

ANSI LIBRARY : stdio, stdlib, string, math, ctype, time, stdarg, limits

The following is a synopsis of functions available in the standard ANSI C library. Other on-line reference tools (i.e., Symantec THINK Reference) provide a more detailed review of the ANSI C Library functions, but a quick review of these functions is provided in this section for your convenience.

As a note, if you plan on programming for the MacOS, you'll find that you won't be using the ANSI C library as much as you might think. This goes especially for input and output functions. This means that you probably don't need to spend a lot of time learning the ins and outs of the ANSI C library - although you should at least be aware of the capabilities it provides.

Here's a list of the ANSI C library header files:

- <stdio.h>
- <stdlib.h>
- <string.h>
- <math.h>
- <ctype.h>
- <time.h>
- <stdarg.h>
- <limits.h>
- <float.h>
- <assert.h>
- <setjmp.h>
- <signal.h>

STANDARD INPUT/OUTPUT <stdio.h>

Filenames are limited to FILENAME_MAX characters. At most FOPEN_MAX files may be open at a given time.

CLEARERR
void clearerr(FILE *stream)

FCLOSE
int fclose(FILE *stream)
Returns EOF if error occurs, zero otherwise.

FEOF
int feof(FILE *stream)
Returns non-zero if EOF is set.

FERROR
int ferror(FILE *stream)
Returns non-zero if error exists for 'stream'.

FFLUSH
int fflush(FILE *stream)
Returns EOF if error, zero otherwise. fflush(NULL) flushes all output streams.

FGETC
int fgetc(FILE *stream)
Returns EOF if error.

FGETS
char *fgets(char *s, int n, FILE *stream)
Returns s, or NULL if error.

FGETPOS

int fgetpos(FILE *stream, fpos_t *ptr)

Records current position in 'stream' in '*ptr'.

FOPEN

FILE *fopen(const char *filename, const char *mode)

modes: "r" read only

"w" write; discard previous contents

"a" append

"r+" read and write

"rb" read (binary)

"wb" write (binary)

"ab" append (binary)

"r+b" read and write (binary)

FPRINTF

int fprintf(FILE *stream, const char *format, ...)

Returns number of characters printed, or negative result if error. Conversion specification begins with '%' and ends with conversion character. In between, there may be (in order):

flags:

'-' left justify

'+' print with sign

' ' <space> prefix with space if no sign

'0' <zero> specifies padding with leading zeros

'#' alternate output form

numbers:

n first number specifies field width

'.' period used as separator

n second number specifies precision (max characters)

m modifier (h - short, l - long, L - long double)

format characters:

d,i int; signed

o int; unsigned octal (without leading zero)

x,X int; unsigned hexadecimal

u int; unsigned

c int; single character

s char *; string

f double;

e,E double; scientific notation

g,G double; %e or %f format, depending on value

p void *; pointer

n int *; number of characters written so far

% no argument, print '%'

example:

```
fprintf( myFilename, "The results are %d and %6.2f\n", myInt, myReal);
```

FPUTC

int fputc(int c, FILE *stream)

Returns c, or EOF if error.

FPUTS

int fputs(const char *s, FILE *stream)

Returns non-negative result, or EOF if error.

FREAD

size_t fread(void *ptr, size_t size, size_t nobj, FILE *stream)

Reads from 'stream' into 'ptr' at most 'nobj' objects of size 'size'. Returns number of objects read.

FREOPEN

FILE *freopen(const char *filename, const char *mode, FILE *stream)

Returns NULL if error.

FSCANF

int fscanf(FILE *stream, const char *format, ...)

Reads from 'stream' and assigns values through subsequent arguments which must be pointers. Returns EOF if end of file occurs before any conversion; otherwise it returns number of items assigned. Format string should contain conversion specifications consisting of '%' followed by:

flag:

- * suppression; ignore field

number:

- n first number specifies maximum field width

width character:

- h short

- l long

- L long double

conversion characters:

- d int *

- i int *; may be octal (leading 0) or hexadecimal (leading 0x)

- o int *; octal integer

- x int *; hexadecimal integer

- c char *; characters

- s char *; string of non-white characters

- e,f float *; could also use 'g'

- p void *; pointer

- n int *; writes into arg number of characters read. Nothing read.

