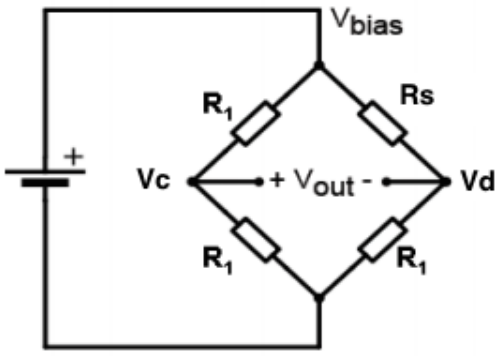
Pre-Lab Assignment 3

BioE 101 Spring 2016

Answer the following questions.

1. **Wheatstone Bridge**
   Sometimes resistors of unknown voltages can be placed in a circuit called a Wheatstone Bridge, shown below. Here, the resistances of three of the legs are the same (R1), but they don't have to be. These three legs are paired with a resistor of unknown resistance (Rs), such as a sensor that changes resistance in response to a stimulus (e.g. light, force, temperature, etc).
   a. Using Kirchoff's Laws, express Rs in terms of Vbias, R1, and Vout. (Hint 1: Assume no current passes between Vc and Vd, Hint 2: Write out the equations for the relationship between currents in the circuit, write out the voltage equations for the two loops in the circuit).



   b. If the range of your sensor's resistance is 20-50 mΩ, what are good choices for the resistances of your three R1?
   c. Why would you use a Wheatstone Bridge instead of directly measuring Vout across the resistor of your sensor?

2. **Current-limiting Diode**
   a. Read this tutorial on LED current limiting resistors: https://www.sparkfun.com/tutorials/219
   b. Using this spec sheet : https://www.sparkfun.com/datasheets/Components/LED/COM-09590-YSL-R531R3D-D2.pdf
      i) What is the forward voltage? What is the forward current?
      ii) What value of resistor should you use if the input voltage is 5V and the maximum current you want through your LED is 20mA?
3. In the last part of the lab you will be making your own DIY force sensor. Explain the working principle behind these simple sensors made of copper plates and conductive foam. How do they work? What value changes/is measured by these sensors? It could be voltage, current, or something else.