Demonstration

In addition to the functional specifications defined in the lab handout, all PWM related code should be partitioned into two files, \texttt{pwm.c} and \texttt{pwm.h}. The two files should include at least the following functions:

- \texttt{int pwm\_init(int dutyCycle, int cycleFrequency);}  
  This function should include all the code required to initialize the PWM output to a specific duty cycle (a number in the range $[0, 100]$), as well as set the PWM cycle frequency (specified in Hz). For this lab, the PWM should be initialized with a 40\% duty cycle and a cycle frequency of 1 kHz. The function should return zero on success, or a non-zero value otherwise.

- \texttt{int pwm\_set(int dutyCycle);}  
  This function should set the PWM duty cycle to the value specified by \texttt{dutyCycle}, where \texttt{dutyCycle} is a number in the range $[0, 100]$ representing the percent duty cycle the PWM should be set to on the next PWM cycle. The function returns zero on success and non-zero otherwise.

- The Timer 2 ISR should be defined in \texttt{pwm.c}.

Report

In addition to the standard report requirements:

- Include oscilloscope captures of the 1 ms cycle period, the button detect ISR, and the duty cycle for each button combination. Use the measurement menu on the oscilloscope to measure the duty cycle. See Figure 5 of the lab handout for an example.

- Address the following questions:
  - Derive an expression that approximates the number of bits required by a conventional DAC to achieve the same resolution as the PWM. Assume a 10MHz peripheral bus clock.
  - What is the relationship between the PWM cycle period (the carrier period) and the PWM duty cycle resolution (the “fineness”)?
  - What is the purpose of the shadow register in the PWM peripheral (OCxRS)?
  - The PWM output is a digital signal that has essentially two values: VDD and GND. How could a design use a PWM signal to generate a continuous signal (such as a sine wave)?
  - What is the effect of changing ONLY the timer prescale value (the PR value and the OCxR value are constant)?