

NAG Library Function Document

nag_search_vector (m01fsc)

1 Purpose

nag_search_vector (m01fsc) searches a vector of arbitrary type data objects for the first or last match to a given value.

2 Specification

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

Nag_Boolean nag_search_vector (Pointer key, const Pointer vec, size_t n,
                               ptrdiff_t stride,
                               Integer (*compare)(const Nag_Pointer a, const Nag_Pointer b),
                               Nag_SortOrder order, Nag_SearchMatch final, Pointer *match,
                               NagError *fail)
```

3 Description

nag_search_vector (m01fsc) searches a sorted vector of n arbitrary type data objects, which are stored in the elements of an array at intervals of length **stride**. **vec** must have previously been sorted into the specified order.

The function searches for the first or last match depending on the value of **final**. It returns Nag_TRUE if an exact match is found and **match** is set to point at that object. If there is no exact match then Nag_FALSE is returned and **match** is set to point to either the next later element, if **final** = Nag_First, or the next earlier element, if **final** = Nag_Last.

4 References

None.

5 Arguments

- | | | |
|----|---|--------------|
| 1: | key – Pointer | <i>Input</i> |
| | <i>On entry:</i> the object to search for. | |
| 2: | vec[n] – const Pointer | <i>Input</i> |
| | <i>On entry:</i> the array of objects to be searched. | |
| 3: | n – size_t | <i>Input</i> |
| | <i>On entry:</i> the number n of objects to be searched. | |
| | <i>Constraint:</i> $0 \leq n \leq \text{MAX_LENGTH}$, where MAX_LENGTH is an implementation-dependent value for the maximum size of an array. | |
| 4: | stride – ptrdiff_t | <i>Input</i> |
| | <i>On entry:</i> the increment between data items in vec to be searched. | |

Note: if **stride** is positive, **vec** should point at the first data object; otherwise **vec** should point at the last data object.

Constraint: $0 < |\mathbf{stride}| \leq p$, where p is an implementation-dependent value for the maximum size_t size on the system, divided by n if n is positive.

- 5: **compare** – function, supplied by the user *External Function*

nag_search_vector (m01fsc) compares two data objects. If its arguments are pointers to a structure, this function must allow for the offset of the data field in the structure (if it is not the first).

The function must return:

- 1 if the first data field is less than the second,
- 0 if the first data field is equal to the second,
- 1 if the first data field is greater than the second.

The specification of **compare** is:

Integer compare (const Nag_Pointer a, const Nag_Pointer b)

- | | | |
|----|---|--------------|
| 1: | a – const Nag_Pointer | <i>Input</i> |
| | <i>On entry:</i> the first data field. | |
| 2: | b – const Nag_Pointer | <i>Input</i> |
| | <i>On entry:</i> the second data field. | |

- 6: **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.

- 7: **final** – Nag_SearchMatch *Input*

On entry: specifies whether to search for the first or last match. This also determines the pointer returned if an exact match cannot be found.

Constraint: **final** = Nag_First or Nag_Last.

- 8: **match** – Pointer * *Output*

On exit: if an exact match is found this is a pointer to a pointer to the matching data object. If an exact match is not found this is set to point to the nearest object. If **final** = Nag_First this is the next later element, otherwise the next earlier element.

- 9: **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, argument **final** had an illegal value.

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

NE_INT_ARG_EQ

On entry, **stride** = $\langle value \rangle$.
 Constraint: **stride** $\neq 0$.

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.
 On entry, **stride** = $\langle value \rangle$.
 Constraint: $|\mathbf{stride}| \leq \langle value \rangle$, an implementation-dependent size that is printed in the error message.

NE_INT_ARG_LT

On entry, **n** = $\langle value \rangle$.
 Constraint: **n** ≥ 0 .

7 Accuracy

Not applicable.

8 Parallelism and Performance

nag_search_vector (m01fsc) is not threaded in any implementation.

9 Further Comments

The maximum time taken by the function is approximately proportional to $\log_2 n$.

10 Example

The example program reads a key and a list of real numbers, which have been sorted into ascending order. It then searches the list for the first number which matches the key.

10.1 Program Text

```
/* nag_search_vector (m01fsc) 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>

#ifdef __cplusplus
extern "C"
{
#endif
    static Integer NAG_CALL compare(const Nag_Pointer a, const Nag_Pointer b);
#ifdef __cplusplus
}
#endif

int main(void)
{
```

```

Integer exit_status = 0;
NagError fail;
Pointer match;
double key, *vec = 0;
size_t i, n;

INIT_FAIL(fail);

/* Skip heading in data file */
#ifdef _WIN32
    scanf_s("%*[^\\n]");
#else
    scanf("%*[^\\n]");
#endif
printf("nag_search_vector (m01fsc) Example Program Results\\n");
/* Read number of points and number to search for */
#ifdef _WIN32
    scanf_s("%" NAG_UFMT "%lf", &n, &key);
#else
    scanf("%" NAG_UFMT "%lf", &n, &key);
#endif
if (n >= 1) {
    if (!(vec = NAG_ALLOC(50, 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_search_vector (m01fsc).
 * Searches a vector for either the first or last match to a
 * given value
 */
if (nag_search_vector((Pointer) &key, (Pointer) vec, n,
                      (ptrdiff_t) (sizeof(double)), compare, Nag_Ascending,
                      Nag_First, &match, &fail)) {
    printf("Exact match found: ");
    if (fail.code != NE_NOERROR) {
        printf("Error from nag_search_vector (m01fsc).\\n%s\\n", fail.message);
        exit_status = 1;
        goto END;
    }
    printf("First match index: %" NAG_UFMT "\\n",
           (size_t) ((double *) match - vec));
}
else {
    printf("No exact match found: ");
    if (match != NULL)
        printf("Nag_First nearest match index = %" NAG_UFMT "\\n",
               (size_t) ((double *) match - vec));
    else
        printf("No match in the input array\\n");
}
END:
    NAG_FREE(vec);
    return exit_status;
}

static Integer NAG_CALL compare(const Nag_Pointer a, const Nag_Pointer b)

```

```
{  
  double x = *((const double *) a);  
  double y = *((const double *) b);  
  return (x < y ? -1 : (x == y ? 0 : 1));  
}
```

10.2 Program Data

```
nag_search_vector (m01fsc) Example Program Data  
20  
2.3  
0.5 0.5 1.1 1.2 1.2 1.2 1.3 2.1 2.3 2.3  
2.3 2.3 4.1 5.8 5.9 6.3 6.5 6.5 8.6 9.9
```

10.3 Program Results

```
nag_search_vector (m01fsc) Example Program Results  
Exact match found: First match index: 8
```
