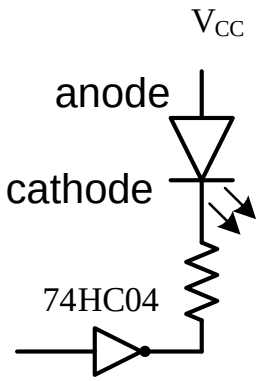
CEG 3136 – Computer Architecture II
Tutorial 4 – The Parallel Ports - LEDs
Fall 2019

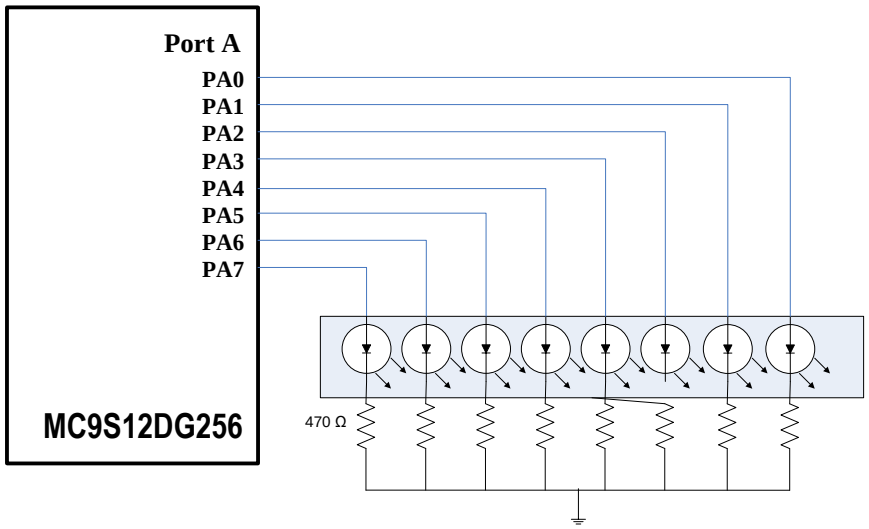
Part A – Driving LEDs

The adjacent circuit illustrates the circuit used to drive an LED. The 74HC04 NOT gate will bring the resistance down to 0V when a 1 is applied to the gate. Calculate the value of the resistance given a current of 10 mA through the circuit, V_{CC} = 5V, and a voltage of 2V across the LED when the 10mA current flows through the LED.



What is the current in the circuit when a 0 is applied to the gate? What effect does this have on the LED?

PART B – Driving LEDs with the MC9S12DG256 Port A.

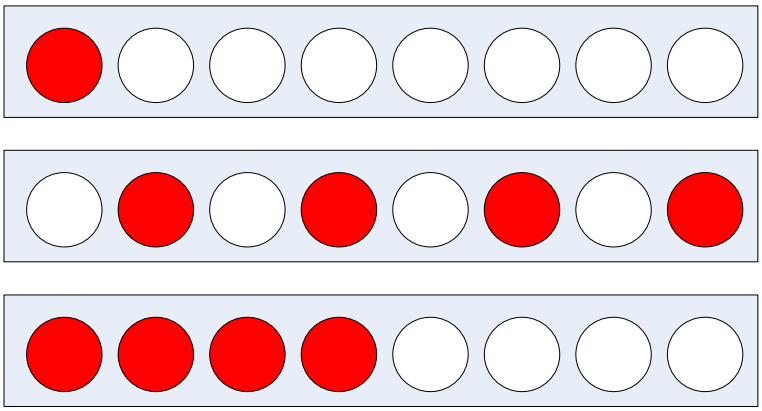


Consider the above bank of LEDs connected to Port A of the MC9S12DG256.

1) Explain how the above LEDs will operate, i.e., what voltage level are applied to the LED anodes to light it up.

2) Define how to configure Port A to allow the micro controller to light up the LEDs.

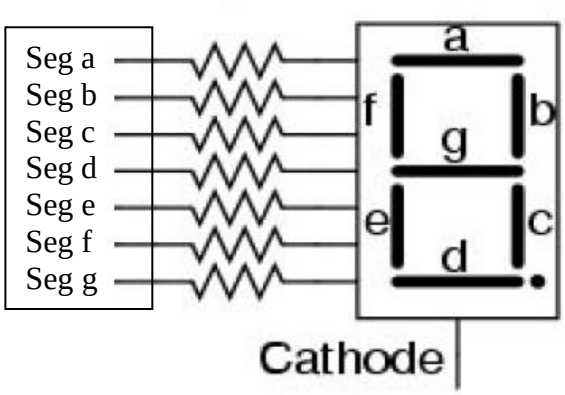
3) What register is used to control the LEDs? What hex values are used to provide the following patterns in the bank of LEDs?



4) Given the subroutine "delay(num)" that generates a delay of num milliseconds (num can vary from 0 to 255 and must be placed in accumulator B), develop a program that will run a light across the bank of LEDs, first from left to right and then from right to left giving the impression that the light is bouncing from side to side. Use ¼ second delay to move the light from LED to LED.

Part C – The 7-Segment Displays

1) Seven segment displays consists of a set of LEDs. Such displays can have either the cathodes or anodes tied together. Below is a diagram that shows a common cathode display. Note that the current limiting resistors are tied to the anodes. To turn on a segment, the cathode must be tied to ground (0V) and 5V applied to the resistor of the corresponding segment anode.
    a. Develop a circuit to display characters on the 7-segment display by connecting it to parallel PORT B of the MC9S12DG256 micro-controller. How would you configure Port B to control the display?
    b. Define a list of bit patterns that are stored in the Port B data register to display the following: characters 0 to 9, A, b, C, d. Choose some alternate patterns for the characters # and *. Note that all these characters have corresponding keys on the Dragon-12 keypad.



2) The following circuit illustrates how 4 seven-segment displays are connected to the MC9S12DG256 micro-controller on the Dragon-12 training board. The displays are common cathode displays. Note that the displays' anodes are connected to an 8-bit bus that is linked to Port B and the common cathodes are connected to Port P: DIG3 to PP3, DIG2 to PP2, DIG1 to PP1, DIG0 to PP0. To enable a display, 0V must be applied to the pin on port P connected to the display. A bit pattern written to the data register of port B will have a character appear on the enabled display.
    c. Is it possible to have different characters appear on different displays simultaneously?
    d. Is it possible to make it look like different characters appear on different displays?
    e. In teams of two, discuss possible designs of a display module that would provide the means to display 4 characters (blanks are allowed also) on the 4 displays. Assume you have access to delay subroutines is a Delay module (recall such a module used in Lab 2). Consider that the module should provide the following sub-routines:
        - A subroutine for initialisation;
        - A subroutine to update the characters to be displayed for each display (note that this subroutine does not manipulate the displays);
        - A subroutine for showing the characters on the displays. The subroutine can retain control for a period of time but must relinquish the control (i.e. return to the caller) so that the CPU can attend to other tasks. Assume that such control would be given to the module on a regular basis.