# CHEN 2450
# HOMEWORK 5
# INTERPOLATION

Submit all your homework using Jupyter notebooks. You are expected to include proper text and discussion for each and every problem including appropriate headings and formatting. You will lose points if your reports are not readable or just include code with a few print out statements. No exceptions.

## Problem 1 (50 pts)

Consider the data in the class notes that showed the viscosity of air as a function of temperature, $\mu(T)$, at atmospheric pressure.

```
T=[ 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800,
    850, 900, 950, 1000] K
mu = [7.110e-06, 1.034e-05, 1.325e-05, 1.596e-05, 1.846e-05, 2.082e-05, 2.301e-05,
      2.507e-05, 2.701e-05, 2.884e-05, 3.058e-05, 3.225e-05, 3.388e-05, 3.546e-05,
      3.698e-05, 3.843e-05, 3.981e-05, 4.113e-05, 4.244e-5] N.s/m2
```

1. (15 pts) Using linear interpolation, estimate $\mu$ at 835 K (by hand).
2. (15 pts) Show the system of equations that you must solve to obtain the polynomial coefficients for a quadratic interpolant suitable for estimating $\mu(835)$. Then solve that system (no need to show that work - show the solution only) and show the approximation for $\mu(835)$ using a quadratic polynomial.
3. (20 pts) Create a table summarizing the estimate for $\mu(835)$ using: linear interpolation, quadratic interpolation, cubic splines, and a polynomial that goes through *all* of the data points. Be sure to submit the code that generates these results.

## Problem 2 (50 pts)

The atmospheric temperature (in F) as a function of time of day (in hrs), for a typical day in August is given by:

```
t=[0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23] hrs
Temperature=[75,74,73,72,71,70,69,69,72,75,79,82,86,88,89,90,91,91,91,90,87,82,80,77] F
```

1. (5 pts) Plot the Temperature as a function of time.

2. (15 pts) Write a Python script to find the linear interpolant for this data set:

   (a) Find the temperature at $t = 22.5$ hrs.

   (b) Create an interpolant on the interval $[0, 23]$ using 100 points. (use linspace to generate the points on the interval).

   (c) Plot this linearly interpolated data alongside the original dataset on the same plot. Make sure you label the $x$ and $y$ axes.

3. (15 pts) Write a Python script to find the polynomial interpolant for this data set:

   (a) What is the order of the polynomial that you can fit this *entire* dataset to?

   (b) Using this order, create a polynomial fit for the entire dataset.

      i. Plot this fit on the interval $[0, 23]$ using 100 points and comment on the plot. You should also plot the original data on the same plot for comparison purposes.

      ii. Find the temperature at $t = 22.5$ hrs and comment on your result.

4. (15 pts) Write a Python script to find the cubic spline interpolant for this data set:

   (a) Find the cubic spline interpolant for this data set

   (b) Plot the cubic spline interpolant on the interval $[0, 23]$ using 100 points and comment on the plot. You should also plot the original data on the same plot for comparison purposes.

   (c) Using this interpolant, find the temperature at $t = 22.5$ hrs and comment on your result.

HINT: Revisit class notes and screencasts on interpolation for examples on how to create linear, polynomial, and cubic spline interpolants.