FSEEK

int fseek(FILE *stream, long offset, int origin)

Sets file position. Values for origin can be:

- SEEK_SET beginning

- SEEK_CUR current position

- SEEK_END end of file

FSETPOS

int fsetpos(FILE *stream, const fpos_t *ptr)

Positions 'stream' at position recorded by fgetpos. Returns non-zero if error.

FTELL

long ftell(FILE *stream)

Returns current position for 'stream', or -1L if error.

FWRITE

size_t fwrite(const void *ptr, size_t size, size_t nobj, FILE *stream)

Writes from 'ptr' to 'stream' 'nobj' objects of size 'size'. Returns number of objects read.

GETC

int getc(FILE *stream)

Same as fgetc, except a macro.

GETCHAR

int getchar(void)

Equivalent to getc(stdin).

GETS

char *gets(char *s)

Returns s, or NULL if error.

PERROR

void perror(const char *s)

Prints error message 's'.

PRINTF

int printf(const char *format, ...)

Equivalent to fprintf(stdout, ...)

PUTC

int putc(int c, FILE *stream)
Same as fputc, except a macro.

PUTCHAR

int putchar(int c)
Equivalent to putc(c, stdout).

PUTS

int puts(const char *s)
Returns non-negative result, or EOF if error.

REMOVE

int remove(const char *filename)
Returns non-zero if attempt to delete file fails.

RENAME

int rename(const char *oldname, const char *newname)
Returns non-zero if attempt to rename file fails.

REWIND

void rewind(FILE *stream)

SCANF

int scanf(const char *format, ...)
Identical to fscanf(stdin, ...)

SPRINTF

int sprintf(char *s, const char *format, ...)
Same as printf except output written to string 's'.

SSCANF

int sscanf(char *s, const char *format, ...)
Equivalent to scanf(...) except input is taken from 's'.

SETBUF

void setbuf(FILE *stream, char *buf)
If 'buf' is NULL, buffering is turned off, otherwise equivalent to 'void setvbuf(stream, buf, _IOFBF, BUFSIZE)'.

SETVBUF

int setvbuf(FILE *stream, char *buf, int mode, size_t size)
Returns non-zero if error. A value of NULL for 'buf' allocates buffer.
modes: _IOFBF full buffering
 _IOLBF line buffering
 _IONBF no buffering

TMPFILE

FILE *tmpfile(void)
Returns NULL if error.

TMPNAM

char *tmpnam(char s[L_tmpnam])
tmpnam(NULL) creates unique filename. TMP_MAX different names guaranteed.

UNGETC

int ungetc(int c, FILE *stream)
pushes 'c' (converted to an unsigned char) back onto 'stream'. Returns 'c' or EOF if error.

VPRINTF

int vprintf(const char *format, va_list arg)

VPRINTF
int vfprintf(FILE *stream, const char *format, va_list arg)

VSPRINTF
int vsprintf(char *s, const char *format, va_list arg)

STANDARD LIBRARY <stdlib.h>

ABORT
void abort(void)
Causes program to abnormally terminate.

ABS
int abs(int n)

ATEXIT
int atexit(void (*fcn)(void))
Registers function to be called when program terminates. Returns non-zero if error.

ATOF
double atof(const char *s)

atoi
int atoi(const char *s)

ATOL
long atol(const char *s)

BSEARCH
void *bsearch(const void *key, const void *base, size_t n, size_t size, int (*cmp)(const void *keyval, const void *datum))

CALLOC
void *calloc(size_t nobj, size_t size)

DIV
div_t div(int num, int denom)

EXIT
void exit(int status)
Causes normal program termination.

FREE
void free(void *p)
Deallocates space pointed to by 'p'. Returns NULL if error.

GETENV
char *getenv(const char *name)

LABS
long labs(long n)

LDIV
ldiv_t ldiv(long num, long denom)

MALLOC
void *malloc(size_t size)
Returns pointer for object of size 'size', or NULL if request for memory denied.

QSORT

void qsort(void *base, size_t n, size_t size, int (*cmp)(const void *, const void *))

RAND

int rand(void)

Returns pseudo-random integer between 0 and RAND_MAX.

