PH 126 LeClair   Fall 2011
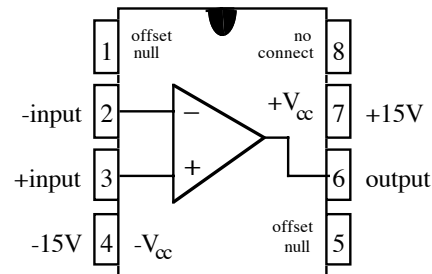
Intro to op-amps lab

You will need:

1. protoboard
2. Arduino and PC
3. oscilloscope and 10x probe
4. various resistors and capacitors
5. 741 or equivalent op-amp $\longrightarrow$

In this laboratory, you will be given a series of tasks that build on one another. These tasks can be completed with the components listed above and recollection of our discussion of op-amps.

Task 0

Figure out which object is the oscilloscope and turn it on. Examine the various knobs and buttons, you will need them later.

Task 1

Produce a square wave signal from your Arduino's digital output. The square wave should oscillate between $5\,\mathrm{V}$ (high) and $0\,\mathrm{V}$ (low) with a period between 200 and $1000\,\mathrm{Hz}$. Prove that you have produced this square wave by displaying it on the oscilloscope.

Hint: the program "BlinkWithoutDelay" under the digital learning examples is essentially what you want. Connect the scope probe to the Arduino digital out, and the scope ground to the Arduino ground.

Task 2

This square wave is too large for what we want to do later. Make a *variable* voltage divider to adjust the amplitude to $0.1 - 0.2\,\mathrm{V}$ peak-to-peak. Recall that the protoboard contains potentiometers. Again, verify that you have reduced the amplitude by displaying the waveform on the oscilloscope.

Task 3

Now feed the $0.1-0.2\,\mathrm{V}$ square wave into a gain of ±10 amplifier (we do not care if it is inverting or not). You should get out a square wave of amplitude $1-2\,\mathrm{V}$, which can still be varied by your construction from task 2.

Note: a potentiometer in series with the input is likely to alter the gain of your amplifier! Try to minimize this effect.

Task 4

Make the square wave into a triangle wave. You can do this with a single capacitor. *Hint: What mathematical operation do you need?*

This capacitor sets a time constant, but of what size? And what value *should* it be, given the period of your input signal? What type of filter did you just construct?

Task 5

Hook the output of your circuit up to the $8\,\Omega$ speaker instead of the oscilloscope. Do the triangle and square waves sound different? Can you speculate on why?

Task 6

Draw the circuit you have constructed, noting component values and supply/signal voltages. Sketch the input and output at various stages of the circuit.