Subject: Further extension to DOT_PRODUCT
From: Van Snyder

1 Introduction

I occasionally need to compute (/ (SUM(A(I,:)*B(I,:), I = 1,N) /) and similarly for more factors. To avoid an array temp if this is just the RHS of an assignment statement, or the need to write a loop, an additional DOT_PRODUCT would be useful.

2 Requirement

Provide syntactic sugar that allows to compute several inner products all at once.

3 Detailed specification

Provide another DOT_PRODUCT function that has a DIMS argument and an indefinite number, but at least two, of further arguments A1, A2, ... The DIMS argument is a rank-one integer array that specifies the dimension of each of the other arrays over which the summation takes place. In the case the A_n arguments are rank-two numeric arguments having the same shape, DOT_PRODUCT((/1,1/), A1, A2) computes (/ (SUM(A1(I,:)*A2(I,:), I = 1, n) /), with an obvious generalization for different values of DIMS, different ranks, and more arguments. In the case of logical arguments, * is replaced by .AND. and SUM is replaced by ANY.

4 Syntax

No new syntax, and no changes to existing syntax.

5 Edits

Edits refer to 04-007. Page and line numbers are displayed in the margin. Absent other instructions, a page and line number or line number range implies all of the indicated text is to be replaced by associated text, while a page and line number followed by + (-) indicates that associated text is to be inserted after (before) the indicated line. Remarks are noted in the margin, or appear between [and] in the text.

DOT_PRODUCT (DIMS, A1, A2, ...) Multiple dot products of arrays with rank higher than one. 297:2+

13.7.32½ DOT_PRODUCT (DIMS, A1, A2 [, A3, ...]) 314:1+

Description. Compute a generalization of multiple dot products of numric or logical arrays.

Class. Transformational function.

Arguments.

DIMS	Shall be a rank-one integer array with extent one less than the total number of arguments of DOT_PRODUCT.
A1	Shall be of numeric type (integer, real or complex) or of logical type.
A2	Shall be of numeric type if A1 is of numeric type and of logical type otherwise.
A3 ... (optional)	Shall be of numeric type if A1 is of numeric type and of logical type otherwise. There shall not be more than three arguments if A1 is of complex type.

None of the arguments shall be a scalar. At least one of A1, A2, ... shall have rank greater than one. The value of DIMS(i) shall satisfy the inequality $1 \leq$ DIMS(i) $\leq$ Rank of A_i. The DIMS(i) dimensions of A_i shall all have the same extents. The arrays that result by suppressing the DIMS(i) dimensions of A_i that are not rank-one arrays shall all have the same shapes.

Result Characteristics. If the arguments are of numeric type, the type and kind type parameter of the result are those of the expression E1 * E2 * ..., where E1, E2, ... are scalars of

the same type and kind type parameters as A1, A2, ..., respectively, according to 7.1.4.2. If the arguments are of logical type, the type of the result is logical and the kind type parameter of the result is that of E1 .AND. E2 .AND. ..., where E1, E2, ... are logical scalars of the same kind type parameters as A1, A2, ..., respectively, according to 7.1.4.2. The shape of the result is the shape of the array that results by suppressing dimension DIMS(i) of A_i, where A_i is an argument having rank greater than one.

Result Value.

Case (i): If A1 is of real or integer type the $(i_1, i_2, \ldots i_k)$ element of the result has the value SUM(A1(i_1, ..., $i_{\mathrm{DIMS}(1)-1}$, :, $i_{\mathrm{DIMS}(1)+1}$, ..., i_k) * A2(i_1, ..., $i_{\mathrm{DIMS}(2)-1}$, :, $i_{\mathrm{DIMS}(2)+1}$, i_k) * ...), where the $(i_1, i_2, \ldots i_k)$ subscripts are suppressed for arguments of rank one.

Case (ii): If A1 is of complex type the $(i_1, i_2, \ldots i_k)$ element of the result has the value SUM(CONJG(A1(i_1, ..., $i_{\mathrm{DIMS}(1)-1}$, :, $i_{\mathrm{DIMS}(1)+1}$, ..., i_k)) * A2(i_1, ..., $i_{\mathrm{DIMS}(2)-1}$, :, $i_{\mathrm{DIMS}(2)+1}$, i_k)), where the $(i_1, i_2, \ldots i_k)$ subscripts are suppressed for arguments of rank one..

Case (iii): If A1 is of logical type the $(i_1, i_2, \ldots i_k)$ element of the result has the value ANY(A1(i_1, ..., $i_{\mathrm{DIMS}(1)-1}$, :, $i_{\mathrm{DIMS}(1)+1}$, ..., i_k) .AND. A2(i_1, ..., $i_{\mathrm{DIMS}(2)-1}$, :, $i_{\mathrm{DIMS}(2)+1}$, i_k) .AND. ...), where the $(i_1, i_2, \ldots i_k)$ subscripts are suppressed for arguments of rank one.

Example. Let A1 be the array $\begin{bmatrix} A & B & C \\ D & E & F \end{bmatrix}$, A2 be the array $\begin{bmatrix} G & H & J \end{bmatrix}$, and A3 be the array $\begin{bmatrix} K & L \\ M & N \\ P & Q \end{bmatrix}$. Then DOT_PRODUCT ((/ 2, 1, 1 /), A1, A2, A3) has the value [A*G*K + B*H*M + C*J*P, D*G*L + E*H*N + F*J*Q].