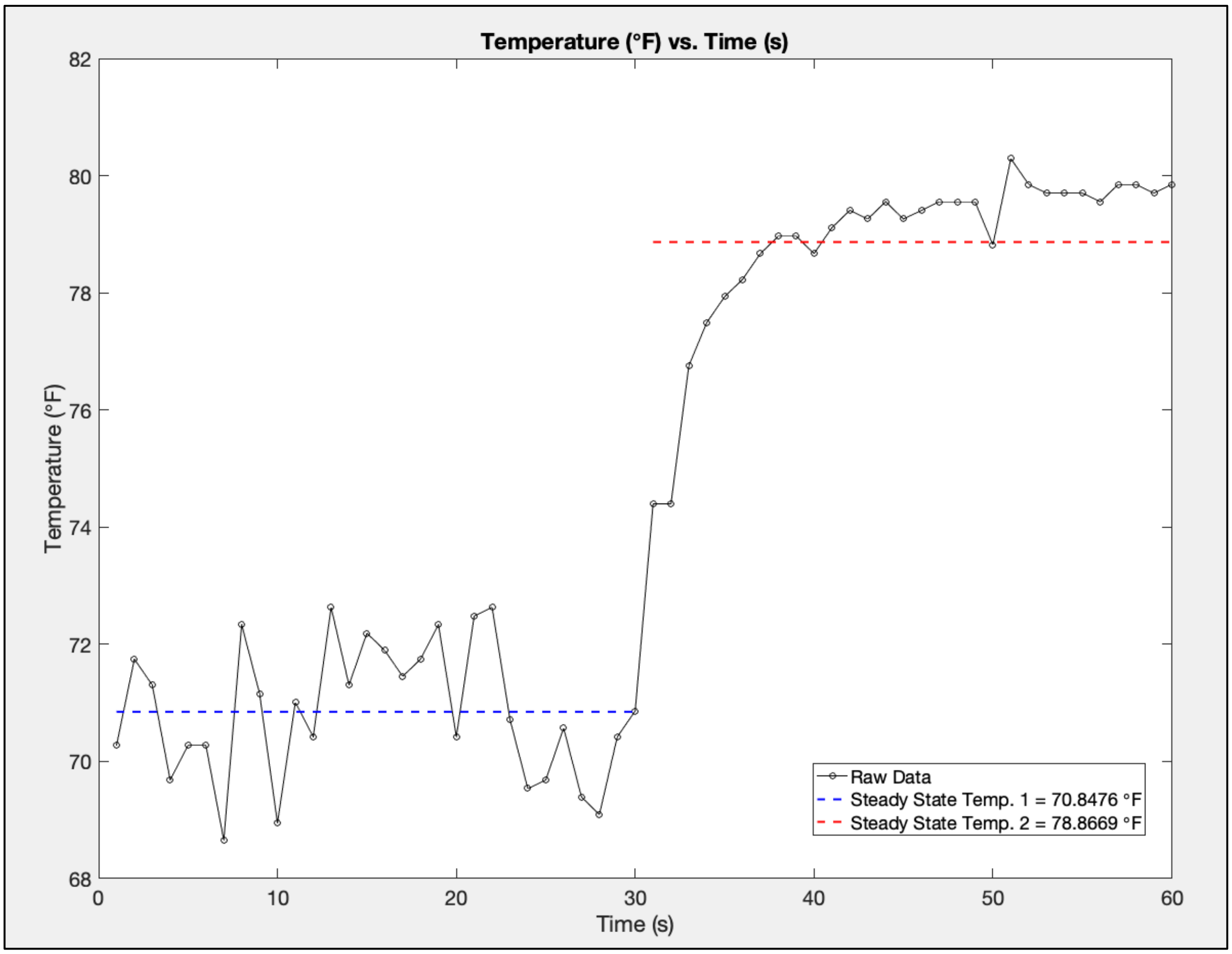
Praveen Ravishankar **Fall 2019**
ME 4405 Section B

Lab Assignment Five
Analytical to Digital Conversion

Questions:

1. Take data from the above setup for approximately 60 sec. Around 30 sec, heat up the temperature sensor (either by placing you fingers on it or through other means). On the plot, show the two steady-state temperatures achieved by the sensor. How long does it take for the sensor to increase from the first steady-state temperature to the second? (Note: You can copy and paste data from the CCS console window directly to the plotting program of your choice, for instance MATLAB or Excel). **(10 pts)**



As seen from the above graph, the first steady-state temperature achieved by the sensor with no application of heat is 70.8476 $_o$F; whereas, the second steady-state temperature reached by the sensor when heat is applied (by placing my fingers on the sensor) is 78.8669 $_o$F. From further observing the graph, it's indicated that the sensor requires approximately **7-8 seconds** to increase from the first steady-state temperature to the second.

2. Calculate the resolution used in this lab in units of mV and in corresponding units of temperature. **(5 pts)**

$$Resolution\ (\mathrm{V}) = \frac{Range\ (\mathrm{V})}{2^N - 1} = \frac{2.5\ \mathrm{V}}{2^{10} - 1}$$

$$Resolution\ (\mathrm{V}) = \frac{2.5\ \mathrm{V}}{1023}$$

$$\boldsymbol{Resolution\ (\mathrm{V}) = 0.002444\ \mathrm{V} = 2.444\ \mathrm{mV}}$$

$$Resolution\ (°\mathrm{F}) = Resolution\ (\mathrm{V}) * \frac{150\ °\mathrm{F}}{2.5\ \mathrm{V}}$$

$$Resolution\ (°\mathrm{F}) = 0.002444\ \mathrm{V} * 60\ \frac{°\mathrm{F}}{\mathrm{V}}$$

$$\boldsymbol{Resolution}\ (°\mathrm{F}) = \mathbf{0.1466}\ °\mathrm{F}$$

3. A generator produces a voltage between 0 and 5V, linearly proportional to its angular velocity, which varies between 0 and 100 rad/s. The generator's output voltage is connected to an ADC which is configured with a 14-bit output. Calculate the voltage input from the generator to the ADC and the digital output of the ADC if the angular velocity of the machine is 65 rad/s. **(5 pts)**

$$V_{gen,out} = 65\frac{rad}{s} * \frac{5\ \mathrm{V}}{100\frac{rad}{s}}$$

$$\boldsymbol{V_{gen,out} = 3.25\ \mathrm{V}}$$

$$Finding\ approximate\ bit\ number: \left(\frac{Bit\ number}{2^{14} - 1}\right) 5\mathrm{V} = 3.25\mathrm{V}$$

$$Bit\ number = 10648.95 = 10648\ (rounded\ down)$$

$$ADC_{out,V} = \frac{Bit\ number}{2^{14} - 1} * 5\ \mathrm{V} = \frac{10648}{16383} * 5$$

$$\boldsymbol{ADC_{out,V} = 3.2497\ \mathrm{V}}$$

$$ADC_{out,vel} = ADC_{out,V} * \frac{100\frac{rad}{s}}{5\ \mathrm{V}} = 3.2497 * 20\frac{\frac{rad}{s}}{\mathrm{V}}$$

$$\boldsymbol{ADC_{out,vel} = 64.9942\frac{rad}{s}}$$