REALLOC

void *realloc(void *p, size_t size)

STRTOD

double strtod(const char *s, char **endp)

STRTOL

long strtol(const char *s, char **endp, int base)

STRTOUL

unsigned long strtoul(const char *s, char **endp, int base)

SRAND

void srand(unsigned int seed)

SYSTEM

int system(const char *s)

STRING FUNCTIONS <string.h>

MEMCHR

void *memchr(const char *cs, int c, size_t n)

Returns first occurrence of character 'c' in 'cs' or NULL.

MEMCMP

int memcmp(const char *cs, const char *ct, size_t n)

Compares 'n' characters of 'cs' with 'ct'.

MEMCPY

void *memcpy(char *s, const char *ct, size_t n)

Copy 'n' characters from 'ct' to 's', returns 's'.

MEMMOVE

void *memmove(char *s, const char *ct, size_t n)

Same as 'memcpy'. Works if objects overlap.

MEMSET

void *memset(char *s, int c, size_t n)

Put character 'c' into first 'n' characters of 's', returns 's'.

STRCAT

char *(char *char *s, const char *ct)

Concatenates 'ct' to 's', returns 's'.

STRCHR

char *strchr(const char *cs, int c)

Returns pointer to first occurrence of 'c' in 'cs' or NULL.

STRCMP

int strcmp(const char *cs, const char *ct)

Returns zero if cs == ct.

STRCPY

char *strcpy(char *s, const char *ct)
Copies 'ct' to 's', including '\0', returns 's'.

STRCSPN

size_t strcspn(const char *cs, const char *ct)

STRERROR

char *strerror(n)
Returns pointer to string defining error 'n'.

STRLEN

size_t strlen(const char *cs)
Returns length of 'cs'.

STRNCAT

char *strncat(char *s, const char *ct, size_t n)

STRNCMP

int strncmp(const char *cs, const char *ct, size_t n)
Returns zero if 'n' characters of both strings are equal.

STRNCPY

char *strncpy(char *s, const char *ct, size_t n)

STRPBRK

char *strpbrk(const char *cs, const char *ct)
Return pointer to first occurrence of any character in 'ct' or NULL.

STRRCHR

char *strrchr(const char *cs, int c)
Returns pointer to last occurrence of 'c' in 'cs' or NULL.

STRSPN

size_t strspn(const char *cs, const char *ct)

STRSTR

char *strstr(const char *cs, const char *ct)
Returns pointer to first occurrence of string 'ct' in 'cs' or NULL.

STRTok

char *strtok(char *s, const char *ct)
Searches 's' for tokens delimited by characters from 'ct'. Returns NULL when no further tokens found.

MATH FUNCTIONS <math.h>

In the following list, 'x' and 'y' are type 'double', n is type 'int'. All angles for trigonometric functions are in radians.

sin(x)
cos(x)
tan(x)
asin(x)
acos(x)
atan(x)
atan2(y,x)
sinh(x)
cosh(x)
tanh(x)
exp(x)

log(x)
log10(x)
pow(x,y)
sqrt(x)
ceil(x)
floor(x)
fabs(x)
ldexp(x,n)
frexp(x, int *exp)
modf(x, double *ip)
fmod(x,y)

CHARACTER TESTS <ctype.h>

All functions in <ctype.h> take a character and return an 'int' which represents a true (non-zero) or false (zero) result.

isalnum(int c) alpha-numeric character
isalpha(int c) upper or lower-case letter
iscntrl(int c) control character
isdigit(int c) decimal digit
isgraph(int c) !space
islower(int c) lower-case
isprint(int c) printing character, including space
ispunct(int c) !(space || letter || digit)
isspace(int c) space, tab, newline
isupper(int c) upper-case
isxdigit(int c) hexadecimal digit

DATA AND TIME FUNCTIONS <time.h>

Many functions in <time.h> utilize a data structure which has the following format:

```
struct tm
{
    int tm_sec;
    int tm_min;
    int tm_hour;
    int tm_mday;
    int tm_mon;
    int tm_year;
    int tm_wday;
    int tm_yday;
    int tm_isdst; // Daylight Savings Time flag
};
```

ASCTIME

char *asctime(const struct tm *tp)
Converts time into standard string; "Fri May 26 19:27:30 1995\n".

CLOCK

clock_t clock(void)
Returns processor time used by the program.

