University of Colorado Denver, Fall 2021

MECH 4428/5228, ELEC 4804/5804

Homework 2: Serial Communication - Arduino and pySerial

**Submission Instructions**: For questions not requiring programming source code, submit a pdf document with your answers. The answers may be hand-written or typed. Clearly label your work and the question being answered. Upload your source-code and pdf to Canvas. It is preferable to submit all work in a single zip file with a .zip extension. That file may include sub-folders to organize your work.

**Programming**:

* Arduino source code will be graded with an Arduino Uno or Nano (they both have the same atmega328p)
* Python source code will be graded with python3.

**Design Questions**

For each of the problems below, assume

* one bit per baud, i.e. baud rate is equivalent to bits per second.
* one start bit, 8 data bits, no parity, and one stop bit for each byte.

*Show your work where appropriate.*

1. What is the Arduino worst-case transmission time for a 20-element array of four-byte unsigned integers? Assume the baud rate is 115200. (5 points)
   1. Transmitted using serial.println().
   2. Transmitted using serial.write(buf,len)
2. Suppose a sensor’s measurement rate can be set at 5, 10, 25, or 75 Hz. The measurement rates correspond to the number of sets of measurements that are produced each second.

Examples:

* When the sensor rate is set to 5 Hz, the sensor produces 5 sets of measurements each second.
* When the sensor rate is set to 10 Hz, the sensor produces 10 sets of measurements each second.

Each set of sensor measurements contains 382 bytes.

* 1. What is the minimum allowable baud rate that allows a sensor to transmit measurements at a rate of 75 Hz?
  2. If the only serial transmission rate available is 57600 baud, what is the maximum sensor rate setting to ensure complete transmission of all data in one second?

1. Modify the Lesson 5 Arduino example to transmit binary values of x and y. You may only use Arduino Serial.write functions for transmission (no print, println functions). Modify the python program to receive the binary data. The python program should print the received x, y values as it does in lesson 5. Name the Arduino program hw23.ino and the python program hw23.py.
2. Timing serial data transmission

Compare the performance of binary versus ASCII character serial transmission using the Serial write, print functions. Write an Arduino program that serially transmits the range of values from 0 to 2^16-2 to a python program.

* 1. What is the total transmission time for write versus print for the range of values 0 to 2^16-2?

The following pseudocode provides an example of the timing and transmission logic

* + 1. Set count to 0
    2. Start timer
    3. While count < 2^16-1
       1. Transmit count
       2. Increment count
    4. Stop timer
  1. Compare total number of bytes transmitted for the range 0 to 2^16-2.
  2. Submit a brief written explanation/analysis of your methodology and results. Include all source code used to obtain the results.

**Grading**

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| --- | --- | --- |
| Problem | Points Possible | Points Earned |
| 1 | 5 |  |
| 2 | 8 |  |
| 3 | 12 |  |
| 4 | 20 |  |
| Total | 45 |  |