

NAME

SLIST_EMPTY, SLIST_ENTRY, SLIST_FIRST, SLIST_FOREACH, SLIST_HEAD, SLIST_HEAD_INITIALIZER, SLIST_INIT, SLIST_INSERT_AFTER, SLIST_INSERT_HEAD, SLIST_NEXT, SLIST_REMOVE, SLIST_REMOVE_HEAD – implementation of a singly linked list

LIBRARY

Standard C library (*libc*, *-lc*)

SYNOPSIS

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

```
SLIST_ENTRY(TYPE);
```

```
SLIST_HEAD(HEADNAME, TYPE);
```

```
SLIST_HEAD SLIST_HEAD_INITIALIZER(SLIST_HEAD head);
```

```
void SLIST_INIT(SLIST_HEAD *head);
```

```
int SLIST_EMPTY(SLIST_HEAD *head);
```

```
void SLIST_INSERT_HEAD(SLIST_HEAD *head,
    struct TYPE *elm, SLIST_ENTRY NAME);
```

```
void SLIST_INSERT_AFTER(struct TYPE *listelm,
    struct TYPE *elm, SLIST_ENTRY NAME);
```

```
struct TYPE *SLIST_FIRST(SLIST_HEAD *head);
```

```
struct TYPE *SLIST_NEXT(struct TYPE *elm, SLIST_ENTRY NAME);
```

```
SLIST_FOREACH(struct TYPE *var, SLIST_HEAD *head, SLIST_ENTRY NAME);
```

```
void SLIST_REMOVE(SLIST_HEAD *head, struct TYPE *elm,
    SLIST_ENTRY NAME);
```

```
void SLIST_REMOVE_HEAD(SLIST_HEAD *head,
    SLIST_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 *SLIST_ENTRY*, named *NAME*. The argument *HEADNAME* is the name of a user-defined structure that must be declared using the macro **SLIST_HEAD()**.

Creation

A singly linked list is headed by a structure defined by the **SLIST_HEAD()** macro. This structure contains a single pointer to the first element on the list. The elements are singly linked for minimum space and pointer manipulation overhead at the expense of O(n) removal for arbitrary elements. New elements can be added to the list after an existing element or at the head of the list. An *SLIST_HEAD* structure is declared as follows:

```
SLIST_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.)

SLIST_ENTRY() declares a structure that connects the elements in the list.

SLIST_HEAD_INITIALIZER() evaluates to an initializer for the list *head*.

SLIST_INIT() initializes the list referenced by *head*.

SLIST_EMPTY() evaluates to true if there are no elements in the list.

Insertion

SLIST_INSERT_HEAD() inserts the new element *elm* at the head of the list.

SLIST_INSERT_AFTER() inserts the new element *elm* after the element *listelm*.

Traversal

SLIST_FIRST() returns the first element in the list, or NULL if the list is empty.

SLIST_NEXT() returns the next element in the list.

SLIST_FOREACH() traverses the list referenced by *head* in the forward direction, assigning each element in turn to *var*.

Removal

SLIST_REMOVE() removes the element *elm* from the list.

SLIST_REMOVE_HEAD() removes the element *elm* from the head of the list. For optimum efficiency, elements being removed from the head of the list should explicitly use this macro instead of the generic **SLIST_REMOVE()**.

RETURN VALUE

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

SLIST_FIRST(), and **SLIST_NEXT()** return a pointer to the first or next *TYPE* structure, respectively.

SLIST_HEAD_INITIALIZER() returns an initializer that can be assigned to the list *head*.

STANDARDS

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

BUGS

SLIST_FOREACH() doesn't allow *var* to be removed or freed within the loop, as it would interfere with the traversal. **SLIST_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;
    SLIST_ENTRY(entry) entries;          /* Singly linked list */
};

SLIST_HEAD(slisthead, entry);

int
main(void)
{
    struct entry *n1, *n2, *n3, *np;
    struct slisthead head;              /* Singly linked list
                                         head */

    SLIST_INIT(&head);                  /* Initialize the queue */

    n1 = malloc(sizeof(struct entry));  /* Insert at the head */
    SLIST_INSERT_HEAD(&head, n1, entries);
```

```
n2 = malloc(sizeof(struct entry));          /* Insert after */
SLIST_INSERT_AFTER(n1, n2, entries);

SLIST_REMOVE(&head, n2, entry, entries); /* Deletion */
free(n2);

n3 = SLIST_FIRST(&head);
SLIST_REMOVE_HEAD(&head, entries);          /* Deletion from the head */
free(n3);

for (unsigned int i = 0; i < 5; i++) {
    n1 = malloc(sizeof(struct entry));
    SLIST_INSERT_HEAD(&head, n1, entries);
    n1->data = i;
}

/* Forward traversal */
SLIST_FOREACH(np, &head, entries)
    printf("%i\n", np->data);

while (!SLIST_EMPTY(&head)) {                /* List deletion */
    n1 = SLIST_FIRST(&head);
    SLIST_REMOVE_HEAD(&head, entries);
    free(n1);
}
SLIST_INIT(&head);

exit(EXIT_SUCCESS);
}
```

SEE ALSO**insque(3), queue(7)**