



Root Finding

9-15-2006





Opening Discussion

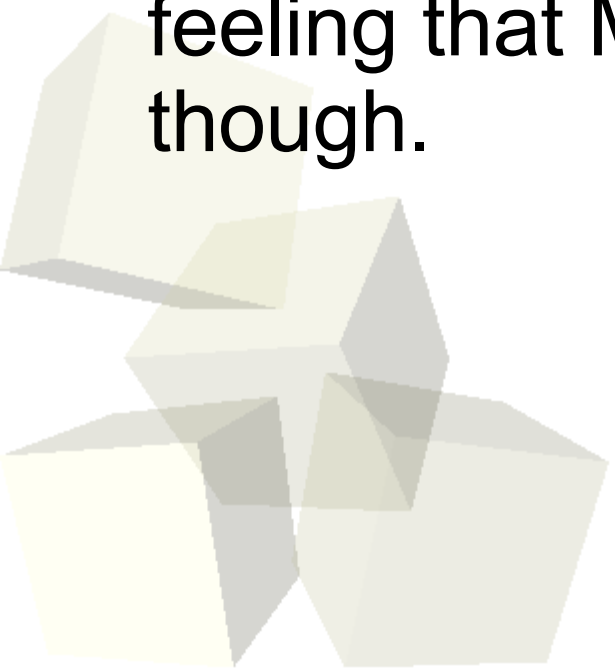
- What did we talk about last class? I finished writing similar code for PAD1 yesterday. We could have a look at that.





Root Finding

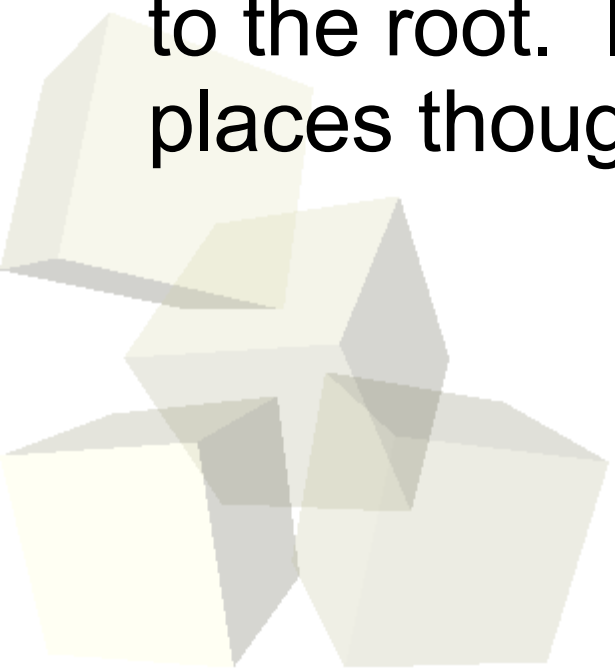
- A common mathematical problem is that of finding where a function has a certain value. Solving for the zeros of a function is called root finding, but since you can easily subtract any value it is very general.
- There are many methods to find roots. One of the most widely used is Newton's method.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





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 #3 is due on Monday.

