SOFTWARE ENGINEERING
Programming Assignment 7 (20 points)
Math 248 Computers and Numerical Algorithms
Fall 2008–Pruett

DATE ASSIGNED: Monday, 17 November, 2008. **DATE DUE:** Wednesday, 3 December, 2008.

BACKGROUND: As discussed in class, computers and calculators do not actually evaluate trigonometric, exponential, or logarithmic functions. Rather, when these *intrinsic functions* are called, the computer actually calls a subprogram to evaluate a polynomial (or rational polynomial expression) that closely approximates the desired function on some interval. (Recall that polynomials are easily and efficiently evaluated by Algorithm 1.1 or its variants, e.g., Alg. 7.1.)

Now let's suppose that you and your partner are software engineers who are responsible for designing the *intrinsic* subprograms for a new version of Fortran 90. The *accuracy* and *efficiency* of these subprograms are of paramount importance to the company and to you (otherwise, someone else might soon have your job).

ASSIGNMENT (C-level): Write a MODULE named *my_functions* containing a FUNCTION named *my_cos(x)* that meets or exceeds each of the following design constraints:

1. Function *my_cos*(x) evaluates $\cos(x)$ for x in radians on the interval $[-\pi/4, \pi/4]$.
2. Function *my_cos*(x) CANNOT use the existing intrinsic function $\cos(x)$ or any other existing Fortran 90 intrinsic functions.
3. Function *my_cos*(x) should return a value that is correct to machine single precision on a PC. (For the **B-level assignment**, you should include as comments appended to the module an error analysis to support the proclaimed accuracy of your new intrinsic function.)
4. Function *my_cos*(x) should use as few operations as possible.
5. Function *my_cos*(x) should be well-structured and carefully and clearly documented.
6. I have written a "driver" program named *pa7driver.f90*, which is located on Blackboard under ASSIGNMENTS. This program, exactly as you find it, will be used to test your module.

ASSIGNMENT (A-level): In addition to the B-level assignment, in comments appended to your MODULE, discuss how you might modify *my_cos* so that it could compute $\cos(x)$ for *any* value of x. HINTS: 1) use the periodicity of the cosine function to shift arbitrary values of x onto the interval $[-\pi, \pi]$. 2) What else might you do to transform the interval to $[-\pi/2, \pi/2]$?

SPECIAL CONSIDERATION: The team with the fastest algorithm that meets or beats the specs will receive the prestigious **Math 248 Top-Bit Programmer's Award**.

This is a team assignment *to be completed by teams of 2 persons only. As always, you are allowed to discuss programming issues with other students, but the actual coding of your program should be accomplished individually (or with your teammate), and your team's program should be unique.*