Root Finding and Data Fitting

2/15/2008

Opening Discussion

- What did we talk about last class?
- Do you have any questions about the reading?

Root Finding with fzero

- We finished last time looking at how to use fzero. We should go ahead and finish that discussion to see if we can use it to find the roots of a function.

Minimization

- Another common problem is trying to find the smallest or largest values that a function takes in a certain range.
- Mathematically, these “local extrema” are points where the first derivative is zero so you just do root finding on that.
- “Hill climbing” methods come in many forms. Their simplest forms wind up working in a manner very similar to root finding.
- Matlab provides you with methods for doing minimization of functions: fminbnd and fminsearch.

Data Interpolation

- Interpolation is the process of estimating values between data points.
- Matlab has the functions interp1 and interp2 for doing interpolation in 1-D and 2-D.
- The last argument is a string that tells the type of interpolation: linear, cubic, spline, and nearest.
- Let's play with some 1-D interpolation and see how the different methods work.

2-D Interpolation

- Matlab can also do 2-D interpolation with interp2. This is easy to do if you have a 2-D array of data and want to find one point.
- To construct a finer mesh we need the meshgrid function that will give us an easy way to represent all points on a grid. It takes two 1-D arrays and returns two 2-D arrays.
- Lets play with this as well. We can use the mesh function to plot out surfaces.

Polynomials

- Matlab provides a simple mechanism for us to deal with polynomials. Row arrays are can be viewed as the coefficients on polynomials.
- Given this form, roots finds the roots of that polynomial.
- Given the roots, poly will return the polynomial with those roots. (This one can be fairly easily done by hand.)
- The conv function will multiply two polynomials.
- Addition can be done easily if the polynomials have the same number of terms. Otherwise one will need to be padded with zeros.
- For division use deconv.

Calculus and Evaluation

- You can take derivatives of polynomials with polyder.
- You can integrate a polynomial with polyint. Remember that this must be passed in a constant along with the polynomial.
- The polyval function will evaluate a polynomial at one value or for an array of values.

Curve Fitting

- Given data, you can use the polyfit to fit a polynomial to it. The arguments are the x and y values followed by the order of the polynomial you want back.
- In general you should use lower order polynomials, they are typically better behaved.
- It turns out this is just a wrapper function for solving a system of linear equations, typically a system that is overspecified.

Closing Comments

- Because we are moving through topics slower than I have done in previous years (though I feel good about the depth of coverage) I've pushed back assignments 4 and 5.