

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING
ME 310 NUMERICAL METHODS
FALL 2014
PROGRAMMING PROJECT 1

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Prepared by : Eren Demircan, İlteriş Berke Harmancı, Dr. Ender Cığeroğlu, Dr. Yiğit Yazıcıoğlu

The programming project will be submitted through METU-Class, as described in the "Programming Project Assignment Guidelines", which is posted on METU-Class.

Write a computer program to find the roots of a function $f(x)$ which may or may not have multiple roots. You will not know this when writing your code since the user of your program will define $f(x)$. The user will also specify the initial root estimate, x_0 and the number of required significant digits (to set the prespecified error tolerance, ε_s) as inputs. (If you are using a programming language such as C/C++, Fortran etc. user also defines $f'(x)$ in addition to $f(x)$. Your program may read the user defined function as an argument to your main root finding function using a function pointer or handle.)

Your code should use the Secant method and its modified version for multiple roots where the roots of $u(x) = \frac{f(x)}{f'(x)}$ are found. Then the convergence performance of these methods should be compared by finding the root of the equation using both methods.

For both versions of Secant method use the formula that requires only one initial guess and a perturbation δx . The user may also specify the amount of perturbation that will be used in the code.

Your code should also do the following:

- Plot the function $f(x)$ first and let the user decide on an appropriate initial guess. (If you are using a programming language such as C/C++, Fortran etc. disregard this step).
- Terminate if the desired numerical precision or the maximum number of iterations is reached.
- Make the necessary error calculations and keep the calculated errors and root estimations in arrays.
- Present the results by displaying the final root estimate, number of iterations, etc. on the screen and, if you are using a programming software such as Matlab, Mathcad, Excel etc., also show the evolution of the numerical computation process by plotting the root estimates and errors, etc. versus iteration number.

Present your results in a short report (a few pages of a word document only, saved as a pdf document) which should include the following:

- A basic introduction paragraph,
- Necessary hand calculations to write your code (type it in the word document)
- Formulations used in the calculations,
- Your numerical results,
- Your plotted graphics including the evolution of the numerical computation process by plotting the root estimates and errors, etc. versus iteration number (applicable to all groups independent from the programming language or software used),
- Discussion of the results and conclusion,
- Appendix section including your code.