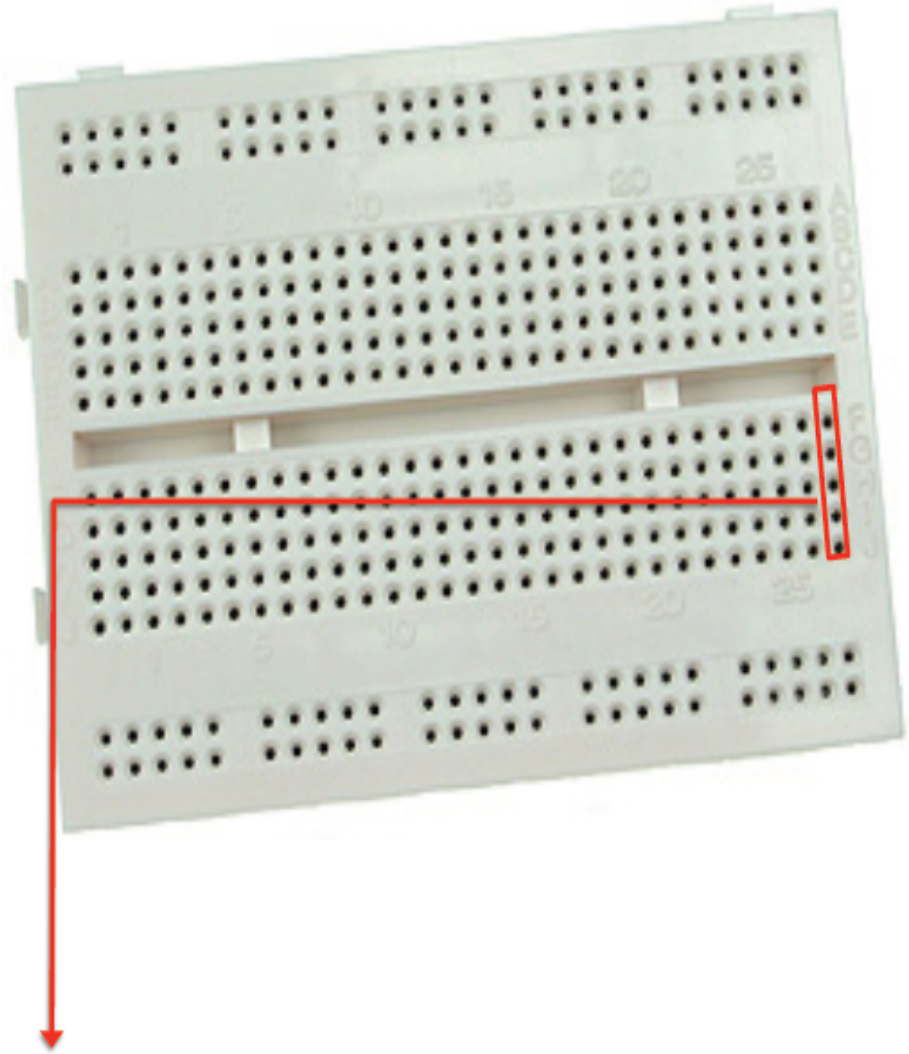
Circuitry Basics

The first thing that you need to understand is how wires in a bread-board are connected to each-other. If we look at this breadboard,



The holes arranged like these are all considered to be directly connected, anything that is plugged into one of these holes is treated as being connected to each other. The same goes for each row of 5 holes such as these, but none of the rows are connected to each other, which is where we come in placing things into the circuit to connect them.

Nets

The next important thing is what we call 'nets'. Nets are basically a connection of wire and places on the breadboard that are all directly connected. If I take a wire and connect two different rows of the breadboard together, those two rows are now considered to be part of the same net. In these instructions I will use three different colors of wire in order to represent the different nets in our circuit. The most important thing to remember about this is that an row of the breadboard which we want connected to a particular 'net' must have a wire in it somewhere that connects directly to one of the other rows in that net. I will use red wires to represent the +5v or power nets, and black wire to represent the ground nets; any row in which you see a red wire connected must be directly connected to all the other rows that have red wires in them.

