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CSS 455 Winter 2012 C. Jackels
Activity No. 11 February 16, 2012
Names (must be present):

Part I. Polynomial Interpolant of Runge function.

Download the file *activity11Polydemo.m* from the web site. Examine the file to see that it is using *polyfit and polyval* to fit and evaluate the interpolant.

1. For 11 data pts, what order of polynomial will give an exact interpolant? Is that the order being used within the script? How do you know?

2. Run the script and examine the plot. To try to improve the quality, add four points, to give a set of 15 evenly spaced interpolation points. This requires only changing line 17 to be *npts=15.* Did the interpolant improve or not? What was your basis for this conclusion?

3. Another idea is to add 4 new points, again using a total of 15, but adding them more strategically. To execute this attempt, comment out line 18 , which generates the 15 evenly spaced points, and uncomment line 19. Line 19 defines x as 11 evenly spaced points, with ones added at -4.5, -3.5, 3.5, and 4.5. Run it. What is your conclusion about the utility of using unevenly distributed points? *Do you think there tradeoffs involved?*

Part II. Cubic Piecewise Interpolants

Download the file *activity*11*splinedemo. m* from the web site. Examine the file to note that it is using the built-in *spline* and *pchip* functions to evaluate the splines. It then uses ppval to evaluate the interpolant. Be sure to notice how the outputs of the spline building functions are stored as a data structure in the structure names such as **PP.** These could be saved and used in other contexts.

1. Run the program, stepping it along with *Enter* keys at each pause. The curves are plotted in the order: Exact Runge curve; Not-a-knot cubic spline; Natural cubic spline; and piecewise cubic Hermite interpolating polynomial *(pchip).* What differences do you observe? Do they seem significant?

2. Change the number of points to be interpolated from 11 to 12 at line 17. Now rerun the program and examine the plots.

a. How does the Not-a-knot spline (first one run) differ from the exact curve?

b. How does the Natural spline differ from the Not-a-knot?

c. How does the *pchip* interpolant differ from the splines above?

d. Can you see evidence from the plot that the 2nd derivative of the *pchip* curve is discontinuous? Where?

e. Leaving *npts* set at 12 (line 17) comment out line 18 and uncomment line 19. This provides twelve slightly different points. Run the script, noting especially the behavior of the *pchip* curve.

    a. Which interpolant would be described as "smoother": *pchip* or *cubic spline?* What is your evidence for this?

    b. Which interpolant may introduce an extremum (maximum or minimum) at a location not dictated by the data?