Objective

The purpose of this lab is to build a basic 4-bit DAC using the resistor string method. We will then measure voltage output for each input combination to generate a table.

Pre-Lab

On 2 separate pages

Procedure

1. Open code and thoroughly read it. Insert wires that corresponds to the GPIO input and output pins.
2. Set up circuit. Each input should lead to a switch and a short wire should be at the end of the switch leading to the red column on the breadboard.
3. Each output should lead through the correct set up of resistor string. The resistors should then lead up to the blue column, which will be ground.
4. Set up a GPIO pin for ground and connect to the blue column
5. Use GPIO pin 1 and connect it to the red column, this will allow you to provide power for your circuit
6. Debug and fix mistakes
7. Run code, press all combinations of switches, and record the voltage onto a table.

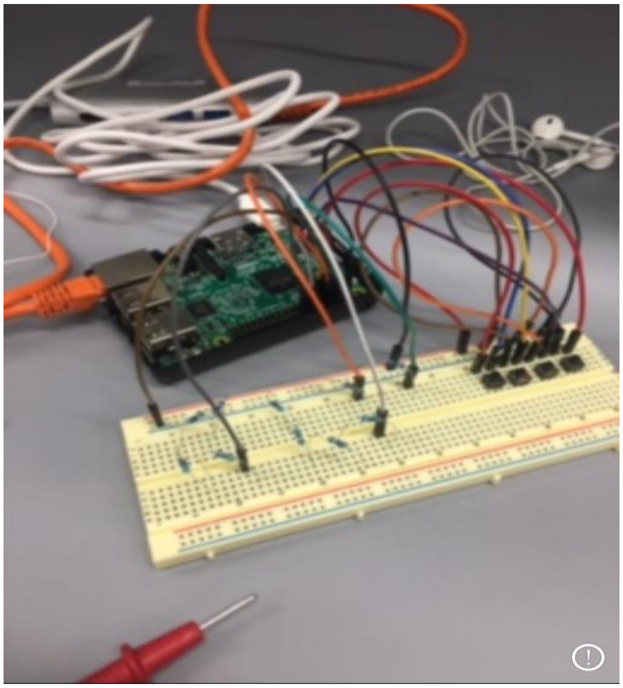
Debugging

Only debugging was to literally start over, go step by step, and reading print errors.

Table

Input	Output (V)
0000	0
0001	.22
0010	.44
0011	.63
0100	.88
0101	1.00
0110	1.24
0111	1.48
1000	1.76
1001	1.86
1010	2.08
1011	2.24
1100	2.45
1101	2.71
1110	3.00
1111	3.30

Pictures



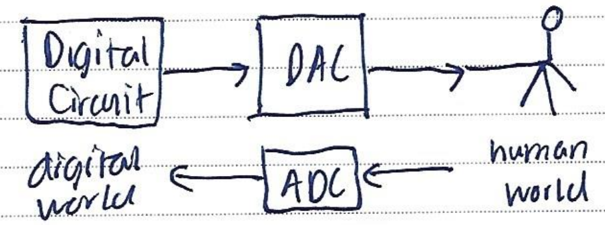
Conclusion

As electrical engineers, we always need to find a way to be more efficient. A DAC allows us to use certain amount of voltage when certain switches are pressed. Each switch passes a certain amount of voltage and when combined with other inputs, it output will yield a different result. We had to combine our knowledge of circuit analysis and careful mathematics to compute the correct amount of output. One small setup error and the whole project would be a bust. Each day we are learning something new and every lab will allow us to combine all of our newly found knowledge into one single procedure.

Lab 9.1

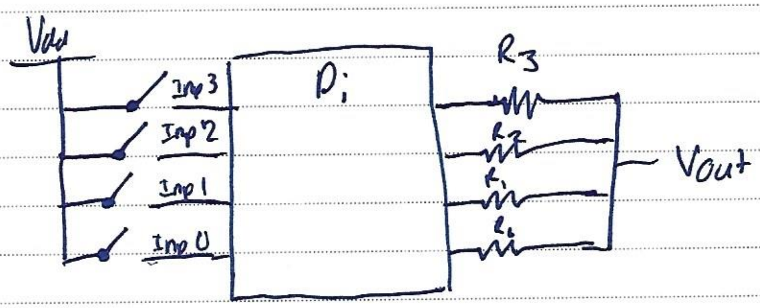
DAC
Digital-to-Analog

Purpose: Take digital input and create a real-world output



Pre lab:

Pi Schematic:



