Itzel Becerril
Github root directory: https://github.com/HadidBuilds/TivaC_project_labs

Date Submitted: **10/22/19**

Task 00:

```
#include<stdint.h>
#include<stdbool.h>
#include"inc/hw_memmap.h"
#include"inc/hw_types.h"
#include"driverlib/debug.h"
#include"driverlib/sysctl.h"
#include"driverlib/adc.h"

int main(void)
{

   uint32_t ui32ADC0Value[4]; //sequencer 1 with depth of 4

    //volatile so that each variable cannot be optimized out by the compiler
    volatile uint32_t ui32TempAvg;
    volatile uint32_t ui32TempValueC;
    volatile uint32_t ui32TempValueF;

    //Have clock run at 40MHz
    SysCtlClockSet(SYSCTL_SYSDIV_5|SYSCTL_USE_PLL|SYSCTL_OSC_MAIN|SYSCTL_XTAL_16MHZ);

    //Enable ADC0 peripheral
    SysCtlPeripheralEnable(SYSCTL_PERIPH_ADC0);
    ADCHardwareOversampleConfigure(ADC0_BASE, 64);

    //ADC will run at default rate of 1Msps
    //Configure ADC sequencer 1
    //want the processor to trigger the sequence and use highest priority
    ADCSequenceConfigure(ADC0_BASE, 1, ADC_TRIGGER_PROCESSOR, 0);

    //Configure all four steps of ADC sequencer
    //temp sensor = ADC_CTL_TS
    ADCSequenceStepConfigure(ADC0_BASE, 1, 0, ADC_CTL_TS);
    ADCSequenceStepConfigure(ADC0_BASE, 1, 1, ADC_CTL_TS);
    ADCSequenceStepConfigure(ADC0_BASE, 1, 2, ADC_CTL_TS);

    //Configure interrupt flag = ADC_CTL_IE
    //Tell ADC logic that this is the last conversion on sequencer 1 = ADC_CTL_END
    ADCSequenceStepConfigure(ADC0_BASE,1,3,ADC_CTL_TS|ADC_CTL_IE|ADC_CTL_END);

    ADCSequenceEnable(ADC0_BASE, 1); //Enable ADC sequencer 1

    //read the value of the temperature sensor and calculate the temperature
endlessly
    while(1)
    {
        ADCIntClear(ADC0_BASE, 1); //clear interrupt flag
        ADCProcessorTrigger(ADC0_BASE, 1); //trigger ADC conversion with software

        //wait for conversion
        while(!ADCIntStatus(ADC0_BASE, 1, false))
        {
        }

        //get data from a buffer in memory
        ADCSequenceDataGet(ADC0_BASE, 1, ui32ADC0Value);

        //Calculate average of the temperature sensor
        ui32TempAvg = (ui32ADC0Value[0] + ui32ADC0Value[1] + ui32ADC0Value[2] +
ui32ADC0Value[3] + 2)/4;

        //Calculate Celsius
        ui32TempValueC = (1475 - ((2475 * ui32TempAvg)) / 4096)/10;

        //Calculate Fahrenheit
        ui32TempValueF = ((ui32TempValueC * 9) + 160) / 5;
    }
}
```

Youtube Link:

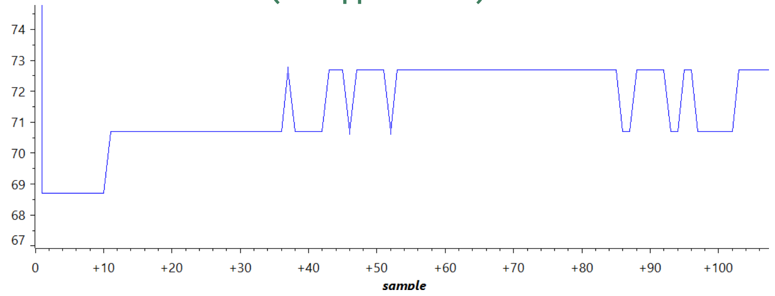
https://www.youtube.com/watch?v=qUxirbQrL-M

Task 01:

In this task, I will change the ADC sequencer to SS2(4 sequences). Once, the temperature is greater than 72 degreesF LED PF2 will turn on else PF1 is ON. I will be using the internal temperature sensor and displaying temperature on the built-in graph tool. In my code I had to do at 70 degrees due to internal temp. sensor.

