Homework 4
ME 581
Due: 4:15 PM October 26, 2017

The following problems are to be documented, solved, and presented in a Jupyter notebook.
On-Campus students: Save the notebook as a single PDF, then print and return a hard copy in class.
Off-Campus students: Save the notebook as a single PDF, then upload and submit the PDF in Blackboard. The name of the file should be SURNAME-HW4.pdf.

Use Lagrange Interpolation for Problems 1 and 2

Problem 1:
Let $x_o = -3$, $x_1 = 0$, $x_2 = e$, and $x_3 = \pi$.

(a) Determine formulas for the Lagrange polynomials $L_{3,0}(x)$, $L_{3,1}(x)$, $L_{3,2}(x)$, $L_{3,3}(x)$ associated with the given interpolating points.
(b) Plot $L_{3,0}(x)$, $L_{3,1}(x)$, $L_{3,2}(x)$, and $L_{3,3}(x)$ on the same set of axes over the range $[-3, \pi]$.

Problem 2:
Consider the function $f(x) = \ln x$
(a) Construct the Lagrange form of the interpolating polynomial for f passing through the points (1, ln 1), (2,ln 2), and (3, ln (3)).
(b) Plot the polynomial obtained in part (a) on the same set of axes as $f(x) = \ln x$. Use an x range of [1,3].
(c) Use the polynomial obtained in part (a) to estimate both $\ln 1.5$ and $\ln 2.4$. What is the error in each approximation?
(d) Establish the theoretical error bound for using the polynomial found in part (a) to approximate $\ln 1.5$. Compare theoretical error bound to the error found in part (c).

Write a Neville's Algorithm and use it for problems 3 and 4

Problem 3:
Use Neville's algorithm to evaluate the interpolating polynomial for $f(x) = sqrt\ (x)$ that passes through the points $(1, sqrt(1))$, $(4, sqrt(4))$, and $(16, sqrt(16))$, at $x = 9$.

Problem 4:
The mean activity coefficient at 25°C for silver nitrate, as a function of molality, is given in the table below. Estimate the mean activity coefficient for a molality of 0.032 and for a molality of 1.682.

Molality	0.005	0.010	0.020	0.050	0.100	0.200	0.500	1.000	2.000
Coefficient	0.924	0.896	0.859	0.794	0.732	0.656	0.536	0.430	0.316

Use Newton's Interpolation for Problems 5 to 7

Problem 5:
Write out the Newton form of the interpolating polynomial for $f(x) = \cos(x)$ that passes through the points (1,cos(1)), (2, cos(2)), and (3, cos(3)).

Problem 6:
The values listed in the table provide the surface tension of mercury as a function of temperature.

Temperature (°C)	10	25	50	75	100
Surface Tension (dyn/cm)	488.55	485.48	480.36	475.23	470.11

Use these values to determine the Newton form of the interpolating polynomial, and then use the polynomial to produce a table of surface tension values for temperatures ranging from 5°C through 100°C in increments of 5°C. Assess the accuracy of the table by plotting the values from the table and the five given data values on the same set of axes.

Problem 7:
The thermal conductivity of air as a function of temperature is given in the table below. Estimate the thermal conductivity of air when T= 240 K and T=485 K, using the Newton form of the interpolating polynomial.

Temparature (K)	100	200	300	400	500	600
Thermal Conductivity (mW/m·k)	9.4	18.4	26.2	33.3	39.7	45.7