

## Third Programming Assignment – Due Monday March 3, 11:59 pm<sup>1</sup>

### Objective

This assignment is designed to introduce you basic programming techniques used for solving roots of equations and to conventional approaches for such tasks in Excel and MATLAB.

### Specific Tasks

All the assignments below should be tested on the equation  $0.0005x^4 = \cos(x)$ . Graph this equation to determine the number of roots it has in the range  $-2 \leq x \leq 8$  and their general location.

1. Use the `fzero` command of MATLAB with different initial guesses to find all the roots of  $0.0005x^4 = \cos(x)$ . Copy all your MATLAB work to a Word file.<sup>2</sup>
2. Write a MATLAB function that uses the false position method and apply it with different initial guesses to find all the roots of  $0.0005x^4 = \cos(x)$  in the range  $-2 \leq x \leq 8$ . Your method should be able to accept a function name in the same way that `fzero` does. Copy all your MATLAB work and all your MATLAB functions to the Word file
3. Use the goal seek method of the Excel worksheet with different initial guesses to find all the roots of  $0.0005x^4 = \cos(x)$  in the range  $-2 \leq x \leq 8$ .
4. Write a VBA routine that uses Newton's method to find all the roots of  $0.0005x^4 = \cos(x)$  in the range  $-2 \leq x \leq 8$ . This should be written as a user-defined function that takes an initial guess from the worksheet as its argument and returns the solution to the worksheet. Your root finder should require you to write two simple, one-line functions to compute  $f(x)$  and  $df/dx$ . Your Newton's method code should then accept a string name for both the function that computes  $f$  and the function that computed  $df/dx$ ; it should the `Application.Run` method to evaluate arbitrary functions that are input as strings to the root solver as discussed in class. This will allow you to use your root solver for any function without changes.

### Submission Requirements

Do both Excel assignments in a single workbook.

Submit the following two files: (1) the Excel workbook for tasks 3 and 4, and (2) the Word file discussing this assignment with the text file output from your MATLAB work for tasks 1 and 2 included as part of the Word file. Your discussion of this assignment should note the ability to solve these problems in Excel and MATLAB without writing code and discuss the general structure of such codes when you need to code a specific method. Comment on the differences between Newton's method and the false position method. Which do you think is better and why? Your Word file or your Excel workbook should include the results of the preliminary task of determining the number and location of the roots.

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<sup>1</sup> It may be submitted by 11:59 pm, Wednesday, March 5, with a 30% penalty. Later submissions will be reviewed to help students who submit them learn their errors (if any), but they will receive a zero grade.

<sup>2</sup> As an alternative to copying all the MATLAB commands to the Word file, you can use the `diary` command of MATLAB to show all the work you do. With the `diary` command on use the `type` command to include both your false-position-method function and your  $f(x)$  function in the diary listing.