Lab 4A - Analog to Digital Converter

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Problem Statements

- Getting familiarized with the internal ADC of TM4C123GH6PM.
- Read the temperature using internal temperature sensor.
- Display the temperature value in decimal format on LCD screen.
- Convert an external analog signal between 0V to 3.3V to digital value and display it on LCD.

ADC on TM4C123GH6PM

- The TM4C123GH6PM microcontroller contains two identical ADC modules.
- These two modules, ADC0 and ADC1, share the same 12 analog input channels.
- Each ADC module operates independently and can therefore execute different sample sequences, sample any of the analog input channels at any time, and generate different interrupts and triggers.

Important terms related to ADC on TM4C123GH6PM

- **Sample Sequencer**
  The sampling control and data capture is handled by the sample sequencers. All of the sequencers are identical in implementation except for the number of samples that can be captured and the depth of the FIFO.
- **Trigger Source**
  ADC can be triggered by various sources like processor, external GPIO, PWM, internal comparators, timer etc.
- **Relative Priority**
  As mentioned earlier, there are 4 sample sequencers. Hence, we need to specify the relative priority of a sequencer in case we are using multiple sample sequencers.

Code Algorithm

- Include the following header files in your code: "stdint.h", "stdbool.h", "inc/hw_memmap.h", "inc/hw_types.h", "driverlib/gpio.h", "driverlib/sysctl.h", "inc/hw_ints.h", "driverlib/interrupt.h", "driverlib/adc.h".
- Enable the system clock, ADC0 peripheral clock and the required port pins.
- Set the enabled port pins to function as output pins.
- Initialize the LCD as you did in previous lab.
- Configure the trigger source for ADC and priority of a sample sequence using the function ADCSequenceConfigure(), Page 38.
- Configure the ADC channel using the function ADCSequenceStepConfigure(), Page 42.
- Enable the sample sequence using the function ADCSequenceEnable(), Page 41.

Code Algorithm (contd...)

- Trigger a sample sequence with processor using the function ADCProcessorTrigger(), Page 36.
- Wait until the sample sequence has completed by checking ADCIntStatus(), Page 34.
- Read the digital value from the ADC using the function ADCSequenceDataGet(), Page 39.
- Triggering should be done after every sample conversion.
- Calculate the temperature reading (in °C) from the internal sensor using the formula:

  $$TEMP = 147.5 - ((75 * (VREFP - VREFN) * ADCValue)/4096)$$

  Refer TM4C123GH6PM Microcontroller datasheet, Page 812 for more details.
- Display the obtained digital value in decimal format on LCD screen.
- Connect a potentiometer to any pin mentioned in Table 13-1 on TM4C123GH6PM Microcontroller datasheet, Page 798. It has a list of pins that can be used as ADC input signal. Potentiometer should give output voltage of minimum=0 and maximum=3.3V. Display the digital value on LCD.