Pre-Lab 2
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Pre-Lab Exercises

1. A/D basics
   a. Describe (with detail) the difference between analog and digital signals.
      i. Analog signals have an infinite amount of different values while digital signals have a discrete finite number of values. For example, within a range of values, lets say from 0-100, an analog signal can hold the value of any possible value within the range like 92.44585819 and still be valid. In comparison with the same value range, a digital signal can only hold a discrete number of values. This could mean the discrete value can only be two specified values like 0 and 100 or 100 possible values being only the whole real numbers between 0 and 100. In arduino and our applications of digital and analog signals, an analog signal could be something like a value between 0-5 volts sent to an LED to control its brightness while a digital signal can only be either 0 volts to turn the LED off or 5 volts to turn the LED on.
   b. Convert the following decimal to binary. Show your work. 37 121 360
      i.

Decimal 37 to binary	½ = 0	2/2 = 1	4/2 = 2	9/2 = 4	18/2 = 9	37/2 = 18
remainder	1	0	0	1	0	1

Answer: 100101

      ii.

Decimal 121 to binary	½ = 0	3/2 = 1	7/2 = 3	15/2 = 7	30/2 = 15	60/2 = 30	121/2 = 60
remainder	1	1	1	1	0	0	1

Answer: 1111001

      iii.

Decimal 360 to binary	½ = 0	2/2 = 1	5/2 = 2	11/2 = 5	22/2 = 11	45/2 = 22	90/2 = 45	180/2 = 90	360/2 = 180
Remainder	1	0	1	1	0	1	0	0	0

Anser: 101101000

   c. Convert the following binary numbers to decimal. Show your work. 1101 01110 10101100
      i.

Binary digit place	3	2	1	0
Binary digit value	1	1	0	1

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Decimal digit value	8	4	0	1

Answer: 13

ii.

Binary Digit Place	4	3	2	1	0
Binary digit value	0	1	1	1	0
Decimal digit value	0	8	4	2	0

Answer: 14

iii.

Binary Digit Place	7	6	5	4	3	2	1	0
Binary digit value	1	0	1	0	1	1	0	0
Decimal digit value	128	0	32	0	8	4	0	0

Answer: 172

2. Arduino ADC
   a. What values can you expect from an analogRead() function call? What voltages do these values correspond to?
      i. For arduino boards with a multichannel 10-bit A/D converter, analogRead() values can be expected from 0 to 1023 which corresponds to voltages 0 and 5 respectively.
   b. What values can be expected and what voltages do they correspond to a digitalRead() operation?
      i. The values expected from the digitalRead() operation are 1 and 0. These values don't correspond to a specific voltage in general but rather being either above or below a voltage threshold. For a 5 volt system, a value of 1 corresponds to being above a 0.6 volt threshold while a values of 0 corresponds to being below it.
   c. What process does the analogWrite() function do to output a variable signal? What pins on the Arduino Uno can do this?
      i. analogWrite() uses pulse width modulation (PWM) to output a variable signal. On the arduino uno, pins 3,5,6,7,10, and 11 are used for PWM.

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3. MATLAB GUI Build the GUI following the steps described below in Section 3.1 MATLAB GUI SETUP. Upload the file Yourname_Lab2_GUI.mlapp to this assignment, where “Yourname” is literally your name, but without any spaces. Doing the tutorial mentioned in Section 2.6 first may help if you are feeling uncomfortable.