Ground Net Wire

+5v or Power net wire

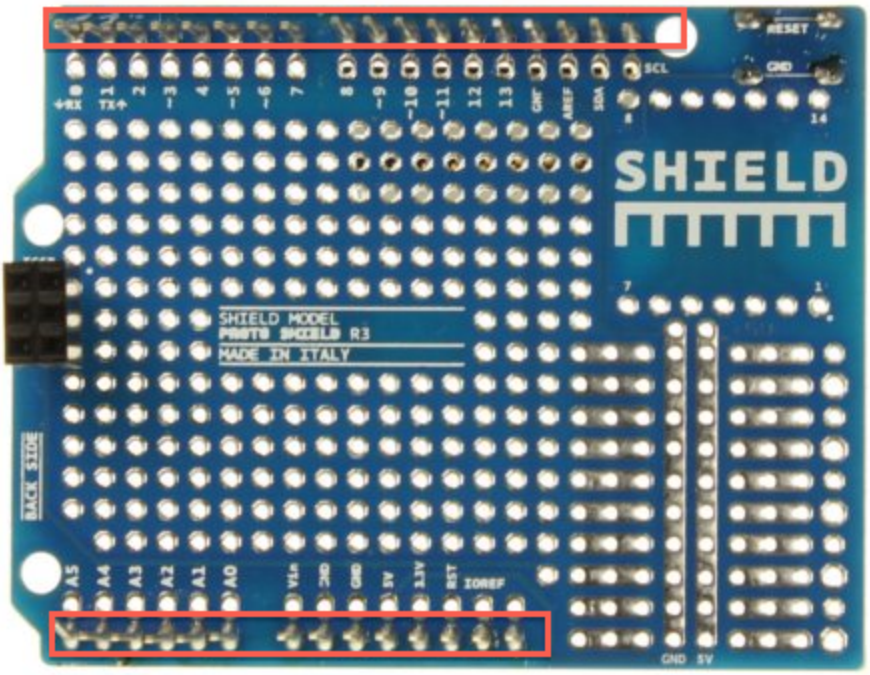
Signals

The most important thing for our circuit for the robot to do is for it to retrieve and send signals to and from different elements of our robot. In order to do this it uses electrical signals, which in our case I have chosen to represent in every case with a yellow wire. If you see a yellow wire connected to a row of the breadboard, you know that that row should be connected directly to the port of the robot which it will be labeled with; that wire should lead off of your breadboard and down onto the shield, and into the correctly labeled hole.

Signal Wire

Shield Connections

The first step for setting up our circuit is to solder in the headers to our shield. The headers should be cut into sections matching the number of holes in each of the four sections lining the outside of your shields, highlighted below. After they are cut to match, you will want to insert the shorter ends of your headers down into your shield on the same side of the board as pictured. Once you have done this, turn the board over, and solder each of the headers in place.



The next step is to solder your leads into the board. The leads will be broken into three different sets, signals, power, and ground leads (these correspond to the nets described earlier). You should try to make sure that each lead for a given net is the same color; typically signals are white or yellow, power is red, and ground is black. Feel free to use other colors of wire as you choose, just make sure to keep track of what you designate for each. These leads will be soldered into the same rows as the headers shown above, just on the inner of the two columns. Leave these wires about 4 to 5 inches long.

