

Lab 3: Demo Questions (10 points)**Mondays students:** Due on April 15, 2019 at the beginning of class**Wednesdays students:** Due on April 17, 2019 at the beginning of class

Print, answer, and hand it back to T.A.

(NO Dropbox submission!)

Student Name: **SOLUTION**

1. **(2 points)** Explain why double-buffering can ensure the coherency of the displayed information (Hint: see textbook page 436).

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.

2. **(2 points)** Suppose the duty ratio of an LCD display is $\frac{1}{4}$ and it has a total of 120 display segments (pixels). How many pins are required to drive this LCD?

$$4 + 120/4 = 34 \text{ pins}$$

If we add Vcc and GND, 36 pins are also an acceptable answer.

3. **(2 points)** Can a single GPIO pin perform all alternate functions simultaneously? (Hint: there are a total of 16 alternate functions. The GPIOx_AFR registers are used to set these functions. For more information, see Reference Manual, page 282.)

No. Technically a chip manufacture could make it happen. But that would increase the costs of the chips too much.

4. **(2 points)** Is the LCD driver (programmed in this lab) built in within the processor chip? What is the function of the COM and SEG pins? (Hint: read textbook section 17.2)

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.

5. **(2 points)** 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.

Grade: _____ out of 10