**Memo to:** Randy Larimer
**From:** Anthony (Louis) Rosenblum
**Date:** January 22, 2019
**Regarding:** EE 465-01, Lab 0 – Heartbeat LED

**Summary:**

In this lab I examined three unique ways to make an LED toggle on and off at a specified frequency. I performed this lab on the demo board LEDs. I worked on this lab with Abigail Stroh.

**Setup:**

The first order of business was to disable the watchdog. Next I set PTBD 6 and 7 to outputs because I like to toggle both LEDs to make it even more obvious. These setup components were necessary for all three solutions.

**First Solution – Counter Loops:**

I initially thought back to the first few labs of EELE 371. The easiest way to implement the 0.5 hz flash rate would be with nested loops. I started with two loops, each going down from $FF to $00. When I checked this on the scope the LED was blinking at about 2.5 hz. In order to slow it down I added a third nested loop counting down from $05 to $00. This got very close to the desired frequency. I had to wiggle the constants a small amount to get more exact. I ended up using $FF, $C8, and $06 for the loops.

**Second Solution – Timer Interrupts:**

This section required additional setup in the TPM module. This included enabling interrupts and selecting the maximum prescale divisor of 128. Then I forced the interrupt to toggle the LED when it triggered. I soon learned that it was necessary to reset the overflow flag of one of the TPM registers so that the interrupt could trigger more than once. When placing $7D00 in the MODH:L registers I achieved the desire frequency.

**Third Solution – Mix of Solutions 1 & 2:**

I started with my code from section and lowered the prescale divisor to the minimum option of 1. I then stored the decimal number 128 in a location in memory. Every time the interrupt triggered I loaded that number into the accumulator and decremented it. When that memory address read zero the interrupt branched to a loop that toggled the LED and placed 128 back in the memory location. This worked as planned.

**Summary Comments:**

In this lab I learned that there are multiple ways to achieve a given idea. Some routes will be more efficient or more hardware exhaustive and it is up to us as students to learn how to use this to our advantage in EELE 465.