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Math128B: Numerical Analysis

Math128B Final Exam, Due May 12, 2010

Here are the four projects in more detail. I've already emailed everyone about their project assignment. People can work together on their projects, but everyone must turn in their project individually, to Alan, by 23:59PM on May 12, 2010.

You are encouraged to look up the wiki pages in all these projects.

- **Brent's Method**: In this project we need to do the following:
  - Write a matlab code to implement the original Brent's Method, and discuss its convergence properties according to Brent's original work.
  - Compare your code with the matlab function fzero.
  - Discuss possible improvements in Brent's Method.
- **QR Algorithm**: In this project we need to do the following:
  - Reduce a given non-symmetric matrix to upper Hessenburg form, while accumulating all the Householder transformations.
  - Find all eigenvalues by perform single shift and double shift QR steps to reduce the upper Hessenburg matrix to quasi-upper-triangular form, while accumulating all the Givens rotations.
  - Find all eigenvalues and eigenvectors.
- **Preconditioned CG** In this project we need to do the following:
  - Write a matlab code to implement PCG.
  - Develop 3 classes of preconditioners: Gauss-Seidel, SOR, Incomplete Cholesky.
  - Test the effectiveness of these preconditioners.
- **Variations of the `fft`**: In this project we need to do the following:
  - Write a matlab code to implement different `sine` and `cosine` transforms.
  - Compare their effectiveness with straightforward `fft`.
  - Discuss applications of the Discrete Cosine Transform (DCT) in image processing.