

NAG Library Function Document

nag_dtptr (f01vcc)

1 Purpose

nag_dtptr (f01vcc) unpacks a real triangular matrix, stored in a standard packed format array, to a full format array.

2 Specification

```
#include <nag.h>
#include <nagf01.h>

void nag_dtptr (Nag_OrderType order, Nag_UploType uplo, Integer n,
               const double ap[], double a[], Integer pda, NagError *fail)
```

3 Description

nag_dtptr (f01vcc) unpacks a real n by n triangular matrix A , stored in an array of length $n(n+1)/2$, to conventional storage in a full format array. This function is intended for possible use in conjunction with functions from Chapters f06, f07, f08 and f16 where some functions use triangular matrices stored in the packed form. Packed storage format is described in Section 3.3.2 in the f07 Chapter Introduction.

4 References

None.

5 Arguments

- 1: **order** – Nag_OrderType *Input*
On entry: the **order** argument specifies the two-dimensional storage scheme being used, i.e., row-major ordering or column-major ordering. C language defined storage is specified by **order** = Nag_RowMajor. See Section 2.3.1.3 in How to Use the NAG Library and its Documentation for a more detailed explanation of the use of this argument.
Constraint: **order** = Nag_RowMajor or Nag_ColMajor.
- 2: **uplo** – Nag_UploType *Input*
On entry: specifies whether A is upper or lower triangular.
uplo = Nag_Upper
 A is upper triangular.
uplo = Nag_Lower
 A is lower triangular.
Constraint: **uplo** = Nag_Upper or Nag_Lower.
- 3: **n** – Integer *Input*
On entry: n , the order of the matrix A .
Constraint: **n** ≥ 0 .
- 4: **ap**[*dim*] – const double *Input*
Note: the dimension, *dim*, of the array **ap** must be at least $\mathbf{n} \times (\mathbf{n} + 1)/2$.

On entry: the n by n triangular matrix A , packed by rows or columns depending on **order**.

The storage of elements A_{ij} depends on the **order** and **uplo** arguments as follows:

if **order** = Nag_ColMajor and **uplo** = Nag_Upper,
 A_{ij} is stored in **ap** $[(j-1) \times j/2 + i - 1]$, for $i \leq j$;
 if **order** = Nag_ColMajor and **uplo** = Nag_Lower,
 A_{ij} is stored in **ap** $[(2n-j) \times (j-1)/2 + i - 1]$, for $i \geq j$;
 if **order** = Nag_RowMajor and **uplo** = Nag_Upper,
 A_{ij} is stored in **ap** $[(2n-i) \times (i-1)/2 + j - 1]$, for $i \leq j$;
 if **order** = Nag_RowMajor and **uplo** = Nag_Lower,
 A_{ij} is stored in **ap** $[(i-1) \times i/2 + j - 1]$, for $i \geq j$.

5: **a** $[dim]$ – double

Output

Note: the dimension, dim , of the array **a** must be at least **pda** \times **n**.

On exit: the triangular matrix A .

If **order** = Nag_ColMajor, A_{ij} is stored in **a** $[(j-1) \times \mathbf{pda} + i - 1]$.

If **order** = Nag_RowMajor, A_{ij} is stored in **a** $[(i-1) \times \mathbf{pda} + j - 1]$.

If **uplo** = Nag_Upper, A is upper triangular and the elements of the array below the diagonal are not set.

If **uplo** = Nag_Lower, A is lower triangular and the elements of the array above the diagonal are not set.

6: **pda** – Integer

Input

On entry: the stride separating row or column elements (depending on the value of **order**) of the matrix A in the array **a**.

Constraint: **pda** $\geq \max(1, \mathbf{n})$.

7: **fail** – NagError *

Input/Output

The NAG error argument (see Section 2.7 in How to Use the NAG Library and its Documentation).

6 Error Indicators and Warnings

NE_ALLOC_FAIL

Dynamic memory allocation failed.

See Section 2.3.1.2 in How to Use the NAG Library and its Documentation for further information.

NE_BAD_PARAM

On entry, argument $\langle value \rangle$ had an illegal value.

NE_INT

On entry, **n** = $\langle value \rangle$.

Constraint: **n** ≥ 0 .

NE_INT_2

On entry, **pda** = $\langle value \rangle$ and **n** = $\langle value \rangle$.

Constraint: **pda** $\geq \max(1, \mathbf{n})$.

NE_INTERNAL_ERROR

An internal error has occurred in this function. Check the function call and any array sizes. If the call is correct then please contact NAG for assistance.

An unexpected error has been triggered by this function. Please contact NAG.

See Section 2.7.6 in How to Use the NAG Library and its Documentation for further information.

NE_NO_LICENCE

Your licence key may have expired or may not have been installed correctly.

See Section 2.7.5 in How to Use the NAG Library and its Documentation for further information.

7 Accuracy

Not applicable.

8 Parallelism and Performance

nag_dtptr (f01vcc) is not threaded in any implementation.

9 Further Comments

None.

10 Example

This example reads in a triangular matrix packed by columns and unpacks it to full format.

