Assignment #3, due October 23th, 2017, IN CLASS
AMATH 740, CS 770, CM 750
Fall 2017

Reading:

C. Moler "Numerical Computing with Matlab" (online, free download), Ch. 4

Quarteroni, Sacco, Saleri "Numerical Mathematics", Ch. 6, electronic copy at the library.

1. (a) Implement Newton's method. Submit print-out of your code.

   (b) Give your own examples when iterations converge well, don't converge, and converge slowly. Choose your own way to give the answer: by hand, as a print-out of a Matlab session, as a table, etc.

2. (a) Derive Newton's iteration for function $f(x) = (x-1)^2 e^x$. Show that they are well defined for $x \neq -1$. What convergence rate would you expect?

   (b) Solve the problem using your code with $x_0 = 2$. Report and discuss the results.

3. (a) Argue that (in general) if $f(x)$ has a multiple root at x^*, then $w(x) = f(x)/f'(x)$ has a simple root at x^*.

   (b) Derive the Newton's iteration formula for $w(x)$ in terms of $f(x)$ and its derivatives.

   (c) Implement the method in (b) and apply it to the function in Q2. Compare the results and discuss advantages and disadvantages of the two methods.

4. Question 5 in Quarteroni. Also compare the method's efficiency to the efficiency of the secant method in terms of the required number of function evaluations.

5. Question 6 in Quarteroni. $\phi_j(x)$ refers to various ways to rewrite $f(x) = 0$ as $g(x) = x$, i.e. $\phi_j(x)$ is $g(x)$.

6. Read about the Muller method in Quarteroni, Ch 6.4.3. (you may skip the refinement part.)