MXDIPR	CERN Program Library	F150

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Submitter : **Submitted:** 15.09.1978
Language : Fortran **Revised:**

Direct or Tensor Matrix Product

Subroutine subprogram `MXDIPR` computes the direct (sometimes called tensor, or Kronecker) product $\mathbf{C} = \mathbf{A} \times \mathbf{B}$ of two matrices **A** and **B**. Let $\mathbf{A} = (a_{ik})$, $(i = 1, 2, \ldots, I; k = 1, 2, \ldots K)$; $\mathbf{B} = (b_{jl})$, $(j = 1, 2, \ldots, J; l = 1, 2, \ldots, L)$; then $\mathbf{C} = (c_{ij;kl})$ with $c_{ij;kl} = a_{ik}b_{jl}$. **C** has $I \times J$ rows and $K \times L$ columns. If, in particular, **A** and **B** are square matrices, **C** is also square.

Structure:

`SUBROUTINE` subprogram
User Entry Names: `MXDIPR`

Usage:

```
CALL MXDIPR(A,B,C,IAD,JBD,IJD,IA,KA,JB,LB)
```

`A,B`	(`REAL`) Matrices `A` and `B`.
`C`	(`REAL`) On exit, `C` contains the direct product $\mathbf{A} \times \mathbf{B}$.
`IAD`	(`INTEGER`) First dimension of `A`.
`JBD`	(`INTEGER`) First dimension of `B`.
`IJD`	(`INTEGER`) First dimension of `C`.
`IA,KA`	(`INTEGER`) Number of rows, columns of **A**.
`JB,LB`	(`INTEGER`) Number of rows, columns of **B**.

Restrictions:

`A`, `B`, `C` must not overlap.

Error handling:

If `IA` or `KA` or `JB` or `LB` are equal to zero, the subprogram acts as do-nothing.

Examples:

```
DIMENSION A(2,2),B(2,2),C(4,4)
...
CALL MXDIPR(A,B,C,2,2,4,2,2,2,2)
```

assuming

$$\mathbf{A} = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \qquad \mathbf{B} = \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix},$$

would set

$$\mathbf{C} = \begin{pmatrix} a_{11}b_{11} & a_{11}b_{12} & a_{12}b_{11} & a_{12}b_{12} \\ a_{11}b_{21} & a_{11}b_{22} & a_{12}b_{21} & a_{12}b_{22} \\ a_{21}b_{11} & a_{21}b_{12} & a_{22}b_{11} & a_{22}b_{12} \\ a_{21}b_{21} & a_{21}b_{22} & a_{22}b_{21} & a_{22}b_{22} \end{pmatrix} = \begin{pmatrix} c_{11;11} & c_{11;12} & c_{11;21} & c_{11;22} \\ c_{12;11} & c_{12;12} & c_{12;21} & c_{12;22} \\ c_{21;11} & c_{21;12} & c_{21;21} & c_{21;22} \\ c_{22;11} & c_{22;12} & c_{22;21} & c_{22;22} \end{pmatrix}.$$

References:

1. E.P. Wigner, Group Theory, (Academic Press, New York 1959) 17
2. W.I. Smirnow, Lehrgang der höheren Mathematik, Vol. III.1, (Deutscher Verlag der Wissenschaften, Berlin 1954) 221

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