Lab Demo Questions:

1. In the **LCD_DisplayName( )** function located in **LCD.c**, why do we use the following while statement (Hint: see textbook page 438)

   ```
   while ((LCD->SR & LCD_SR_UDD) == 0);
   ```

UDD: Update Display Done
This bit is set by hardware. It is cleared by writing 1 to the UDDC bit in the LCD_CLR register. The bit set has priority over the clear.
- 0: No event
- 1: Update Display Request done. A UDD interrupt is generated if the UDDIE bit in the LCD_FCR register is set.

2. What clock is used to drive the LCD? (Hint: see textbook page 438 and 439)

Low Speed External (LSE), which is the same clock as RTC module.

3. Explain to TA why double-buffering can ensure the coherency of the displayed information

This technology utilizes two buffers: an off-screen buffer (also called a back buffer) and an on-screen buffer (also known as a front buffer). The rationale is that copying to the on-screen buffer takes much less time than generating display data. Software does not directly modify the display information in the on-screen buffer. Instead, all data are written to the off-screen buffer (LCD_RAM). After software writes a whole display frame to the off-screen buffer, the LCD controller takes three steps:

1. locks the off-screen buffer first to prevent any modification by clearing UDR flag in status register SR,
2. quickly copies data from the off-screen buffer to the on-screen buffer, and
3. finally frees up the lock to allow modification to the off-screen buffer.

The LCD software driver should follow the above double buffering protocol to ensure the coherency of the displayed information.

Lab 2: Post-Lab Assignment

Answer the following questions in the file Readme.md and *submit it with your lab code to the gitlab server*.

1. Suppose the duty ratio of a LCD display is ¼ and it has a total of 120 display segments (pixels). How many pins are required to drive this LCD?
   4 + 120/4 = 34 pins
   If we add Vcc and GND, 36 pins are also an acceptable answer.

2. Can a GPIO pin perform all alternative functions simultaneously?
   No. Technically a chip manufacture could make it happen. But that would increase the costs of the chips too much.

3. Is the LCD driver (programmed in this lab) built in within the processor chip? What is the function of the COM driver and SEG driver?
   STM32L4 has an internal LCD driver.
   The COM and SEG drivers generate the multiplexing signals for the COM pins and the SEG pins, respectively. The COM signals are shared by all pins.

4. How many pixels does the LCD installed on the STM32L4 discovery kit have?

   96 pixels.
   Many bits in LCD_RAM are not used because the external LCD glass has only 96 pixels. The LCD_RAM can support 8 * 40 = 320 pixels.