# Design Overview

Breadboarding simple circuits (like our photo-sensor circuit) and testing them are easy and not too costly; however, breadboarding larger and more complex circuits becomes costlier and time consuming. In order to have a good level of confidence in the integrity of a circuit before it is committed to manufacturing, schematics and simulation programs are used to test out the design.

Today, we will learn about one of these schematic capture and simulation tools, LTSpice. LTSpice provides a nice graphical interface for doing schematic capture. It also automatically generates a SPICE model for simulating the design. By setting the correct simulation parameters, such as the simulation duration and time steps, one can then test out the circuit, observe voltages/currents at various points in the circuit and compare them to the expected values.

## Schematics



Figure 1 – Simple Photosensor Circuit

Note that the black box circuit in the schematics above is marked by the dashed rectangle. The followings are the specs for the black box:

* *Vb ≥ 4V* for the LED to turn on

## Procedure

Given the circuit shown in Figure 1, determine the value of R1 for which the LED turns on when the amount of light detected by the sensor is less than “ambient” daylight.

1. Look through your data for the “Series Resistor Network” project to find the resistance value of the photo-resistor for ambient light. Let’s notes this value as *Rph = Ramb*
2. Recall that the “voltage divider” equation from your “Series Resistor Network” project. Applying the voltage divider equation to find *Vb* we have
3. In order to make sure, the LED is off in ambient light, we need *Vb ≤ 4V* for *Rph = Ramb*. Substituting these in the voltage divider equation above, determine the value of *R1*:
4. Use the equation above and the value for *Ramb* to find *R1*.
5. Look through your resistor kit to find one (or a combination of) resistor(s) whose value comes as close as possible to the value you calculated for *R1* in step D above.
6. Construct the circuit given in Figure 1.
   1. Your breadboards should already have the black box circuit constructed on them.
   2. Add your photo-resistor and *R1* to the circuit.
   3. Connect the battery and test the circuit to make sure it is working correctly.
7. As an extra bonus, measure the voltage at *Vb* for which the LED turns on.  
     
   *Vb = \_\_\_\_\_\_\_*