Youtube Link:
https://www.youtube.com/watch?v=O4vN-P4HWEs

Modified Schematic (if applicable):



Modified Code:

```
#include<stdint.h>
#include<stdbool.h>
#include"inc/hw_memmap.h"
#include"inc/hw_types.h"
#include"driverlib/debug.h"
#include"driverlib/sysctl.h"
#include"driverlib/adc.h"
#include "driverlib/gpio.h"
```

```
int main(void)
{
   uint32_t ui32ADC0Value[4]; //sequencer 2 with depth of 4

    //volatile so that each variable cannot be optimized out by the compiler
    volatile uint32_t ui32TempAvg;
    volatile uint32_t ui32TempValueC;
    volatile uint32_t ui32TempValueF;

    //Have clock run at 40MHz
    SysCtlClockSet(SYSCTL_SYSDIV_5|SYSCTL_USE_PLL|SYSCTL_OSC_MAIN|SYSCTL_XTAL_16MHZ);

    //Enable ADC0 peripheral
    SysCtlPeripheralEnable(SYSCTL_PERIPH_ADC0);
    ADCHardwareOversampleConfigure(ADC0_BASE, 64);

    //ADC will run at default rate of 1Msps
    //Configure ADC sequencer 2
    //want the processor to trigger the sequence and use highest priority
    ADCSequenceConfigure(ADC0_BASE, 2, ADC_TRIGGER_PROCESSOR, 0);

    //Configure all four steps of ADC sequencer
    //temp sensor = ADC_CTL_TS
    ADCSequenceStepConfigure(ADC0_BASE, 2, 0, ADC_CTL_TS);
    ADCSequenceStepConfigure(ADC0_BASE, 2, 1, ADC_CTL_TS);
    ADCSequenceStepConfigure(ADC0_BASE, 2, 2, ADC_CTL_TS);

    //Configure interrupt flag = ADC_CTL_IE
    //Tell ADC logic that this is the last conversion on sequencer 2 = ADC_CTL_END
    ADCSequenceStepConfigure(ADC0_BASE,2,3,ADC_CTL_TS|ADC_CTL_IE|ADC_CTL_END);

    ADCSequenceEnable(ADC0_BASE, 2); //Enable ADC sequencer 2

    //Enable PortF and all 3 LEDs
    SysCtlPeripheralEnable(SYSCTL_PERIPH_GPIOF);
    GPIOPinTypeGPIOOutput(GPIO_PORTF_BASE, GPIO_PIN_1|GPIO_PIN_2|GPIO_PIN_3);

    //read the value of the temperature sensor and calculate the temperature
endlessly
    while(1)
    {
        ADCIntClear(ADC0_BASE, 2); //clear interrupt flag
        ADCProcessorTrigger(ADC0_BASE, 2); //trigger ADC conversion with software

        //wait for conversion
        while(!ADCIntStatus(ADC0_BASE, 2, false))
        {
        }

        //get data from a buffer in memory
        ADCSequenceDataGet(ADC0_BASE, 2, ui32ADC0Value);

        //Calculate average of the temperature sensor
        ui32TempAvg = (ui32ADC0Value[0] + ui32ADC0Value[1] + ui32ADC0Value[2] +
ui32ADC0Value[3] + 2)/4;
```

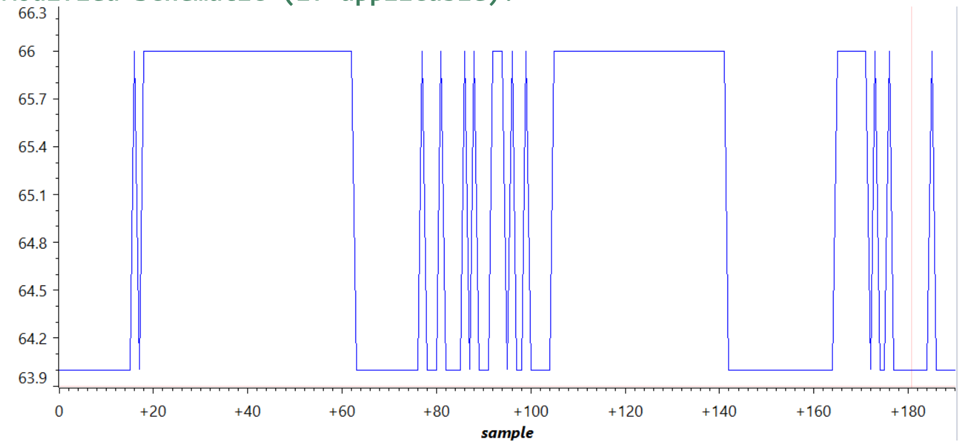
```
        //Calculate Celsius
        ui32TempValueC = (1475 - ((2475 * ui32TempAvg)) / 4096)/10;

        //Calculate Fahrenheit
        ui32TempValueF = ((ui32TempValueC * 9) + 160) / 5;

        if(ui32TempValueF >= 70)
        {
            GPIOPinWrite(GPIO_PORTF_BASE, GPIO_PIN_1, 0);
            GPIOPinWrite(GPIO_PORTF_BASE, GPIO_PIN_2, 4);
        }
        else
        {
            GPIOPinWrite(GPIO_PORTF_BASE, GPIO_PIN_2, 0);
            GPIOPinWrite(GPIO_PORTF_BASE, GPIO_PIN_1, 2);
        }
    }
}
```

Task 02:

In this task I was to set the hardware averaging to 32 and have the interrupt to occur every 0.5 sec.

