General Sir John Kotelawala Defence University
Faculty of Engineering
Department of Mathematics
Mathematical Software - MA 1232

Learning Outcomes Covered: LO3, LO4, LO5
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Intake 39 - Semester 2 | Tutorial 05 | 12.09.2022

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1. Write a MATLAB function file for the Bisection Method to give the approximate root as the output. Use the four inputs, function, initial point of the considered interval, end point of the considered interval and required accuracy.

   function root=bisection_method(f,x0,x1,acc)
   -
   -
   -
   end

2. The function $f(x) = x^3 - x^2 - 1$ has exactly one zero in $[1, 2]$. Use Bisection method to approximate the zero of f to within 10^{-4}.

3. Find a root of $f(x) = x^3 + 2x - 3$ in the range $0 \leq x \leq 7/5$ using Bisection method.

4. Modify the Bisection Method code to get tabular output and using modified code, do question 02 and 03 again.

5. Write a MATLAB function file for the Newton-Raphson method to give the approximate root as the output. Use the four inputs, function, derivative of the function, initial guess and required accuracy.

   function root=newton_raphson(f,df,x0,acc)
   -
   -
   -
   end

6. Write a script file to find and approximate solution of $f(x) = x^6 - x - 1 = 0$, near $x = 1$ with an accuracy of 0.001 using Newton-Raphson Method.

7. Write a script file to find and approximate solution of $f(x) = x - cos(x)$, in the interval $[0, \pi/2]$ with an accuracy of 0.0001 using Newton-Raphson Method.

8. Modify your code in Question 02, to get a tabular output inside the function file, instead of the output, 'root'. Let n be the iteration.

```
-------------------------------------------------
  n           x_n               f(x_n)
-------------------------------------------------
0          1.000000          -1.000000
1          0.750364          0.459698
2          0.739113          0.018923
3          0.739085          0.000046
-------------------------------------------------
```

9. Using the modified code, do the problem 06 and 07 again.

10. Write a script file to find and approximate solution of $f(x) = -0.74 + 0.765x + 1.1x^2 - 3.55x^3$, near $x = 5/9$ using Newton-Raphson Method. Explain what happens in this problem.

11. Write a MATLAB function file for the Secant method to give the approximate root as the output. Use the four inputs, function, two initial guesses and required accuracy.

    function root=secant_method(f,x0,x1,acc)
    -
    -
    -
    end

12. Modify the Secant Method code to get tabular output and Find the roots of the following equations correct upto six decimal places using the both the codes.
    (a) $f(x) = x^2 - 7 = 0$
    (b) $e^x + xsin(x) = 0$ near $x = 0$
13. Check whether the Secant Method works for the problem in question 10 and Explain why.
14. Find approximations to a root of each equation below correct to the nearest 6th decimal place using
    (a) Bisection Method.
    (b) Newton-Raphson Method.
    (c) Secant Method.
        i. $f(x) = x^2 - 7 = 0 \qquad ([2, 3], x_0 = 2.5, x_1 = 2.4)$
        ii. $f(x) = x^2 - 10 = 0 \qquad ([-3.5, -2.5], x_0 = -3.4, x_1 = -3.5)$
        iii. $f(x) = x^3 - x - 2 = 0 \qquad ([1, 2], x_0 = 1.3, x_1 = 1.4)$
        iv. $f(x) = x^2 - 2x - 8 = 0 \qquad ([3, 5], x_0 = 3.5, x_1 = 3.8)$
        v. $f(x) = x^4 + 3x^3 - 2x^2 - 12x - 8 = 0 \qquad ([-1.5, -0.5], x_0 = -1.2, x_1 = -1.1)$
        vi. $f(x) = 3e^x - 4cos(x) = 0$
        vii. $f(x) = x^5 - 3x^3 - x + 4 = 0$
        viii. $f(x) = e^x + x\ sin(x) = 0$
        ix. $f(x) = x^3 - x + e^x = 0$
        x. $f(x) = 3x^3 - x + 4 = 0$

    (Use the interval, and two initial guesses given in the brackets, appropriately)