The leads will need to be soldered into the following pin holes…

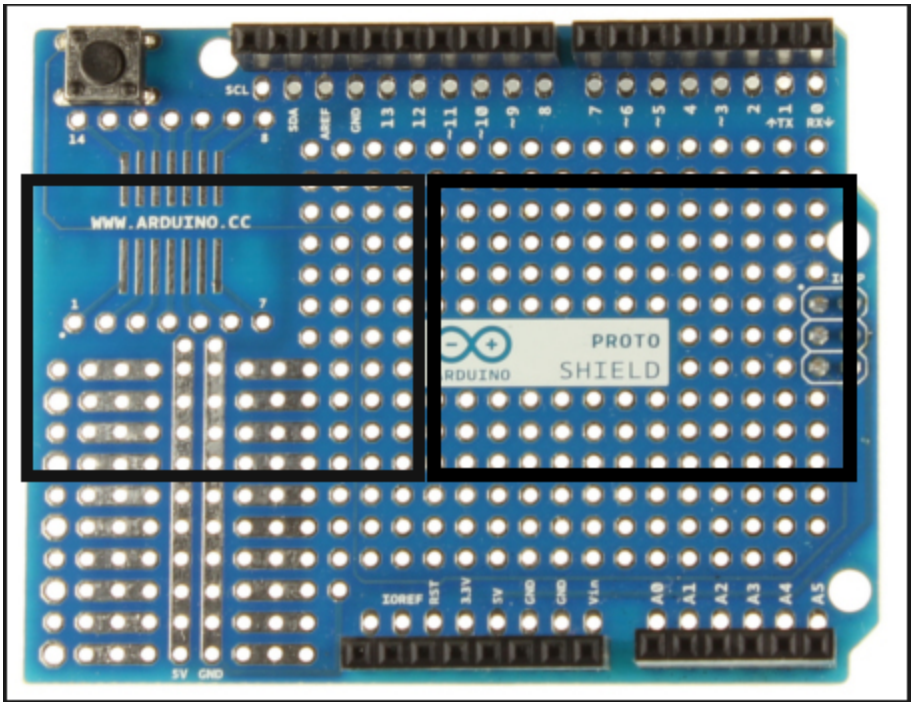
Signal Wires: A0, A1, A2, A3, 13, 12, 11, 10, 9, 8

Power: 5v, Vin

Ground: Any of the three GND ports. Only one is needed, although you may use more if you would like.

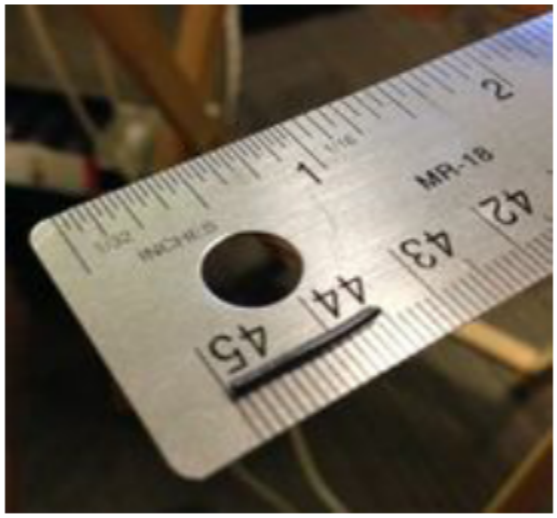
Putting the Breadboards onto the Shield

Once you have soldered in all of your leads, you are ready to mount your breadboards. These should be mounted at the same place on the shield as shown in the image below, with the same logo facing up (make sure you don't do this on your Leonardo board… A shield with headers is shown in the image in order to illustrate the relative position of your breadboards, but make sure you use the shield you just soldered on in order to mount the breadboards).



This side is the front of your board (for reference when wiring your breadboard)

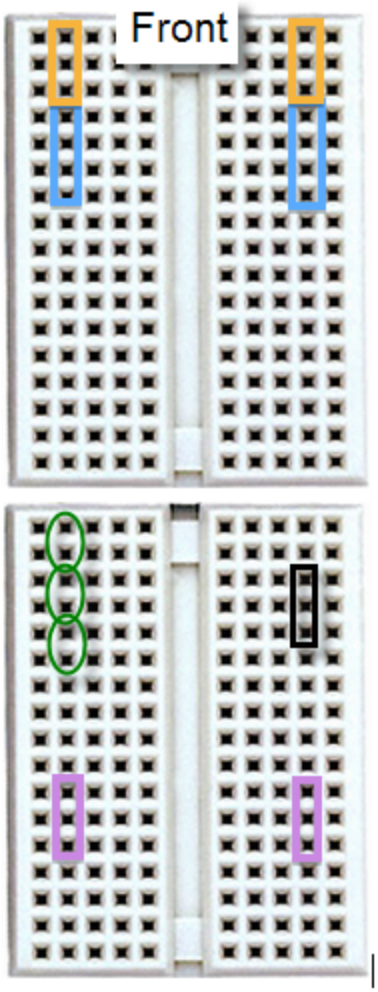
Connecting Sensors and Motors to the Breadboard



At this point, all of your sensor and motor wires should be crimped and placed into crimp housings. Once these are in place, just follow the steps below to connect them to your breadboards.

