Homework 09

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Work in groups of two. Include both of your names as a comment in the first line of each file. Then submit those files on canvas (once per group!).

1. Interpolation. You are given the data points $(0,-1)$, $(2,-2)$, $(3,-1)$, $(4,3)$, $(5,-1)$, $(6,-1)$, $(7,5)$. Hint: see the files related to interpolation on canvas.

   (a) Use Matlab to interpolate these points using 1) a polynomial (using monomials), 2) a cubic spline, and 3) a piece-wise linear function. Create a plot with the points and the three curves (in one plot, include a legend).

   Make sure all methods go through the data points.

   Hint: You do not need to compute the piece-wise linear function, you can just ask Matlab to connect the points with straight lines.

   (b) Compute and output the condition number (using the infinity norm) of the matrix you computed for 1) in a).

   (c) Compute and output the value of the interpolating function at $x = 1$ for the three methods.

   (d) Compute the slope at $x = 1$ using the centered difference formula with $h = 10^{-3}$ for the three methods.

   Submit code `hw09q1.m` that produces the plot and all other output when run.

2. Even though midpoint and trapezoidal rules have the same order of accuracy, the midpoint rule usually gives about half the error of the trapezoidal rule. Test this theory on the two functions

$$f(x) = \sin^2(x), \qquad g(x) = \cos(x)$$

   on the interval [0.5, 1.0].