ECE2049: Homework 5

Content: Lectures 8-10

Submission notes:

- For full credit, please show your work and denote your answers with a circle or a box.
- Always write or draw your diagrams neatly! We cannot be expected to GUESS what you meant to write! Some problems (such as those involving code) must be typed to be graded—the others may be handwritten (neatly!) or typed.
- Points for each problem are as indicated. Some portions of problems are marked as "BONUS," which count as extra credit.

1. (10 pts) Read the text below and answer the following questions about keeping track of wall-clock time using timers.

In computing, time scales usually store the current time as the number of seconds that have elapsed since the beginning of some "epoch", which is an arbitrary date that determines the starting time. For example, the Network Time Protocol (NTP) uses an epoch of midnight on January 1st (GMT) 1900. The elapsed seconds since the epoch are stored in a 32-bit unsigned integer.

a. How many years can be represented in an NTP timestamp (ie, an unsigned 32-bit integer storing the number of seconds since 1 January 1900)?

b. In many embedded systems, it is more practical to just consider the current year. In this case, the format is often modified such that 0 corresponds to midnight on January 1st of the current year. If a clock that was initialized to 0 at midnight of 1 January 2020 currently has a count of 3665044 seconds, what day and time does it represent?
(For example, your answer should be in the form June 6, 8:47:12 am)

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2. (10 pts) For a certain application, Timer A2 has been configured as shown below with the goal of creating periodic interrupts every 0.005 seconds.

```
void runtimerA2(void)
{
    TA2CTL = TASSEL_2 | MC_1 | ID_2;
    TA2CCR0 = 1309;
    TA2CCTL0 = CCIE; // Enable timer A2 interrupt
}
```

a. Assuming that ACLK, SMCLK, and MCLK are running at their default settings, what is the **exact time** between interrupts, t_{INT}? (Your answer should be close to 0.005 sec.)

b. If the system clock and timer settings from this problem are used to implement some kind of time-critical system, how long until the time count is off by 0.005 seconds? Will it be fast or slow? How do you know?

c. Write an interrupt service routine for Timer A2 for this application, using a single level of leap counting to keep the display accurate for longer.

3. (5 pts) Consider the following scenario involving a configuration for a timer with periodic interrupts.

a. What is the smallest time interval, t_{INT}, that you could theoretically measure with Timer A2 using ACLK or SMCLK, assuming the default clock settings?

b. Is it a good idea to set the timer to that interval? Speculate on why or why not. (We will discuss the details in class—you don't need to have a correct answer, just think about it.)