



Root Finding

2/13/2008





Opening Discussion

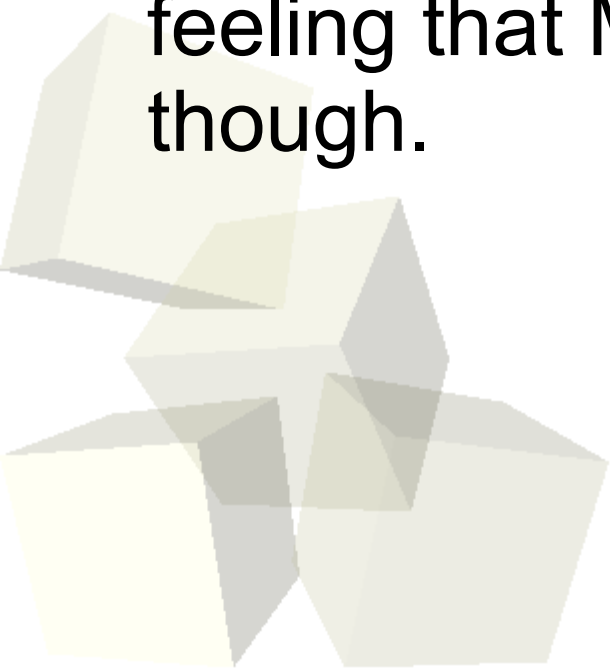
- Do you have any questions about the quiz?
- What did we talk about last class?
- Do you have any data from your work that you want to look at? Keep your data handy so that we can consider coming back to it in the coming days.





Root Finding

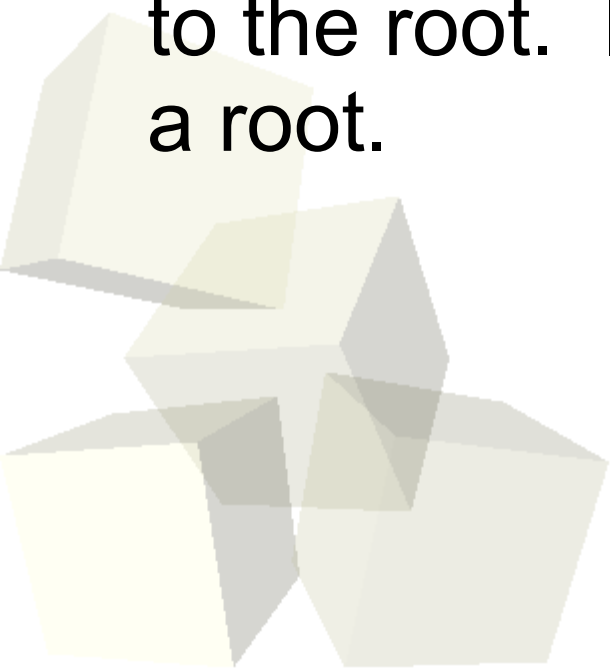
- A common mathematical problem is that of finding where a function has a certain value. Solving for the zeros of a function is called root finding, but since you can easily subtract any value it is very general.
- There are many methods to find roots. One of the most widely used is Newton's method. I get the feeling that Matlab uses a binary search method though.





Newton's Method

- Newton's method uses a linear approximation to a function and follows the line to zero, then uses that as a better guess.
- $f(x) \sim f'(v)(x-v) + f(v)$
- If you don't know the analytic derivative you can use a secant method or take a numeric derivative.
- This method is very fast if you have a guess close to the root. It can be poorly behaved farther from a root.





Binary Searching

- A binary search root finding method needs a range such that $f(x_1) \cdot f(x_2) < 0$ (the two endpoints must have a different sign).
- You can either cut the range in half or use a line approximation between the two endpoints.
- The trick in this method is finding the endpoints for the range. If a function has a very small region of negative values, for example, this can be hard to do.





- 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.



Closing Comments

- Assignment #4 is due next Monday.