CTIME

char *ctime(const time_t *tp)
Converts calendar time to local time.

DIFFTIME

double difftime(time_t time2, time_t time1)
Returns difference in two times in seconds.

GMTIME

struct tm *gmtime(const time_t *tp)
Converts calendar time into Coordinated Universal Time (UTC).

LOCALTIME

struct tm *localtime(const time_t *tp)
Converts calendar time into local time.

MKTIME

time_t mktime(struct tm *tp)
Converts local time to calendar time.

STRFTIME

size_t strftime(char *s, size_t smax, const char *fmt, const struct tm *tp)
Formats date and time data from *tp into string 's'. Available formats include:

- %a abbreviated weekday name
- %A full weekday
- %b abbreviated month
- %B full month
- %c date and time
- %d day of month (01-31)
- %H hour (24 hr)
- %I hour (12 hr)
- %j day of year
- %m month
- %M minute
- %p AM or PM
- %S second
- %U week number (Sunday 1st day of week)
- %w weekday (0-6)
- %W week number (Monday 1st day of week)
- %x date
- %X time
- %y year without century
- %Y century
- %Z time zone name
- %% %

TIME

time_t time(time_t *tp)
Returns current calendar time. If 'tp' is not NULL, return value is also assigned to 'tp'.

VARIABLE ARGUMENT LISTS <stdarg.h>

Use the functions in <stdarg.h> to retrieve arguments from a variable length function argument list. An example of using variable argument lists can be found in Section 'Functions'. Before using functions, you must declare a variable of type 'va_list' as follows:

```
va_list ap;
```

You then use the 'va_start' macro to initialize. Afterwards, each subsequent call to 'va_arg' returns the next argument. Finally, call 'va_end'.

VA_START

void va_start(va_list ap, lastarg)

Provide the last argument in a variable length function list as 'lastarg' to initialize va_list variable.

VA_ARG

type va_arg(va_list ap, type)

Returns next argument in variable length function list. You must supply the data type in 'type'. va_arg returns type specified in 'type'.

VA_END

void va_end(va_list ap)

Execute after arguments have been processed, but prior to exiting function.

IMPLEMENTATION SPECIFICS <limits.h> and <float.h>

The following constants are defined in <limits.h>:

CHAR_BIT
CHAR_MAX
CHAR_MIN
INT_MAX
INT_MIN
LONG_MAX
LONG_MIN
SCHAR_MAX
SCHAR_MIN
SHRT_MAX
SHRT_MIN
UCHAR_MAX
UINT_MAX
ULONG_MAX
USHRT_MAX

The following constants are defined in <float.h>:

FLT_RADIX
FLT_ROUNDS
FLT_DIG
FLT_EPSILON
FLT_MANT_DIG
FLT_MAX
FLT_MAX_EXP
FLT_MIN
FLT_MIN_EXP
DBL_DIG
DBL_EPSILON
DBL_MANT_DIG
DBL_MAX
DBL_MAX_EXP
DBL_MIN
DBL_MIN_EXP

DIAGNOSTICS <assert.h>

Built-in diagnostic macro which is rarely used but included just to be complete.

ASSERT

void assert(int expr)

If 'expr' is zero, prints error message on stderr. If NDEBUG is defined, assert macro is ignored.

NON-LOCAL JUMPS <setjmp.h>

Bad idea which is rarely used but included just to be complete.

SETJMP

int setjmp(jmp_buf env)

Saves state information for later use by 'longjmp'.

LONGJMP

void longjmp(jmp_buf env, int val)

Restores state saved by most recent call to setjmp. Execution resumes as if the setjmp function had just executed and returned the non-zero value val. Function containing setjmp must not have terminated.

SIGNALS <signal.h>

Precursor to C++ exception handling? Rarely used but included just to be complete.

SIGNAL

void (*signal(int sig, void (*handler)(int)))(int)

Calls function pointed to by handler with argument of the type of signal.

SIG_DFL default behavior: handler ignored

SIG_IGN ignore signal: handler ignored

SIGABRT abnormal termination

SIGFPE arithmetic error

SIGILL illegal instruction

SIGINT interrupt

SIGSEGV illegal storage access

SIGTERM termination request

RAISE

int raise(int sig)

Sends the signal 'sig' to the program, returns non-zero is unsuccessful.