



### ***Rocky Enterprise Linux 9.2 Manual Pages on command 'LIST\_EMPTY.3'***

**\$ man LIST\_EMPTY.3**

LIST(3)                      Linux Programmer's Manual                      LIST(3)

#### NAME

LIST\_EMPTY, LIST\_ENTRY, LIST\_FIRST, LIST\_FOREACH, LIST\_HEAD, LIST\_HEAD\_INITIALIZER, LIST\_INIT, LIST\_INSERT\_AFTER, LIST\_INSERT\_BEFORE, LIST\_INSERT\_HEAD, LIST\_NEXT, LIST\_REMOVE - implementation of a doubly linked list

#### SYNOPSIS

```
#include <sys/queue.h>

int LIST_EMPTY(LIST_HEAD *head);

LIST_ENTRY(TYPE);

struct TYPE *LIST_FIRST(LIST_HEAD *head);

LIST_FOREACH(struct TYPE *var, LIST_HEAD *head, LIST_ENTRY NAME);

LIST_HEAD(HEADNAME, TYPE);

LIST_HEAD LIST_HEAD_INITIALIZER(LIST_HEAD head);

void LIST_INIT(LIST_HEAD *head);

void LIST_INSERT_AFTER(struct TYPE *listelm, struct TYPE *elm,
                       LIST_ENTRY NAME);

void LIST_INSERT_BEFORE(struct TYPE *listelm, struct TYPE *elm,
```

```

        LIST_ENTRY NAME);

void LIST_INSERT_HEAD(LIST_HEAD *head, struct TYPE *elm,
        LIST_ENTRY NAME);

struct TYPE *LIST_NEXT(struct TYPE *elm, LIST_ENTRY NAME);

void LIST_REMOVE(struct TYPE *elm, LIST_ENTRY NAME);

```

## DESCRIPTION

These macros define and operate on doubly linked lists.

In the macro definitions, TYPE is the name of a user-defined structure, that must contain a field of type LIST\_ENTRY, named NAME. The argument HEADNAME is the name of a user-defined structure that must be declared using the macro LIST\_HEAD().

A list is headed by a structure defined by the LIST\_HEAD() macro. This structure contains a single pointer to the first element on the list.

The elements are doubly linked so that an arbitrary element can be removed without traversing the list. New elements can be added to the list after an existing element, before an existing element, or at the head of the list. A LIST\_HEAD structure is declared as follows:

```
LIST_HEAD(HEADNAME, TYPE) head;
```

where struct HEADNAME is the structure to be defined, and struct TYPE is the type of the elements to be linked into the list. A pointer to the head of the list can later be declared as:

```
struct HEADNAME *headp;
```

(The names head and headp are user selectable.)

The macro LIST\_HEAD\_INITIALIZER() evaluates to an initializer for the list head.

The macro LIST\_EMPTY() evaluates to true if there are no elements in the list.

The macro LIST\_ENTRY() declares a structure that connects the elements in the list.

The macro LIST\_FIRST() returns the first element in the list or NULL if the list is empty.

The macro LIST\_FOREACH() traverses the list referenced by head in the forward direction, assigning each element in turn to var.

The macro `LIST_INIT()` initializes the list referenced by `head`.

The macro `LIST_INSERT_HEAD()` inserts the new element `elm` at the head of the list.

The macro `LIST_INSERT_AFTER()` inserts the new element `elm` after the element `listelm`.

The macro `LIST_INSERT_BEFORE()` inserts the new element `elm` before the element `listelm`.

The macro `LIST_NEXT()` returns the next element in the list, or `NULL` if this is the last.

The macro `LIST_REMOVE()` removes the element `elm` from the list.

## RETURN VALUE

`LIST_EMPTY()` returns nonzero if the list is empty, and zero if the list contains at least one entry.

`LIST_FIRST()`, and `LIST_NEXT()` return a pointer to the first or next `TYPE` structure, respectively.

`LIST_HEAD_INITIALIZER()` returns an initializer that can be assigned to the list head.

## CONFORMING TO

Not in POSIX.1, POSIX.1-2001 or POSIX.1-2008. Present on the BSDs (LIST macros first appeared in 4.4BSD).

## BUGS

The macro `LIST_FOREACH()` doesn't allow `var` to be removed or freed within the loop, as it would interfere with the traversal. The macro `LIST_FOREACH_SAFE()`, which is present on the BSDs but is not present in glibc, fixes this limitation by allowing `var` to safely be removed from the list and freed from within the loop without interfering with the traversal.

## EXAMPLES

```
#include <stddef.h>

#include <stdio.h>

#include <stdlib.h>

#include <sys/queue.h>

struct entry {
```

```

int data;

LIST_ENTRY(entry) entries;      /* List. */

};

LIST_HEAD(listhead, entry);

int

main(void)
{
    struct entry *n1, *n2, *n3, *np;

    struct listhead head;      /* List head. */

    int i;

    LIST_INIT(&head);          /* Initialize the list. */

    n1 = malloc(sizeof(struct entry)); /* Insert at the head. */

    LIST_INSERT_HEAD(&head, n1, entries);

    n2 = malloc(sizeof(struct entry)); /* Insert after. */

    LIST_INSERT_AFTER(n1, n2, entries);

    n3 = malloc(sizeof(struct entry)); /* Insert before. */

    LIST_INSERT_BEFORE(n2, n3, entries);

    i = 0;                      /* Forward traversal. */

    LIST_FOREACH(np, &head, entries)

        np->data = i++;

    LIST_REMOVE(n2, entries);    /* Deletion. */

    free(n2);

                                /* Forward traversal. */

    LIST_FOREACH(np, &head, entries)

        printf("%i\n", np->data);

                                /* List Deletion. */

    n1 = LIST_FIRST(&head);

    while (n1 != NULL) {

        n2 = LIST_NEXT(n1, entries);

        free(n1);

        n1 = n2;

    }

    LIST_INIT(&head);

```

```
    exit(EXIT_SUCCESS);  
}
```

## SEE ALSO

insque(3), queue(7)

## COLOPHON

This page is part of release 5.10 of the Linux man-pages project. A description of the project, information about reporting bugs, and the latest version of this page, can be found at <https://www.kernel.org/doc/man-pages/>.

GNU

2020-12-21

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