

Name:

1) The next lab uses the ultrasound sensor to detect distance to an object. It does this by measuring the time it takes for a sound wave to reflect back to the sensor. According to LEGO, it can measure distances from 0-255 cm. Looking at the communication protocol between the sensor and NXT brick, this value *appears* to be transmitted as an 8-bit number. Given this information:

a) What is Δ , the quantization level in cm? Show your work.

b) The dynamic range is the ratio of the largest value that can be measured divided by the smallest nonnegative value. What is the dynamic range?

Now for more information. LEGO states that the precision of the ultrasound measurement is ± 3 cm. This means the *effective* value of Δ is 6cm.

c) Given this information, what is the *effective* dynamic range?

d) Given this information, what is the *effective* number of bits of precision (i.e. the value of N needed to obtain a Δ of 6cm given the min and max sensor range of 0-255 cm). Note: you can solve for this exactly (the answer is not an integer). Alternatively, you can determine the two successive integer values that result in values of Δ that are just above and just below 6 cm. Either way, show your work and explain your answer.

2) In the next lab, you are going to program your robot to move towards an object when it is detected. To think about the task, consider this scenario. Let D be the distance returned by the ultrasound sensor. When D is > 100 cm, spin in place searching for an object. When $D < 100$ cm, presume you have detected a “not very large” object. Move towards it. Finally, when $D < 20$ cm, stop. Assume that when the robot starts the program, D is > 100 cm.

In the space below, prepare a flow chart of this task. Your boxes should be clear enough to understand, and you do not need to attempt to duplicate detailed LabView elements.