**ENGR 313**

**Dr. Sherine Elbaradei**

**Group Project - Part 1 (Report)**

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**Pseudo-code:**

#1

*Bisection Method:*

*function bisection(f(x)):*

*xl = read lower bound guess*

*xh = read higher bound guess*

*Validate\_the\_existence\_of\_root()*

*x0 = (xl + xh) / 2.0*

*error = ∞*

*iterate while(error > ε):*

*if f(xl)\*f(x0) < 0 :*

*xNew = (xl + x0) / 2.0*

*else:*

*xNew = (x0 + xh) / 2.0*

*endif*

*error = |xNew – x0| / xNew*

*x0 = xNew*

*endloop*

*return xNew*

*endfunction*

*Secant Method:*

*function secant(f(x)):*

*x0 = read lower bound guess*

*x1 = read higher bound guess*

*x1 = nextGuess(f(x), x0, x1)*

*error = ∞*

*iterate while(error > ε):*

*xNew = nextGuess(f(x), x0, x1)*

*error = |xNew – x1| / xNew*

*x0 = x1*

*x1 = xNew*

*endloop*

*return xNew*

*endfunction*

*function nextGuess(f(x), x0, x1):*

*return x1 - f(x1)\*((x1 – x0)/(f(x1) – f(x0)))*

*endfunction*

*False-Position Method:*

*function falsePosition(f(x)):*

*xl = read lower bound guess*

*xh = read higher bound guess*

*Validate\_the\_existence\_of\_root()*

*x0 = nextGuess(f(x), xl, xh)*

*error = ∞*

*iterate while(error > ε):*

*if f(xl) \* f(x0) < 0 :*

*xNew = nextGuess(f(x), xl, x0)*

*else*

*xNew = nextGuess(f(x), x0, xh)*

*endif*

*if f(xl) \* f(xNew) < 0 :*

*xh = xNew*

*else*

*xl = xNew*

*endif*

*error = |xNew – x0| / xNew*

*x0 = xNew*

*endloop*

*return xNew*

*endfunction*

*function nextGuess(f(x), x0, x1):*

*return x1 - f(x1)\*((x1 – x0)/(f(x1) – f(x0)))*

*endfunction*

*Newton-Raphson Method:*

*function newtonRaphson(f(x), f’(x)):*

*x0 = read lower initial guess*

*x0 = nextGuess(f(x), f’(x), x0)*

*error = ∞*

*iterate while(error > ε):*

*xNew = nextGuess(f(x), f’(x), x0)*

*error = |xNew – x0| / xNew*

*x0 = xNew*

*endloop*

*return xNew*

*endfunction*

*function nextGuess(f(x), f’(x), x0):*

*return x0 – f(x0)/f’(x0)*

*endfunction*

#2

*Gauss-Jordan Elimination Method:*

*function gaussJordan(Matrix coefficients)*

*for i: 0 🡪 3:*

*pivot = coefficients[i, i]*

*for j: 0 🡪 3:*

*if j = i:*

*continue*

*factor = -1 \* coefficients[j, i] / pivot*

*coefficients[j] = coefficients[j] + factor \* coefficients[i]*

*endloop*

*endloop*

*return { coefficients[0, 3], coefficients[1, 3], coefficients[2, 3] }*

*endfuncion*

*The Jacobi Method:*

*function jacobi(Equation f0(x, y), Equation f1(x, y), Equation f2(x, y))*

*x0 = x1 = x2 = 0*

*err0 = err1 = err2 = error = ∞*

*iterate while(error > ε):*

*xNew0 = f0(x1, x2)*

*xNew1 = f1(x0, x2)*

*xNew2 = f2(x0, x1)*

*err0 = |xNew0 – x0| / xNew0*

*err1 = |xNew1 – x1| / xNew1*

*err2= |xNew2 – x2| / xNew2*

*error = max(err0, err1, err2)*

*x0 = xNew0*

*x1 = xNew1*

*x2 = xNew2*

*endloop*

*return {x0, x1, x2}*

*endfunction*

**Flowcharts:**

|  |  |
| --- | --- |
| Bisection |  |
| Secant |  |
| False-Position |  |
| Newton-Raphson |  |
| Gauss-Jordan |  |
| The Jacobi |  |

**Computer Programs:**

*C++ files are attached, definitions of variables, functions and procedures are outlined through the comments of the source code.*

*Recommended Initial Guesses:*

*Equation1: [0.4, 0.6]*

*Equation2: [-0.6, -0.4]*

*Equation3: [0.4, 0.6]*

*Equation4: [1, 1.2]*

*Equation5: [0, 0.2]*

**Test Results:**

*Gauss-Jordan Elimination Method:*

*x0 = 0.5, x1 = 8, x2 = -6*

*error = 0%*

*iterations: N/A*

*The Jacobi Method:*

*x0 = 0.500022, x1 = 8.00002, x2 = -6*

*error = 0.00318659%*

*iterations: 10*

**Graphs for Initial Guesses:**

#1

|  |  |
| --- | --- |
| Equation 1 |  |
| Equation 2 |  |
| Equation 3 |  |
| Equation 4 |  |
| Equation 5 |  |

**Solutions using Excel’s goal-seek:**

|  |  |
| --- | --- |
| Equation 1 |  |
| Equation 2 |  |
| Equation 3 |  |
| Equation 4 |  |
| Equation 5 |  |