

NAG Library Function Document

nag_double_sort (m01cac)

1 Purpose

nag_double_sort (m01cac) rearranges a vector of real numbers into ascending or descending order.

2 Specification

```
#include <nag.h>
#include <nagm01.h>

void nag_double_sort (double vec[], size_t n, Nag_SortOrder order,
                     NagError *fail)
```

3 Description

nag_double_sort (m01cac) is based on Singleton's implementation of the 'median-of-three' Quicksort algorithm, see Singleton (1969), but with two additional modifications. First, small subfiles are sorted by an insertion sort on a separate final pass, see Sedgewick (1978). Second, if a subfile is partitioned into two very unbalanced subfiles, the larger of them is flagged for special treatment: before it is partitioned, its end-points are swapped with two random points within it; this makes the worst case behaviour extremely unlikely.

4 References

Maclaren N M (1985) *Comput. J.* **28** 448

Sedgewick R (1978) Implementing Quicksort programs *Comm. ACM* **21** 847–857

Singleton R C (1969) An efficient algorithm for sorting with minimal storage: Algorithm 347 *Comm. ACM* **12** 185–187

5 Arguments

- 1: **vec[n]** – double *Input/Output*
On entry: elements of **vec** must contain real values to be sorted.
On exit: these values are rearranged into sorted order.
- 2: **n** – size_t *Input*
On entry: the length of **vec**.
Constraint: $1 \leq n \leq \text{MAX_LENGTH}$, where MAX_LENGTH is an implementation-dependent value for the maximum size of an array.
- 3: **order** – Nag_SortOrder *Input*
On entry: specifies whether the array will be sorted into ascending or descending order.
Constraint: **order** = Nag_Ascending or Nag_Descending.
- 4: **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_BAD_PARAM

On entry, **order** had an illegal value.

NE_INT_ARG_GT

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

Constraint: **n** $\leq \langle value \rangle$, an implementation-dependent size that is printed in the error message.

NE_INT_ARG_LT

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

Constraint: **n** ≥ 1 .

7 Accuracy

Not applicable.

8 Parallelism and Performance

nag_double_sort (m01cac) is not threaded in any implementation.

9 Further Comments

The average time taken by the function is approximately proportional to $n \log(n)$. The worst case time is proportional to n^2 but this is extremely unlikely to occur.

10 Example

The example program reads a list of real numbers and sorts them into ascending order.

10.1 Program Text

```
/* nag_double_sort (m01cac) Example Program.
 *
 * NAGPRODCODE Version.
 *
 * Copyright 2016 Numerical Algorithms Group.
 *
 * Mark 26, 2016.
 */

#include <nag.h>
#include <stdio.h>
#include <nag_stdlib.h>
#include <nag_stddef.h>
#include <nagm01.h>

int main(void)
{
    Integer exit_status = 0, i, n;
    NagError fail;
    double *vec = 0;

    INIT_FAIL(fail);

    /* Skip heading in data file */
#ifdef _WIN32
    scanf_s("%*[^\\n]");
#else
    scanf("%*[^\\n]");
#endif
    #endif
```

```

    printf("nag_double_sort (m01cac) Example Program Results\n");
#ifdef _WIN32
    scanf_s("%" NAG_IFMT "", &n);
#else
    scanf("%" NAG_IFMT "", &n);
#endif
    if (n >= 1) {
        if (!(vec = NAG_ALLOC(n, double)))
        {
            printf("Allocation failure\n");
            exit_status = -1;
            goto END;
        }
    }
    else {
        printf("Invalid n.\n");
        exit_status = 1;
        return exit_status;
    }
    for (i = 0; i < n; ++i)
#ifdef _WIN32
        scanf_s("%lf", &vec[i]);
#else
        scanf("%lf", &vec[i]);
#endif
    /* nag_double_sort (m01cac).
     * Quicksort of set of values of data type double
     */
    nag_double_sort(vec, (size_t) n, Nag_Ascending, &fail);
    if (fail.code != NE_NOERROR) {
        printf("Error from nag_double_sort (m01cac).\n%s\n", fail.message);
        exit_status = 1;
        goto END;
    }
    printf("Sorted numbers\n\n");
    for (i = 0; i < n; ++i)
        printf("%10.6g%c", vec[i], (i % 7 == 6 || i == n - 1) ? '\n' : ' ');
END:
    NAG_FREE(vec);
    return exit_status;
}

```

10.2 Program Data

```

nag_double_sort (m01cac) Example Program Data
16
1.3 5.9 4.1 2.3 0.5 5.8 1.3 6.5
2.3 0.5 6.5 9.9 2.1 1.1 1.2 8.6

```

10.3 Program Results

```

nag_double_sort (m01cac) Example Program Results
Sorted numbers

```

0.5	0.5	1.1	1.2	1.3	1.3	2.1
2.3	2.3	4.1	5.8	5.9	6.5	6.5
8.6	9.9					
