NAME
        lsearch – linear search and update

SYNOPSIS
        #include <stdio.h>
        #include <search.h>

        char *lsearch ((char *)key, (char *)base,
        nelp, sizeof(*key), compar)
        unsigned *nelp;
        int (*compar)( );

        char *lfind ((char *)key, (char *)base,
        nelp, sizeof(*key), compar)
        unsigned *nelp;
        int (*compar)( );

DESCRIPTION
        Lsearch is a linear search routine generalized from Knuth (6.1)
        Algorithm S. It returns a pointer into a table indicating where a
        datum may be found. If the datum does not occur, it is added at
        the end of the table. *Key* points to the datum to be sought in the
        table. *Base* points to the first element in the table. *Nelp* points
        to an integer containing the current number of elements in the
        table. The integer is incremented if the datum is added to the
        table. *Compar* is the name of the comparison function which the
        user must supply (*strcmp*, for example). It is called with two
        arguments that point to the elements being compared. The func-
        tion must return zero if the elements are equal and non-zero other-
        wise.

        Lfind is the same as *Lsearch* except that if the datum is not
        found, it is not added to the table. Instead, a NULL pointer is
        returned.

NOTES
        The pointers to the key and the element at the base of the table
        should be of type pointer-to-element, and cast to type pointer-to-
        character.
        The comparison function need not compare every byte, so arbi-
        trary data may be contained in the elements in addition to the
        values being compared.
        Although declared as type pointer-to-character, the value returned
        should be cast into type pointer-to-element.

EXAMPLE
        This fragment will read in less than TABSIZE strings of length
        less than ELSIZE and store them in a table, eliminating dupli-
        cates.

                #include <stdio.h>
                #include <search.h>

                #define TABSIZE 30
                #define ELSIZE 120

                        char line[ELSIZE], tab[TABSIZE][ELSIZE],
                        *lsearch( );

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```
            unsigned nel = 0;
            int strcmp( );
            ...
            while (fgets(line, ELSIZE, stdin) != NULL &&
                    nel < TABSIZE)
                    (void) lsearch(line,(char *)tab,&nel,
                            ELSIZE, strcmp);
```

SEE ALSO

bsearch(3C), hsearch(3C), string(3C), tsearch(3C).

DIAGNOSTICS

If the searched for datum is found, both *lsearch* and *lfind* return a pointer to it. Otherwise, *lfind* returns NULL and *lsearch* returns a pointer to the newly added element.

BUGS

Undefined results can occur if there is not enough room in the table to add a new item.

NAME

malloc, free, realloc, calloc – main memory allocator

SYNOPSIS

char *malloc (size)
unsigned size;

void free (ptr)
char *ptr;

char *realloc (ptr, size)
char *ptr;
unsigned size;

char *calloc (nelem, elsize)
unsigned nelem, elsize;

int mallopt (cmd, value)
int cmd, value;

DESCRIPTION

Malloc and *free* provide a simple general-purpose memory alloca-
tion package. *Malloc* returns a pointer to a block of at least *size*
bytes suitably aligned for any use.

The argument to *free* is a pointer to a block previously allocated
by *malloc*; after *free* is performed this space is made available for
further allocation, but its contents are left undisturbed.

Undefined results will occur if the space assigned by *malloc* is
overrun or if some random number is handed to *free*.

Malloc allocates the first big enough contiguous reach of free space
found in a circular search from the last block allocated or freed,
coalescing adjacent free blocks as it searches. It calls *sbrk* (see
brk(2)) to get more memory from the system when there is no
suitable space already free.

Realloc changes the size of the block pointed to by *ptr* to *size*
bytes and returns a pointer to the (possibly moved) block. The
contents will be unchanged up to the lesser of the new and old
sizes. If no free block of *size* bytes is available in the storage
arena, then *realloc* will ask *malloc* to enlarge the arena by *size*
bytes and will then move the data to the new space.

Realloc also works if *ptr* points to a block freed since the last call
of *malloc*, *realloc*, or *calloc*; thus sequences of *free*, *malloc* and
realloc can exploit the search strategy of *malloc* to do storage
compaction.

Calloc allocates space for an array of *nelem* elements of size
elsize. The space is initialized to zeros.

Mallopt provides for control over the allocation algorithm. The
available values for *cmd* are:

M_MXFAST   Set *maxfast* to *value*. The algorithm allo-
cates all blocks below the size of *maxfast*
in large groups and then doles them out
very quickly. The default value for *max-
fast* is 24.

M_NLBLKS	Set *numlblks* to *value*. The above men-tioned "large groups" each contain *numlblks* blocks. *Numlblks* must be greater than 0. The default value for *numlblks* is 100.
M_GRAIN	Set *grain* to *value*. The sizes of all blocks smaller than *maxfast* are considered to be rounded up to the nearest multiple of *grain*. *Grain* must be greater than 0. The default value of *grain* is the smallest number of bytes which will allow align-ment of any data type. Value will be rounded up to a multiple of the default when *grain* is set.
M_KEEP	Preserve data in a freed block until the next *malloc, realloc,* or *calloc*. This option is provided only for compatibility with the old version of *malloc* and is not recom-mended.

These values are defined in the $<malloc.h>$ header file.

Mallopt may be called repeatedly, but may not be called after the first small block is allocated.

Each of the allocation routines returns a pointer to space suitably aligned (after possible pointer coercion) for storage of any type of object.

SEE ALSO

brk (2).

DIAGNOSTICS

Malloc, *realloc* and *calloc* return a NULL pointer if there is not enough available memory. When *realloc* returns NULL, the block pointed to by *ptr* is left intact. If *mallopt* is called after any allo-cation, or if *cmd* or *value* are invalid, non-zero is returned. Other-wise, it returns zero.

NOTE

Search time increases when many objects have been allocated; that is, if a program allocates but never frees, then each successive allocation takes longer.

NAME

      matherr – error-handling function

SYNOPSIS

      #include <math.h>

      int matherr (x)
      struct exception *x;

DESCRIPTION

      Matherr is invoked by functions in the Math Library when errors
      are detected. Users may define their own procedures for handling
      errors by including a function named *matherr* in their programs.
      Matherr must be of the form described above. A pointer to the
      exception structure x will be passed to the user-supplied *matherr*
      function when an error occurs. This structure, which is defined in
      the **<math.h>** header file, is as follows:

```
struct exception {
        int type;
        char *name;
        double arg1, arg2, retval;
};
```

      The element *type* is an integer describing the type of error that
      has occurred, from the following list of constants (defined in the
      header file):

DOMAIN	domain error
SING	singularity
OVERFLOW	overflow
UNDERFLOW	underflow
TLOSS	total loss of significance
PLOSS	partial loss of significance

      The element *name* points to a string containing the name of the
      function that had the error. The variables *arg1* and *arg2* are the
      arguments to the function that had the error. *Retval* is a double
      that is returned by the function having the error. If it supplies a
      return value, the user's *matherr* must return non-zero. If the
      default error value is to be returned, the user's *matherr* must
      return 0.

      If *matherr* is not supplied by the user, the default error-handling
      procedures, described with the math functions involved, will be
      invoked upon error. These procedures are also summarized in the
      table below. In every case, *errno* is set to non-zero and the pro-
      gram continues.

EXAMPLE

```
matherr(x)
register struct exception *x;
{
        switch (x->type) {
        case DOMAIN:
        case SING: /* print message and abort */
                fprintf(stderr, "domain error in %s\n", x->name);
                abort( );
```

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