Math 248 Computers and Numerical Algorithms–Pruett

LABORATORY ASSIGNMENT
One-Dimensional Arrays (Vectors)

Consider the vectors $\vec{a} = [1,2,3,4,5,6,7,8]$ and $\vec{b} = [1,-1,2,-2,3,-3,4,-4]$.

C______ Write a Fortran 90 program **VECTOR1** that declares $\vec{a}$ as a 1-D REAL array of length 8. Initialize the array using array constants. Print out the components of the array in the normal order.

C______ Write a Fortran 90 program **VECTOR2** that declares $\vec{b}$ as a 1-D REAL array of length 8. Initialize the array using a READ loop, reading in the normal order. Print out the components of the array in *reverse* order.

B______ Write a Fortran 90 MODULE named **VECTOR_LIBRARY** that contains a single FUNCTION subprogram **SUMMATION**, which returns the sum of the elements of a 1-D array given the array and its length n. Compile the MODULE.

B______ Write a Fortran 90 program that calls **FUNCTION SUMMATION** to sum the elements of vector $\vec{a}$ above. Initialize $\vec{a}$ using an implied DO loop in the main program.

B______ Add another FUNCTION subprogram **AVERAGE** to your MODULE that computes the average of n real values. Use it to compute the average value of the vector $\vec{b}$. Hint: copy, paste, and modify your previous subprogram.

A______ The *dot product* or *inner product* of two n vectors $\vec{a}$ and $\vec{b}$ is defined as

$$\vec{a} \cdot \vec{b} = \sum_{i=1}^{n} a_i b_i$$

Write a FUNCTION subprogram named **INNER_PRODUCT** that returns the dot product of two n-vectors, given the vectors and their length n. Encapsulate **INNER_PRODUCT** in the same MODULE you wrote above. (Don't forget to recompile.) Write a simple program to test your inner_product subprogram on the vectors $\vec{a}$ and $\vec{b}$ above. Use any method you want to initialize the vectors. (NOTE: Fortran 90 provides an intrinsic function **DOT_PRODUCT**, which accomplishes the same task as **INNER_PRODUCT**. You may want to compare results if you have time.)

A+______ The *length* or *norm* of a vector, denoted $|\vec{a}|$, is defined

$$|\vec{a}| = \sqrt{\vec{a} \cdot \vec{a}}$$

Add one more subprogram **VECTOR_NORM** to your MODULE to compute the norm of a vector. Test it using vector $\vec{b}$. HINT: Save yourself effort by having **VECTOR_NORM** make use of **INNER_PRODUCT**.