Select One of The Three Projects - CS 510

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1 General Comments

1. Groups of up four are allowed.
2. Each group will make a presentation on last day of class December 5, using PowerPoint etc.
3. Projects must be reasonably substantial and use reasonable size data.
4. There shall be no dangling project, i.e. one or more specific group may be assigned to it.
5. I will make more clarifications during upcoming lectures.
6. By next lecture groups and projects must be revealed.

2 Programming Project I

A number of programming projects can be described based on the Robust Newton Method. Some of them are described below. If you do 1 then 2 must also attempted.

1. Implement the Robust Newton Method and test it on some polynomial. You can also combine it with the usual Newton Method in this way:

Given an iterate z_t, generate Newton's iterate $z_{t+1} = z_t - p(z_t)/p'(z_t)$. If $|p(z_{t+1}| < |p(z_t)|$, pick z_{t+1} to be the next iterate. Otherwise, using z_t select z_{t+1} to be based on Robust Newton Method. Give a thorough description of the performance of these on some generated polynomials.

2. Use the Robust Newton Method to compute all roots of $p(z)$. This will be described later.

3. Produce a polynomiography of the performance of Robust Newton Method, and the combination of Robust Newton Method and Newton Method. This means pick a square, divide it into pixels and for each pixel iterate the Robust Newton Method and do color coding.

3 Programming Project II

Make a numerical comparison of the following algorithms for solving $Ax = b$:

1. Jacobi
2. Gauss-Seidel
3. SOR
4. Triangle Algorithm

4 Programming Project III

Generate a direct graph. Define the corresponding column stochastic matrix A. Then $\overline{A}$ if there are dangling nodes. Then the matrix

$$M = d\overline{A} + (1-d)\frac{1}{n}ee^T, \quad d \in (0,1).$$

Usually $d = .85$.

1. Apply the power method to compute the solution to $Mx = x$.
2. Apply your power method to general real matrices. In particular, symmetric matrices.
3. Apply the Triangle Algorithm to solving $Mx = x, \quad e^T x = 1, \quad x \geq 1$.