Skill Demo 5: Digital to Analog Converter

NAME____________________ GTID_____________________

Goals:

Understand what a digital to analog converter is and how to make one.
Demonstrate an ability to use an oscilloscope

Tools/supplies:

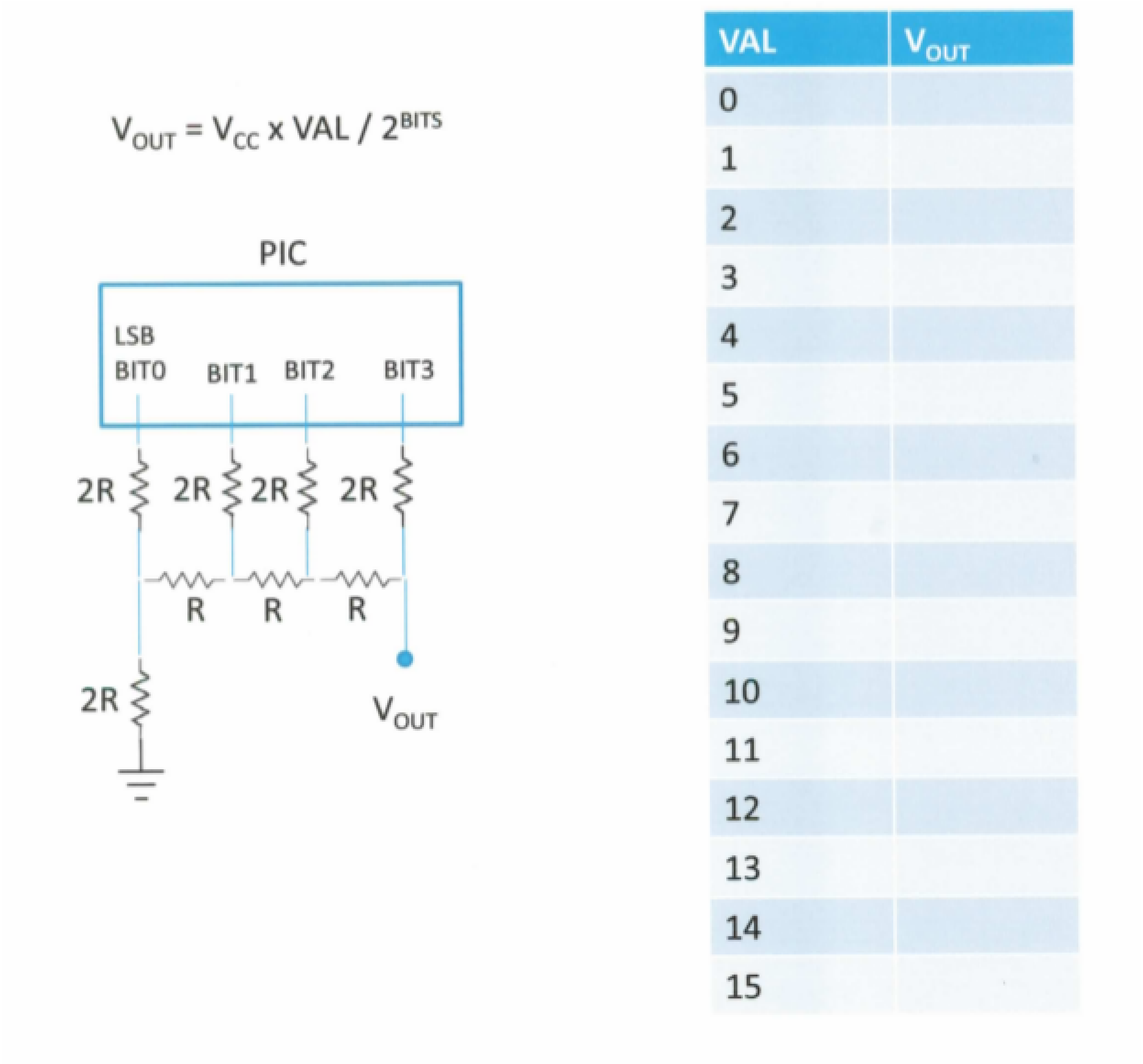
Teensy
various resistors, LED
laptop
breadboard
USB cable

Background:

All videos from Skill Demos 1-4
Digital to Analog Converter - CS 3651 - APIA - Parts 1-3
CS 3651 - APIA - using an oscilloscope

In Skill Demo #4 you established your reputation as a miracle worker. Now the CEO of your start-up (PIAC) thinks you can do anything - a dangerous reputation to have! He was on a plane recently to Taiwan and sat next to one of the high level business leaders of Jabil. Jabil has 200,000 left over epoxy packaged microcontrollers that they are willing to sell to PIAC for $2,000! Your CEO agreed to the deal, thinking that he could use them for your electronic greeting card line. Unfortunately, he did not check the specs. The microcontroller only has digital output lines! Your job is to create a digital to analog circuit that can create simple audio waveforms (sine waves at different frequencies) that can then be sent to the audio amplifier and piezo speaker circuit that PIAC already has made for the electronic greeting card market. Specifically:

Build a 4 bit Digital to Analog Converter (DAC) pictured in the image below. Write a program that creates a sine wave at Vout by counting from 0 to 15 in binary on the pins and back to 0 repeatedly (I would suggest doing it relatively slowly so you can see the values changing). Then, using an oscilloscope, show the voltage changes at each increment. The chart below is provided to help you work out the voltages.



$V_{OUT} = V_{CC} \times VAL / 2^{BITS}$

VAL	V_{OUT}
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

2) Connect Vout to an input on your microcontroller. Use AnalogRead (the EASY way to use the Arduino to read in analog values, as opposed to what you did in previous skill demos) to determine which state the digital output is in. Print this to the screen. Show your demonstration and code to one of the instructors.

Initials__________________ Date_________________ Time__________________

3) Your CEO now wants you to also control an LED with the same cheap microcontroller. Using 1 digital output line, use pulse width modulation to control four levels of brightness of an LED. Do this part using a software loop you write yourself (not using the PWM feature of the Arduino).

Dark = no voltage to the LED

Low = for every 20ms, the LED is on for 20% of the time and off for 80% of the time

Medium = for every 20ms, the LED is on for 50% of the time and off for 50% of the time

High = the LED is on all the time

Initials________________ Date_______________ Time________________

4) Do #3 the easy way, using the PWM feature of the Arduino. Feel free to use the web to find out how.

Initials________________ Date_______________ Time________________