**CPEN 291 - Lab 2 Questions**

*Lab section: L2A Team (Bench) #: A-T20*

Answer the following questions. Submit the completed document (in word or pdf, one per team) to Canvas by the deadline.

Q1 – GUI Design Process: You are to design your own GUI using TKinter for the Lab 2 user interface. Describe clearly the process you used for the following design aspects. Please spend time to carefully answer each of them.

1. **Use of process**: Describe your approach to adapt and apply a general design process for the GUI design. What was your approach?
2. **Constraint identification**: Explain the constraints that you must consider in the design of the GUI.
3. **Solution generation**: Explain at least two possible varieties of GUI layout and additional features that you considered for the design of the GUI.
4. Use of process:

We first designed our target layout on a piece of paper and drew arrows from buttons to windows to show opening new windows. We then determined functionality of the components in our design, Using the examples given in class and links on the lecture notes, we learned the about the basic widgets (label, button, text entry) and we searched online documentation to find more advanced components, for example how to dynamically update the graph. We followed this process to get the bare minimum (as described on the Lab 2 canvas page) and our progress bar feature (described in more detail in section 3). We then repeated this process for the design of our game (our second additional feature, which is described in more detail in section 3).

1. Constraint identification:

The bare minimum as laid out on the Lab 2 canvas page are the requirements and constraints of our GUI. The circuit is required to have a temperature and light sensor that feed input into the MC3008, which in turn communicates the information to the raspberry pi.

1. Solution generation:

The first GUI we considered had all the information about temperature and luminance on the left side in the format: (temperature: 17\*C), but this design was not as visually appealing as we wanted our GUI to be. The second GUI, which is the one we implemented stores the temperature and luminance data in the center of the GUI, with a progress bar for each one showing the current level. The progress bars are one of the additional features that we added, they make the temperature and luminance much easier to observe as well as adding colour to the GUI. Our second feature is a game based on the temperature and luminance sensors on the breadboard. The game gives the user tasks such as raising the temperature to above 20\*C. These tasks get increasingly harder as the user completes more of them. If the user does the task within the given period, they increase their score, but once the user fails to complete a task their score and level (difficulty of the task) is reset. The high scores and users who scored them (the name of the user can be entered after the game ends) are stored in a csv file, with the top 5 being displayed in the starting screen.

Q2 - spidev: The following code was used (slide 2-10) to calculate the final value of the data read from MCP3008 using spidev:

data = ((adc[1]& 3) << 8) +adc[2]

Can you explain, in plain English, what the above statement is doing?

It adds the first 2 bits of adc[1] to the front of adc[2] (this results in a ten bit value with the first two bits being from adc[1] and the remaining 8 being adc[2]).

(adc[1]& 3) will give us the lower 2 bits of adc[1].

Shifting it 8 bits to the left then adding adc[2] will place adc[2] in the lower 8 bit of data.

Q3 - SPI: How many SPI chip selects does Raspberry Pi have? What are they called?

Raspberry Pi has 2 SPI chip selects, CE0 (GPIO 8) and CE1(GPIO 7).

Q4 – gpiozero MCP3008: Read the documentation for the gpiozero SPI devices. What is the default for the clock\_pin and for the select\_pin?

Clock\_pin defaults to GPIO11, and select\_pin defaults to GPIO8.

Q5 - Capacitor use: How can we make a more stable power supply voltage at the terminals of an electronic component? Use an RPi schematic (see lecture notes) as an example to explain such an application.

We can stabilize power supply by using bypass capacitors. Since a capacitor is short-circuit to “relative” high frequencies, it suppresses the signal we do not want, such as noise. In the RPi schematic, bypass capacitors are present so that the noise caused by other circuit element goes through the capacitor, reducing the effect of noise on the rest of the circuit.

Q6 - Datasheets: Read the LM35 datasheet (provided under references). The purpose here is to exercise reading datasheets. Answer the following questions: a) what is the maximum supply voltage (V)? b) what is the maximum output current (mA)? c) Our LM35 is LM35DZ/NOPB. What is its package type and what is the range of its operation temperature?

Maximum supply voltage is 35V.

Maximum output current is 10mA.

Package type for LM35DZ/NOPB is TO-92, and its operation temperature range is 0 -100 (℃).