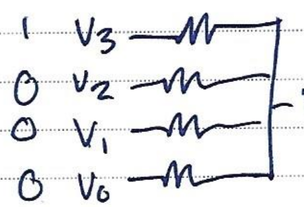
Set

$R_0 = 80\,k\Omega$

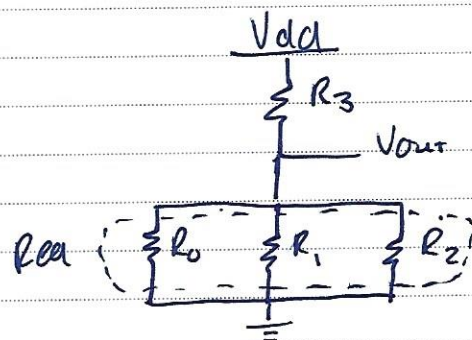
$R_1 = 40\,k\Omega$

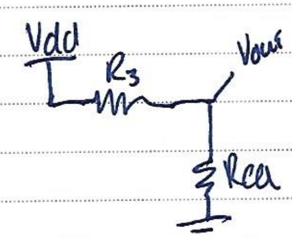
$R_2 = 20\,k\Omega$

$R_3 = 10\,k\Omega$

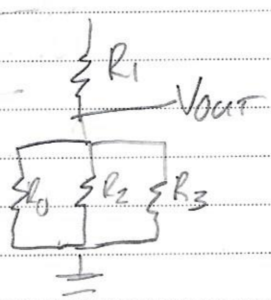


Input [1,0,0,0]





Input [0,0,1,0]



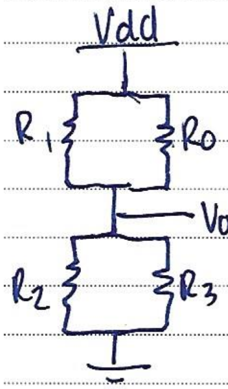
$$V_{OUT} = \frac{R_{eq}}{R_3 + R_{eq}} V_{dd}$$

$$V_{OUT} = \frac{R_0 \| R_1 \| R_2}{R_3 + R_0 \| R_1 \| R_2}$$

$$R_{eq} = \left(\frac{1}{80} + \frac{2}{80} + \frac{4}{80}\right)^{-1} = \frac{80}{7}$$

$$V_{OUT} = \frac{80/7}{10 + \frac{80}{7}} 100 = .53\, V_{dd} \approx 1.7V$$

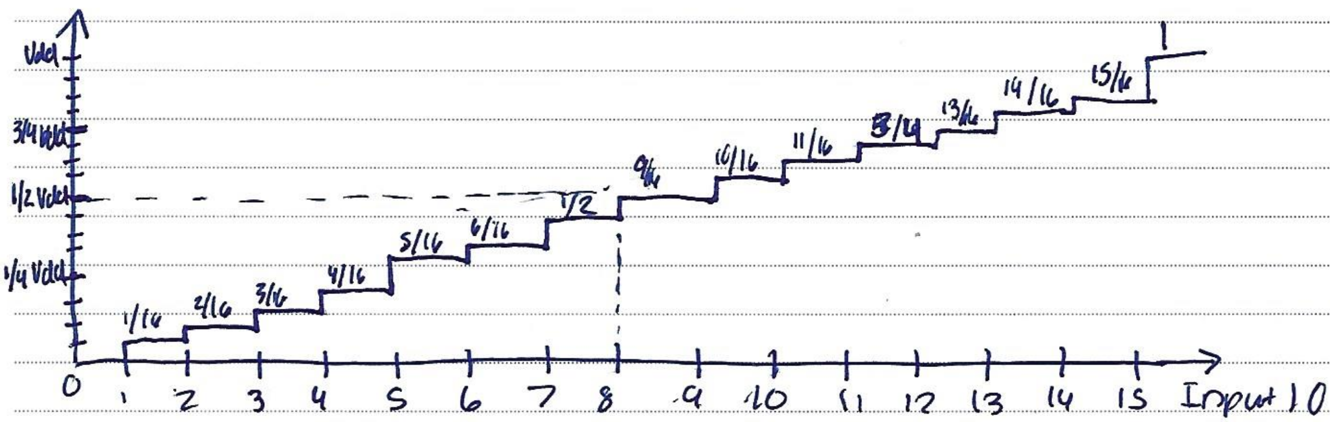
Input [0,0,0,1]



$$V_{OUT} = \frac{R_2 || R_3}{R_2 || R_3 + R_1 || R_0} Vdd$$

$$= \frac{80/3}{80/3 + 20/3} Vdd = .2 Vdd = .66V$$

$\frac{3}{16} = .1875$



Input	Output
0000	0
0001	.21V
0010	.41V
0011	.62V
0100	.83V
0101	1.04V
0110	1.25V
0111	1.46V
1000	1.65V
1001	1.86V
1010	2.06V
1011	2.27V
1100	2.48V
1101	2.69V
1110	2.89V
1111	3.33V