# Computer Science 230
# Assignment 2
# Due before 11:55pm October 15, 2016

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**Objectives**
More practice writing assembly language programs
Introduction to peripherals: LEDs and buttons
Introduction to subroutines

**Academic Integrity**
Prior to submitting your assignment, you should familiarize yourself with the University policy on Academic Integrity: http://web.uvic.ca/calendar2014/FACS/UnIn/UARe/PoAcI.html
We will use a plagiarism detection tool on all assignment submissions.

**AVR Studio Project**
As in assignment 1, you should create a new assembly language project in AVR Studio for this assignment. Download the sample code and add the files to the project.

**Please note that this assignment comes in two parts. Part 1 is a problem set on conneX. You fill your answers directly on conneX. Part 2 is a set of programming assignments that are given below.**

## Assignment 2 Part 1: Problem set on conneX

Complete the Assignment 2 Part1 problem set on conneX. This is available in Tests & Quizzes section.

## Assignment 2 Part II – Assembly Programming Assignments

## Question 1: Lighting the LEDs

As you've seen in the lab, the boards include a 6 LED strip, where each LED can be controlled independently from the others. Although the LEDs are wired to adjacent Arduino pins, they are controlled using two AVR ports: PORTB and PORTL. The exact mapping is shown in the table below:

| Pin | PORT | Bit # |
|---|---|---|
| 42 | L | 7 |
| 44 | L | 5 |
| 46 | L | 3 |
| 48 | L | 1 |
| 50 | B | 3 |
| 52 | B | 1 |

You should modify the code in **a2q1.asm** so that it displays the binary value in R0 of bits 5-0 in binary using the 6 LEDs ignoring bits 6 and 7. You should consider the LED on Pin 42 to be the least-significant bit and the LED on Pin 52 to be the most-significant bit.

For example, if R0 contains the value 0x13, the LEDs should look like:

| **Pin** | 52 | 50 | 48 | 46 | 44 | 42 |
|---|---|---|---|---|---|---|
| **Value** | OFF | ON | OFF | OFF | ON | ON |

Be sure to test your code on several different values. Your instructor's solution used a combination of **ANDI** and **BRNE** instructions to test the individual bits in **R0** and then used **ORI** to set individual bits in two output registers: one that is output to PORTL and another that is output to PORTB.

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## Question 2 – Subroutines and timing

Using the code you wrote in Question 1 above and the delay code provided to you in Lab 4, using **a2q2.asm** write a program that does the following:

**counter = 0**
**start:**
**display counter in binary on the LEDs**
**counter = counter + 1**
**delay between 100 and 200 milliseconds**
**goto start**

First you should turn the code you wrote in Question 1 above into a subroutine called **display**. Then write a main program that implements the algorithm shown above. It will be easiest if you use **R0** for your counter.

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## Question 3 – Button press counting

Using the button code and delay code provided to you in Lab 4, using **a2q3.asm** that is provided to you write a program that does the following:

```
counter = 0
start:
        if button pressed
                counter = counter + 1
                delay between 100 and 200 milliseconds
        display counter in binary on the LEDs
        goto start
```

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## Question 4 – Improved button code

Improve the button code so that it correctly determines which button has been pressed. Study the comments in **a2q4.asm** for details on the values returned from the analog to digital conversion when the buttons are pressed.

You've been provided with a main program – you'll need to fix the button subroutine and include your LED display subroutine. Once you do that, a different light should come on for each button you press. Your instructor's solution used the BRSH instruction.

## Submission

**Submit your a2q1.asm, a2q2.asm, a2q3.asm and a2q4.asm using connex. Do NOT submit your project file – just the .asm files.**

**Grading**

If you submit a program that does not assemble you will receive 0 for that part of the assignment.

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|---|---|
| Question 1 | 5 marks |
| Question 2 | 5 marks |
| Question 3 | 6 marks |
| Question 4 | 4 marks |

Total 20 marks