MATH 417: Numerical Analysis

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Homework assignment 8 – due 4/5/2007

Problem 1 (Steepest descent iteration). Repeat what you did for Problem 1 of Homework 6 (Jacobi iteration) and Problem 2 of Homework 7 (Gauss-Seidel iteration), but use the steepest descent algorithm instead to compute the vectors $x^{(k)}$. Generate the same plots as before. Compare your results with the previous results, in particular compare how quickly the iterations appear to converge. **(5 points)**

Problem 2 (Conjugate gradient iteration). Do the same as in Problem 1 one last time, but use the Conjugate Gradient algorithm this time to compute the vectors $x^{(k)}$. Generate the same plots as before. Compare your results with the previous results, in particular compare how quickly the iterations appear to converge. **(5 points)**

Problem 3 (Lagrange interpolation).

(a) Compute the Lagrange interpolation polynomials $L_{4,k}, k = 0 \dots 3$, for the points $x_0 = 1$, $x_1 = 2$, $x_2 = 1.5$ and $x_3 = 1.6$.

(b) Calculate the interpolating polynomial for the data set where $y_k = \log x_k$ at the four points x_k. Write the polynomial in the form $p_4(x) = a_3x^3 + a_2x^2 + a_1x + a_0$. **(4 points)**

Problem 4 (Lagrange interpolation). The polynomial $p_4(x)$ calculated in Problem 3 by construction interpolates the function $f(x) = \log x$. Compute an upper bound for the error on the interval $[1, 2]$, using the theorem that states how large $|f(x) - p_4(x)|$ can at most be. **(3 points)**