Intro to Medical Robotics

Binary and Analog-to-Digital Conversion practice

**Solutions**

1. *Convert to binary:*

Remember: 256 128 64 32 16 8 4 2 1

* 1. *178*

178

-128

50

- 32

28

-16

12

- 8

4

- 4

0

**10111100**

**b.** *253*

253

-128

125

-64

61

-32

29

-16

13

-8

5

-4

1

-1

0

**11111101**

**c.** *41*

41

-32

9

-8

1

-1

0

**101001**

d. 20

20

-16

4

-4

0

**10100**

**e.** *99*

99

-64

35

-32

3

-2

1

-1

0

**1100011**

1. *Convert to decimal:*
   1. *10010100*

22+24+27= **148**

* 1. *01100011*

20+21+25+26=**99**

* 1. *11100101*

20+22+25+26+27=**229**

* 1. *10000101*

20+22+27=**133**

* 1. *10111010*

21+23+24+25+27=**186**

1. *As in your Arduino, you have a 10-bit analog-to-digital converter (ADC) that measures a signal between 0 and 5 volts.* 
   1. *For an input of 3 volts, what does your ADC read inside the microcontroller?*

There are a total of 210-1=1023 counts in the ADC. This means that the ratio of counts per volt is 1023/5, so we can get 3 Volts \* 1023 counts/5 volt = 3\*1023/5= 613.8 counts. This will round to **614 counts**, since you can’t have partial counts.

* 1. *For an input of 1.5 volts, what does your ADC read?*

Using the same formula as in part a, 1.5\*1023/5=306.9, or **310 counts** when rounded.

* 1. *If you read 575, what voltage is on the output?*

Now we need to flip the proportion. There are 5 Volts per 1023 counts, so for 575 counts we can see 575\*5/1023=**2.81 Volts**

* 1. *How about if you read 70?*

Using the same equation, 70\*5/1023 = **0.34 Volts**

1. *For a slightly different ADC, input ranges from 0 to 10 volts and uses a 12-bit conversion.*
   1. *For an input of 0 volts, what does the ADC read?*

It should give a reading of **0**.

* 1. *For an input of 3 volts, what does the ADC read?*

If there are 12 bits, the ADC can count up to 212-1 = 4095. Also we have a difference in the voltage range, going from 0-10 Volts. Therefore the number of counts per volt is 4095/10. So to find the counts at 3 volts, we calculate:

3 Volts \* 4095 Counts/10 Volts= 1228.5, which must round to **1229 Counts**.

* 1. *What voltage is being read if you get a sensor reading of 300?*

We flip the proportion again, getting 10 Volts/4095 Counts. Calculating

300 Counts \* 10 Volts/4095 Counts = **0.733 Volts**.