Computer Science 3731/6906 **Fall 2018**

Assignment 3

Date due: October 3 (in class) See Assignment 2 for instructions for electronic submission.

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1. Write a real Fortran function *Series(x)* which returns an approximate sum of the sequence

$$\frac{x}{1!} - \frac{x^2}{2!} + \frac{x^3}{3!} - \frac{x^4}{4!} + \cdots$$

   i.e., which adds consecutive elements of this sequence until the addition of another term does not change the value of the sum.

   Write also a Fortran program which reads consecutive values x and uses the function *Series* to find the approximate sum for each of these values. Assume that the value 0 indicates the end of data.

2. The secant method of finding a root of a continuous function $f(x)$ (i.e., solving the equation $f(x) = 0$) uses two initial values a and b which are "close" to the solution. In each iteration step an approximation x to the solution is determined by the straight line (the secant line) defined by the points $(a, f(a))$ and $(b, f(b))$, so:

$$x = b - (b - a)\frac{f(b)}{f(b) - f(a)}$$

   The iteration continues using the most recent approximation x and b as the pair for the next iteration, so actually:

$$x_i = x_{i-1} - (x_{i-1} - x_{i-2})\frac{f(x_{i-1})}{f(x_{i-1}) - f(x_{i-2})}$$

   where $x_0 = b$ and $x_{-1} = a$. The iteration ends when two consecutive approximations are sufficiently close (i.e., when they differ by less than a small value ε).

   Write a Fortran function $Secant(a, b, eps, limit, iter)$ which finds the root of a function $fun(x)$ using the secant method. *limit* is the limit on the number of iteration steps - the secant method can be non-convergent, especially when the initial values a and b are not close to the solution. *iter* returns the number of iterations used for finding the solution. Use several values of a and b to see how these values affect the required number of iterations.