First you will want to strip several inches of the wire insulation off of the end of a wire (any wire will do), and then you will want to cut it into 1.5 cm segments like the one shown here (although make sure that they are stripped when you do this).

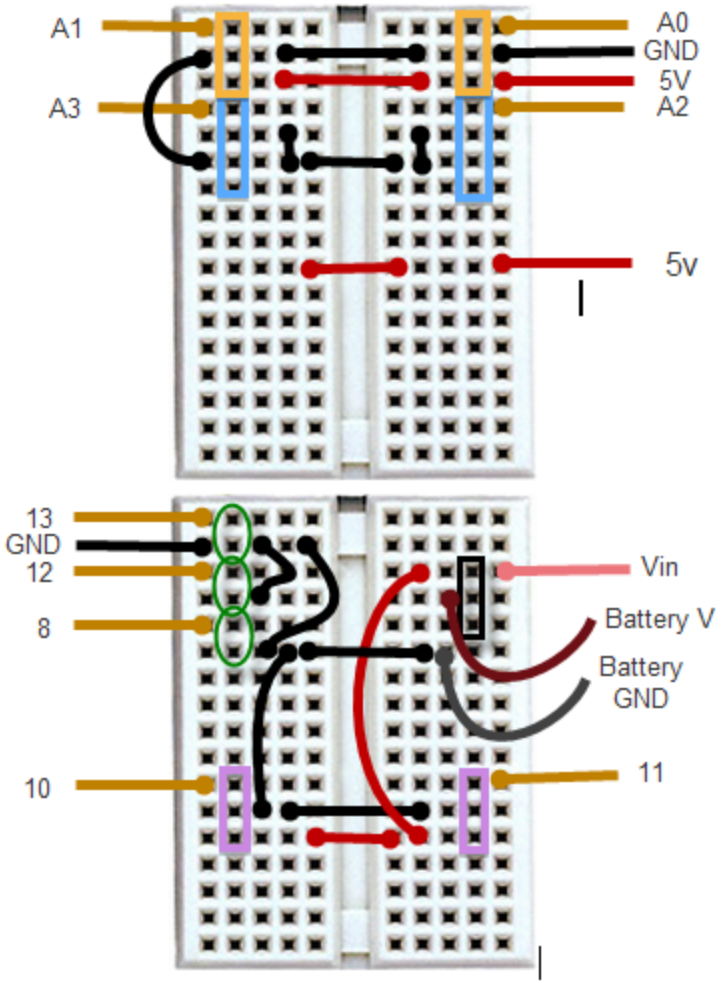
Once you have enough of these, put one each of these bare wire segments into the end of a crimp housing (as shown below), and the header is now ready to be directly plugged into the board. Plug the headers into the boards at the locations corresponding to their color. Make sure to always put the signal wire, which will either be white or yellow, for the sensor (or motor) towards the front end of your robot (or the top side in these pictures). The colors are as follows: Orange for Distance Sensors, Blue for Floor Sensors, Purple for Motors, Green for LEDs, and Black for the Power Switch. Make sure to keep track of which leg is longer for the LED's, these will be assumed to be towards the front for the purposes of the wiring diagram.



Wiring the Leads to the Board

We will now wire the leads into the breadboard. To do this, you will first want to trim the lead to an appropriate length to reach the port which it will be plugging into. Then, you will want to strip the insulation off of the last 1.5 cm of the lead; this should be just enough to insert fully into the breadboard, if there is any significant amount of exposed wire coming out of the hole, pull it out and trim the wire back a little. The wires that are just connected on the board itself should be color coded to reflect the net to which they belong.

The leads in the diagram below are labeled by which port they connect to on the shield. Two of the leads come directly from your battery pack. The wires off of the battery pack should be crimped and placed into opposite ends of a 3-crimp header (leave the middle port empty), and plugged into the board as shown in the diagram. When wiring your LEDs, make sure that their signal wires go to the longer leg, and their grounds go to the shorter.



Floor Sensor Circuit

We will now add the floor sensor circuit elements, our resistors and capacitors. Make sure to put the long leg of your capacitors into the same spot as shown in the diagram below. If you don't, you'll be going against the polarity of your capacitors, and you could make the magic smoke come out. Look to the top of the board, the Green line is the 220 Ohm resistor, Blue line is the 10K Ohm, and the Orange Elipses are the capacitors.