Youtube Link:
https://www.youtube.com/watch?v=sQUfnzrPhIc

Modified Schematic (if applicable):



Modified Code:

```
#include<stdint.h>
#include<stdbool.h>
#include "inc/hw_memmap.h"
#include "inc/hw_types.h"
#include "driverlib/debug.h"
#include "driverlib/sysctl.h"
#include "driverlib/adc.h"
#include "driverlib/gpio.h"
#include "inc/tm4c123gh6pm.h"
```

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```
#include "driverlib/timer.h"
#include "driverlib/interrupt.h"

uint32_t ui32ADC0Value[4]; //sequencer 2 with depth of 4

//volatile so that each variable cannot be optimized out by the compiler
volatile uint32_t ui32TempAvg;
volatile uint32_t ui32TempValueC;
volatile uint32_t ui32TempValueF;

uint32_t ui32Period;

int main(void)
{
    //Have clock run at 40MHz
    SysCtlClockSet(SYSCTL_SYSDIV_5|SYSCTL_USE_PLL|SYSCTL_OSC_MAIN|SYSCTL_XTAL_16MHZ);

    //Enable ADC0 peripheral
    SysCtlPeripheralEnable(SYSCTL_PERIPH_ADC0);
    ADCHardwareOversampleConfigure(ADC0_BASE, 32); //hardware average of 32

    //ADC will run at default rate of 1Msps
    //Configure ADC sequencer 2
    //want the processor to trigger the sequence and use highest priority
    ADCSequenceConfigure(ADC0_BASE, 2, ADC_TRIGGER_PROCESSOR, 0);

    //Configure all four steps of ADC sequencer
    //temp sensor = ADC_CTL_TS
    ADCSequenceStepConfigure(ADC0_BASE, 2, 0, ADC_CTL_TS);
    ADCSequenceStepConfigure(ADC0_BASE, 2, 1, ADC_CTL_TS);
    ADCSequenceStepConfigure(ADC0_BASE, 2, 2, ADC_CTL_TS);

    //Configure interrupt flag = ADC_CTL_IE
    //Tell ADC logic that this is the last conversion on sequencer 2 = ADC_CTL_END
    ADCSequenceStepConfigure(ADC0_BASE,2,3,ADC_CTL_TS|ADC_CTL_IE|ADC_CTL_END);

    ADCSequenceEnable(ADC0_BASE, 2); //Enable ADC sequencer 2

    //Enable PortF and all 3 LEDs
    SysCtlPeripheralEnable(SYSCTL_PERIPH_GPIOF);
    GPIOPinTypeGPIOOutput(GPIO_PORTF_BASE, GPIO_PIN_1|GPIO_PIN_2|GPIO_PIN_3);

    SysCtlPeripheralEnable(SYSCTL_PERIPH_TIMER1);
    TimerConfigure(TIMER1_BASE, TIMER_CFG_PERIODIC);

    ui32Period = (SysCtlClockGet() / 10) / 2;//10Hz and 50% DC
    TimerLoadSet(TIMER1_BASE, TIMER_A, ui32Period -1);

    //Enabling Interrupt
    IntEnable(INT_TIMER1A);
    TimerIntEnable(TIMER1_BASE, TIMER_TIMA_TIMEOUT);
    IntMasterEnable();

    //Will start the timer and interrupts will begin triggering on the timeouts
    TimerEnable(TIMER1_BASE, TIMER_A);
```

Grading scheme: 30% Coding, 30% Documentation, 40% Execution/Video.

```
    //Enable ADC interrupt
    ADCIntEnable(ADC0_BASE, 3);

    //The toggling of the GPIO will happen in the interrupt service routine
    while(1)
    {
    }
}

void Timer1IntHandler(void)
{
    TimerIntClear(TIMER1_BASE,TIMER_A);
    //read the value of the temperature sensor and calculate the temperature
endlessly
    ADCIntClear(ADC0_BASE, 2); //clear interrupt flag
    ADCProcessorTrigger(ADC0_BASE, 2); //trigger ADC conversion with software

    //wait for conversion
    while(!ADCIntStatus(ADC0_BASE, 2, false))
    {
    }

    //get data from a buffer in memory
    ADCSequenceDataGet(ADC0_BASE, 2, ui32ADC0Value);

    //Calculate average of the temperature sensor
    ui32TempAvg = (ui32ADC0Value[0] + ui32ADC0Value[1] + ui32ADC0Value[2] +
ui32ADC0Value[3] + 2)/4;

    //Calculate Celsius
    ui32TempValueC = (1475 - ((2475 * ui32TempAvg)) / 4096)/10;

    //Calculate Fahrenheit
    ui32TempValueF = ((ui32TempValueC * 9) + 160) / 5;

    if(ui32TempValueF  >= 66)
    {
       GPIOPinWrite(GPIO_PORTF_BASE, GPIO_PIN_1, 0);
       GPIOPinWrite(GPIO_PORTF_BASE, GPIO_PIN_2, 4);
    }
    else
    {
       GPIOPinWrite(GPIO_PORTF_BASE, GPIO_PIN_2, 0);
       GPIOPinWrite(GPIO_PORTF_BASE, GPIO_PIN_1, 2);
    }
}

-------------------------------------------------------------------------------------
```