Keshav Dandeva #11

Numerical Methods (ENUME) – Project
Assignment B: Solving nonlinear equations

1. Write a program to solve an equation $f(x)=0$ with:

$$f(x)=\left(\frac{6}{5}\right)^{x}+x+\sin\left(\sqrt{x}\right)-\frac{33}{4} \quad \text{for } x\in(0,10]$$

Apply the procedure ***fzero*** for this purpose. Plot the graph of the function $f(x)$ in a given range of x and mark on it the solution $\dot{x}$ to be considered later as an exact solution..

2. Write a program for solving the equation $f(x)=0$ using the bisection methods, as defined on the slide 3-16, with $a_0=10^{-6}$ and $b_0=10$. Use the inequality $\frac{1}{2}(b_i-a_i)<\Delta$ as the criterion for terminating the iterations. Find the solution of the equation $f(x)=0$ for $\Delta=10^{-3},10^{-4},\ldots,10^{-16}$. Plot the graph (Fig. 1) of the number of iterations *I versus* Δ. Plot the graph (Fig. 2) of the actual absolute error of the solution $\hat{\Delta}x=|\hat{x}-\dot{x}|$ *versus* Δ and compare with the criterion value $\frac{1}{2}(b_I-a_I)$ *versus* Δ.

3. Write a program for solving the equation $f(x)=0$ using the *regula-falsi* method, as defined on the slide 3-17, choose an integer value not closer to $\dot{x}$ than 0.5 as a constant point x_0; choose the proper starting point x_1. Use the inequality $|x_i-x_{i-1}|<\Delta$ as the criterion for terminating the iterations. Find the solution of the equation $f(x)=0$ for $\Delta=10^{-3},10^{-4},\ldots,10^{-16}$. Add the graph of number of iterations *I versus* Δ to Fig. 1. Plot the graph (Fig. 3) of the actual absolute error of the solution $\hat{\Delta}x=|\hat{x}-\dot{x}|$ *versus* Δ and compare with the criterion value $|x_I-x_{I-1}|$ *versus* Δ.

4. Write a program for solving the equation $f(x)=0$ using the secant methods, as defined on the slide 3-20. Choose the proper starting points x_0 and x_1. Use the inequality $|x_i-x_{i-1}|<\Delta$ as the criterion for terminating the iterations. Find the solution of the equation $f(x)=0$ for $\Delta=10^{-3},10^{-4},\ldots,10^{-16}$. Add the graph of the number of iterations *I versus* Δ to Fig. 1. Plot the graph (Fig. 4) of the actual absolute error of the solution $\hat{\Delta}x=|\hat{x}-\dot{x}|$ *versus* Δ and compare with the criterion value $|x_I-x_{I-1}|$ *versus* Δ.

5. Write a program for solving the equation $f(x)=0$ using the Newton's method, as defined on the slide 3-18. Choose the proper starting point x_0; compute $f'(x)$ analytically. Use the inequality $|x_i-x_{i-1}|<\Delta$ as the criterion for terminating the iterations. Find the solution of the equation $f(x)=0$ for $\Delta=10^{-3},10^{-4},\ldots,10^{-16}$. Add the graph of the number of iterations *I versus* Δ to Fig. 1. Plot the graph (Fig. 5) of the actual absolute error of the solution $\hat{\Delta}x=|\hat{x}-\dot{x}|$ *versus* Δ and compare with the criterion value $|x_I-x_{I-1}|$ *versus* Δ.

6. Examine the impact of the starting points on the relationships presented in Figs. 1–5.