

San José State University
Department of Computer Engineering
CMPE 146-03, Real-Time Embedded System Co-Design, Fall 2019

Lab Assignment 6

Due date: Friday, 11/15/2019

1. Description

In this assignment, we will be familiarized with ADC (analog-to-digital converter) and the temperature sensor of the MCU. The output of the sensor is connected to one of the ADC channels. We convert the sensor's analog voltage to temperature in Celsius and Fahrenheit.

Details of the ADC and the temperature sensor can be found in the MCU datasheet and technical reference.

2. Exercise 1

We are going to read the temperature of the chip through an ADC. The sensor is sensitive to its environment. If you touch the MCU, you should get a higher reading because the finger's temperature is higher than the bare surrounding. You can duplicate the example project

adc14_single_channel_temperature_sensor_MSP_EXP432P401R_nortos_ccs on your local CCS for this exercise. Study the example project carefully. Note that the program uses two calibration points to convert the ADC value to temperature.

Modify the program so that it outputs the temperature in Fahrenheit to the debug console once every second. Do not use any floating arithmetics because they are expensive in computation time and there is no floating point hardware in most low-end MCUs. You are not allowed to use any float data types explicitly or implicitly. Display the readings with two decimal points of accuracy.

Lab Report Submission

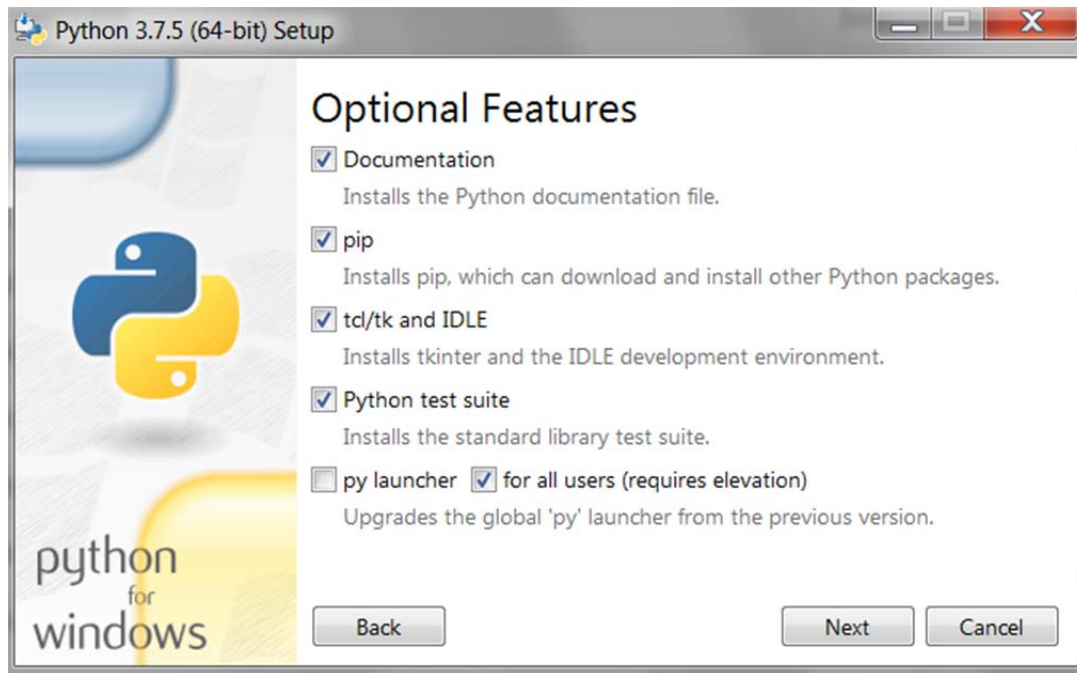
Explain how you compute the temperature to two decimal points of accuracy without using any floating point instructions. Include a screenshot of the output results showing the difference between touching and not touching the chip. List the program.

3. Exercise 2

In this exercise, we are going display the temperature reading on a simple GUI on the laptop. After getting the reading through the ADC, we'll send the data to the laptop through the UART.

Exercise 2.1

The GUI on the laptop is created through a Python script. You'll need to have python 3.7.5 installed in your laptop. You can download python from <https://www.python.org/downloads/>. Make sure you make the following selections during installation:



After the installation is done, open a command window and install one additional package for serial communication: `pip install pyserial`.

Lab Report Submission

List any issue you may have during installation.

Exercise 2.2

Modify the program in Exercise 1 to send out the temperature reading to the UART once every second. Use the UART routines that you had used in a previous lab. In addition to Fahrenheit, also compute the temperature in Celsius. Send out the two readings separated by a space in an ASCII string terminated by a newline. Run the python script `show_temp.py` that comes with this assignment. The script sets baud rate to be 115,200. So, your program must use the same rate.

Open a command window, run the script: `python show_temp.py --port com5`. Note that the com port number may be different on your laptop.

Lab Report Submission

Show a screenshot of the GUI. List your program.

4. Grading

	Points
Exercise 1	4
Exercise 2.1	2
Exercise 2.2	3
Report Contents	1

Total	10
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Grading Policy:

The lab's grade is primarily determined by the report. We will grade the report first. Based on what we see in the demo, we may adjust the grade by either deducting or adding points.

Demo is mandatory. If you don't show up for demo, half of the points will be deducted.

If you miss the submission deadline for the report, you will get zero point. However, you can still come to the demo to show what you have done and hopefully learn something as well. And you may get a maximum of 30% of the full grade for the assignment. I will drop the lowest score of the lab assignments when I determine the final grade.

As for the report contents, do not use screenshots to show your codes. In the report body, list the relevant codes only for the exercise you are discussing. Put the entire program listing in appendix. Put the contents of one exercise in one section. Do not separate them to two different sections. This will make the grading easier.