Math 4363 – Numerical Analysis Fall 2019

Program 2
Due Friday, October 11, 2019

1. Write a function to find a root of $f(x)$ using the bisection method. Call this routine bisect and call the file bisect.m; its first line should be

   ```
   function [l,r,nf] = bisect(fname,a,b,tol)
   ```

   fname is the name of the m-file which evaluates the function $f(x)$, a and b are the endpoints of an interval $[a, b]$ that brackets a root (say x^*) and tol is an upper bound on length of the final interval [l,r] which also brackets x^*. Also return nf, the total number of function evaluations (of $fname$) executed.

2. Write a function to find a root of $f(x)$ using the secant method. Call this routine secant, call the file secant.m; its first line should be

   ```
   function [x,nf] = secant(fname,x0,x1,tol)
   ```

   fname is the name of the m-file which evaluates the function $f(x)$, x_0 and x_1 are initial approximations to x^*, and tol is a stopping tolerance. Your code should return an approximation $x = x_{k+1}$ to x^* so that $|x_{k+1} - x_k| < tol$, or a report of failure. Also, return nf, the total number of function evaluations (of $fname$) executed.

3. Write a function fofx.m that evaluates $f(x) = \cos(x) - \sin(x)$. The first line of fofx.m should be something like

   ```
   function y = fofx(x)
   ```

4. I will email you NAProg2Test.m that tests your subroutines.

Notes:

1. The body of fofx.m can be as simple as

   ```
   function y = fofx(x)
   y = cos(x) - sin(x);
   ```

2. Make sure your code is documented (all input and output variables unambiguously defined in the "help-block comments".

3. Try to avoid overflow, but don't be too zealous: dividing by something tiny is ok if the numerator is also tiny...

4. Don't return junk unless it is accompanied by a message (nf can double as an error flag).

5. Beware the infinite loop...

6. My test is very mild. It is easy to break the secant method (even with $f(x) = \cos(x) - \sin(x)$). You might play with your code to see how it behaves with different starting points.