

Arduino Thermistor Lab Part 1 (in-class)

This week the goal for class time is to set up a circuit for measuring resistance using a thermistor. We will analyze the circuit, make measurements in class and then each of you will measure overnight at home. You will program the Arduino to print resistance to the serial monitor, then we will use Python to capture those values, convert to temperature and plot.

This circuit will be similar For the circuit analysis, refer back to the LED lab notes as needed. Also, recall Ohm's law ($V = IR$), which allows to relate voltage to current and resistance.

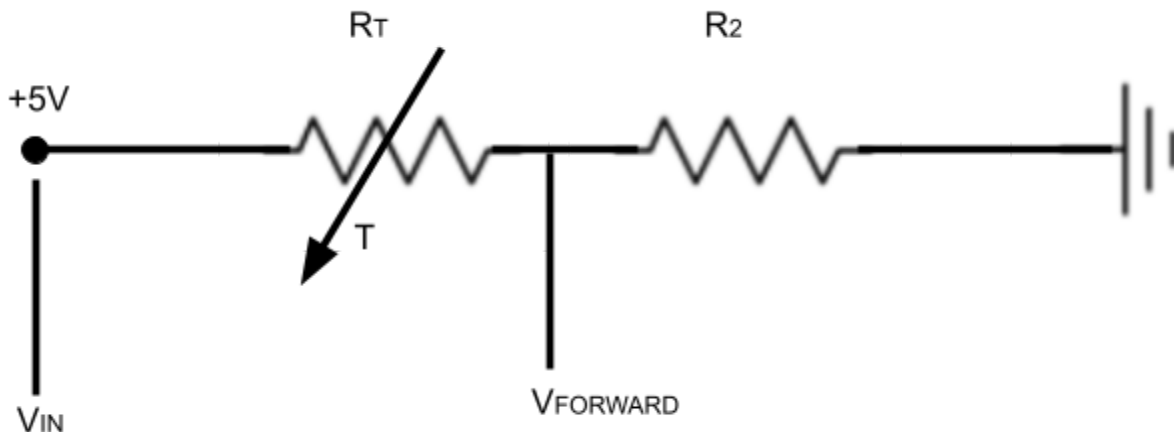
How a thermistor works:

(<https://en.wikipedia.org/wiki/Thermistor>). A **thermistor** is a type of resistor whose resistance is dependent on temperature, more so than in standard resistors. This means that resistance will change with temperature. If we can make a circuit that allows us to determine the value of this changing resistance, we can measure temperature from it.

Resistance is related to temperature by the Steinhart-Hart Equation

(https://en.wikipedia.org/wiki/Steinhart%E2%80%93Hart_equation). For our thermistors, the values of A, B, and C coefficients are found in the therm_plotter.ipynb file.

Similar to the LED lab, the circuit that we need looks like the drawing below. Two resistors (one is the thermistor) are wired in series. We can measure voltage at the positions V_{in} and $V_{forward}$, with respect to ground. We know the value of R_2 , but have to solve for the value of R_T .



Analyze the circuit to determine the value of R_T .

1. Recall that we can measure V_{in} and $V_{forward}$ with Arduino.
2. R_2 is known and won't change with temperature. Its value can be confirmed with the resistor chart.
3. Use Ohm's law and the values of V_{in} and $V_{forward}$, and R_2 to solve for R_T . **Hint: Write Ohm's law twice and solve for the unknown resistance, R_2 .**
4. The equation you determine in this section will be programmed into the Arduino.

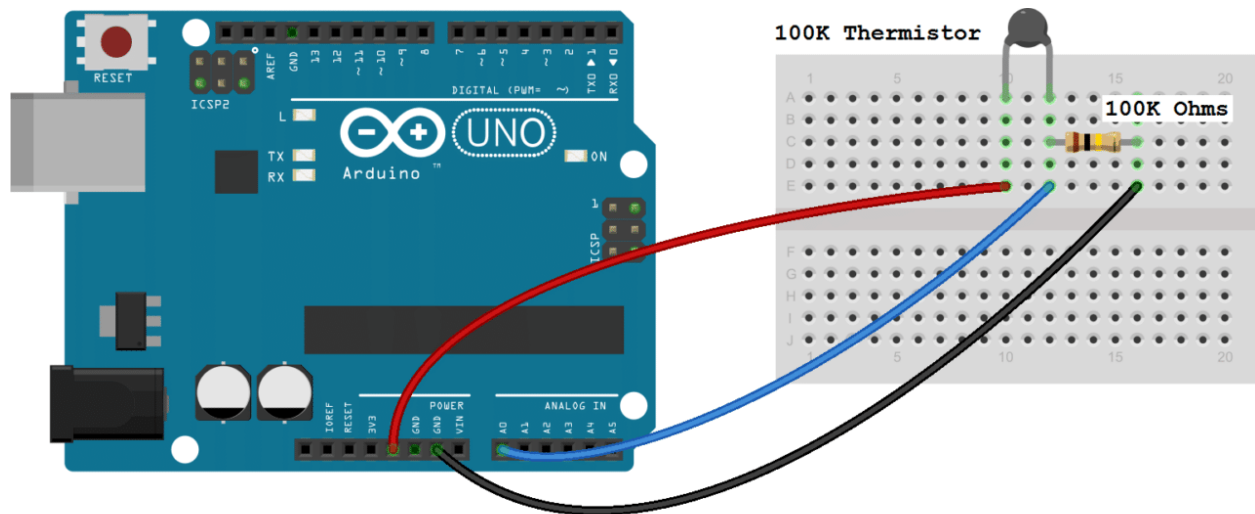


Figure: Diagram of Arduino and thermistor circuit. Note, we will use a kind of thermistor called an RTD which has much lower resistance - around 100 Ohms rather than 100 kOhms, so the reference resistor is also 100-200 Ohms.

Build your circuit using the Arduino Mega, breadboard, resistors.

1. Follow the diagram above and refer back to last week's wiring if you have questions. Recognize that the circuit is almost identical, except the LED has been replaced by a resistor. Note: We want to measure V_{in} and $V_{forward}$, so you will need jumper wires going to both A0 and A1.
2. Starting with the LED analysis code, make a .ino script and program the Arduino to report the resistance to the serial monitor. This will require:
 - a. Measurement of V_{in} and $V_{forward}$ with two analog input pins.
 - b. Digital to Analog conversion to convert from binary integers to engineering units (voltage).
 - c. Print the values of V_{in} and $V_{forward}$, and R_T to the screen. Given the values of V_{in} and $V_{forward}$, does your equation predict R_T ?
3. Implement polled logging from the Arduino using 2-way serial communication as you did with the LED take home assignment. Follow the comment prompts in [Therm Lab 2022.ino](#).

What to turn in?

1. Make a short PDF writeup describing your circuit analysis.
2. Report the values of V_{in} and $V_{forward}$.
3. From step 3 above, use Ohm's law to compute the value of R_T and report those (show your work).
4. Take a picture of the serial monitor on your computer reporting the values of R_T , and take another picture of your thermistor wired up correctly. Include both pictures in your writeup.
5. Work with your group, but everyone should turn in their own writeup.