10.1 Program Text

```
/* nag_dtptr (f01vcc) Example Program.
 *
 * NAGPRODCODE Version.
 *
 * Copyright 2016 Numerical Algorithms Group.
 *
 * Mark 26, 2016.
 */

#include <stdio.h>
#include <nag.h>
#include <nag_stdlib.h>
#include <nagf01.h>
#include <nagx04.h>

int main(void)
{
    /* Scalars */
    Integer exit_status = 0, indent = 0, ncols = 80, i, j, pda;
    Integer lenap, n;
    /* Arrays */
    double *a = 0, *ap = 0;
    char nag_enum_arg[40], form[] = "%5.2f";
    /* Nag Types */
    Nag_OrderType order;
    Nag_UploType uplo;
    Nag_MatrixType matrix;
    NagError fail;

#ifdef NAG_COLUMN_MAJOR
    order = Nag_ColMajor;
#define KU(I,J) (I + J*(J+1)/2)
#define KL(I,J) (J*(n-1) - J*(J-1)/2 + I)
#else
```

```

    order = Nag_RowMajor;
#define KL(I,J) (J + I*(I+1)/2)
#define KU(I,J) (I*(n-1) - I*(I-1)/2 + J)
#endif

    INIT_FAIL(fail);

    printf("nag_dtptr (f01vcc) Example Program Results\n\n");
    /* Skip heading in data file */
#ifdef _WIN32
    scanf_s("%*[\n] ");
    scanf_s("%" NAG_IFMT "%*[\n] ", &n);
    scanf_s("%39s  %*[\n] ", nag_enum_arg, (unsigned)_countof(nag_enum_arg));
#else
    scanf("%*[\n] ");
    scanf("%" NAG_IFMT "%*[\n] ", &n);
    scanf("%39s  %*[\n] ", nag_enum_arg);
#endif
    pda = n;
    lenap = (n * (n + 1)) / 2;
    if (!(a = NAG_ALLOC(pda * n, double)) || !(ap = NAG_ALLOC(lenap, double)))
    {
        printf("Allocation failure\n");
        exit_status = -1;
        goto END;
    }
    uplo = (Nag_UploType) nag_enum_name_to_value(nag_enum_arg);

    /* Read the packed vector ap using macros KL or KU. */
    for (i = 0; i < n; i++) {
        if (uplo == Nag_Upper) {
#ifdef _WIN32
            for (j = i; j < n; j++)
                scanf_s("%lf ", &ap[KU(i, j)]);
#else
            for (j = i; j < n; j++)
                scanf("%lf ", &ap[KU(i, j)]);
#endif
        }
        else {
#ifdef _WIN32
            for (j = 0; j <= i; j++)
                scanf_s("%lf ", &ap[KL(i, j)]);
#else
            for (j = 0; j <= i; j++)
                scanf("%lf ", &ap[KL(i, j)]);
#endif
        }
    }

    /* Print the packed vector using macros KL or KU. */
    printf(" Packed Array AP (printed using KL/KU macros):\n\n");
    for (i = 0; i < n; i++) {
        printf(" ");
        if (uplo == Nag_Upper) {
            for (j = 0; j < i; j++)
                printf("%6s", " ");
            for (j = i; j < n; j++)
                printf("%6.2f", ap[KU(i, j)]);
        }
        else {
            for (j = 0; j <= i; j++)
                printf("%6.2f", ap[KL(i, j)]);
        }
        printf("\n");
    }

    /* Convert to triangular matrix from packed vector to full form using
    * nag_dtptr (f01vcc).
    */
    nag_dtptr(order, uplo, n, ap, a, pda, &fail);

```

```

if (fail.code != NE_NOERROR) {
    printf("Error from nag_dtptr (f01vcc).\n%s\n", fail.message);
    exit_status = 1;
    goto END;
}

/* Print the unpacked matrix. */
matrix = (uplo == Nag_Upper ? Nag_UpperMatrix : Nag_LowerMatrix);

/* nag_gen_real_mat_print_comp (x04cbc).
 * Print real general matrix (comprehensive).
 */
fflush(stdout);
nag_gen_real_mat_print_comp(order, matrix, Nag_NonUnitDiag, n, n, a, pda,
                             form, "Unpacked Matrix A:", Nag_IntegerLabels,
                             NULL, Nag_IntegerLabels, NULL, ncols, indent,
                             NULL, &fail);
if (fail.code != NE_NOERROR) {
    printf("Error from nag_gen_real_mat_print_comp (x04cbc).\n%s\n",
          fail.message);
    exit_status = 1;
}

END:
    NAG_FREE(a);
    NAG_FREE(ap);
    return exit_status;
}

```

10.2 Program Data

```

nag_dtptr (f01vcc) Example Program Data
4                : n
Nag_Upper        : uplo
1.1  1.2  1.3  1.4
      2.2  2.3  2.4
          3.3  3.4
              4.4      : ap[]

```

10.3 Program Results

nag_dtptr (f01vcc) Example Program Results

Packed Array AP (printed using KL/KU macros):

```

1.10  1.20  1.30  1.40
      2.20  2.30  2.40
          3.30  3.40
              4.40

```

```

Unpacked Matrix A:
      1      2      3      4
1  1.10  1.20  1.30  1.40
2      2.20  2.30  2.40
3          3.30  3.40
4              4.40

```
