

# C Reference Card (ANSI)

## Program Structure/Functions

<i>type fnc(type<sub>1</sub>,...)</i>	function declarations
<i>type name</i>	external variable declarations
<i>main()</i> { <i>declarations</i> <i>statements</i> }	main routine
	local variable declarations
<i>type fnc(arg<sub>1</sub>,...)</i> { <i>declarations</i> <i>statements</i> return <i>value</i> ; }	function definition
	local variable declarations
<i>/* */</i>	comments
<i>main(int argc, char *argv[])</i>	main with args
<i>exit(arg)</i>	terminate execution

## C Preprocessor

include library file	#include <filename>
include user file	#include "filename"
replacement text	#define <i>name text</i>
replacement macro	#define <i>name(var) text</i>
Example. #define max(A,B) ((A)>(B) ? (A) : (B))	
undefine	#undef <i>name</i>
quoted string in replace	#
concatenate args and rescan	##
conditional execution	#if, #else, #elif, #endif
is <i>name</i> defined, not defined?	#ifdef, #ifndef
<i>name</i> defined?	defined( <i>name</i> )
line continuation char	\

## Data Types/Declarations

character (1 byte)	char
integer	int
float (single precision)	float
float (double precision)	double
short (16 bit integer)	short
long (32 bit integer)	long
positive and negative	signed
only positive	unsigned
pointer to int, float,...	*int, *float,...
enumeration constant	enum
constant (unchanging) value	const
declare external variable	extern
register variable	register
local to source file	static
no value	void
structure	struct
create name by data type	typedef <i>typename</i>
size of an object (type is <i>size_t</i> )	sizeof <i>object</i>
size of a data type (type is <i>size_t</i> )	sizeof( <i>type name</i> )

## Initialization

initialize variable	<i>type name=value</i>
initialize array	<i>type name[]={value<sub>1</sub>,...}</i>
initialize char string	char <i>name[]="string"</i>

## Constants

long (suffix)	L or l
float (suffix)	F or f
exponential form	e
octal (prefix zero)	0
hexadecimal (prefix zero-ex)	0x or 0X
character constant (char, octal, hex)	'a', '\ooo', '\xhh'
newline, cr, tab, backspace	\n, \r, \t, \b
special characters	\\, \?, \', \"
string constant (ends with '\0')	"abc...de"

## Pointers, Arrays & Structures

declare pointer to <i>type</i>	<i>type *name</i>
declare function returning pointer to <i>type</i>	<i>type *f()</i>
declare pointer to function returning <i>type</i>	<i>type (*pf)()</i>
generic pointer type	void *
null pointer	NULL
object pointed to by <i>pointer</i>	* <i>pointer</i>
address of object <i>name</i>	& <i>name</i>
array	<i>name[dim]</i>
multi-dim array	<i>name[dim<sub>1</sub>][dim<sub>2</sub>]...</i>

### Structures

struct <i>tag</i> { <i>declarations</i> };	structure template declaration of members
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create structure	struct <i>tag name</i>
member of structure from template	<i>name.member</i>
member of pointed to structure	<i>pointer -&gt; member</i>
Example. (*p).x and p->x are the same	
single value, multiple type structure	union
bit field with <i>b</i> bits	<i>member : b</i>

## Operators (grouped by precedence)

structure member operator	<i>name.member</i>
structure pointer	<i>pointer-&gt;member</i>
increment, decrement	++, --
plus, minus, logical not, bitwise not	+, -, !, ~
indirection via pointer, address of object	* <i>pointer</i> , & <i>name</i>
cast expression to type	( <i>type</i> ) <i>expr</i>
size of an object	sizeof
multiply, divide, modulus (remainder)	*, /, %
add, subtract	+, -
left, right shift [bit ops]	<<, >>
comparisons	>, >=, <, <=
comparisons	==, !=
bitwise and	&
bitwise exclusive or	^
bitwise or (incl)	
logical and	&&
logical or	
conditional expression	<i>expr<sub>1</sub> ? expr<sub>2</sub> : expr<sub>3</sub></i>
assignment operators	+=, -=, *=, ...
expression evaluation separator	,

Unary operators, conditional expression and assignment operators group right to left; all others group left to right.

## Flow of Control

statement terminator	;
block delimiters	{ }
exit from switch, while, do, for	break
next iteration of while, do, for	continue
go to	goto <i>label</i>
label	<i>label:</i>
return value from function	return <i>expr</i>

### Flow Constructions

if statement	if ( <i>expr</i> ) <i>statement</i> else if ( <i>expr</i> ) <i>statement</i> else <i>statement</i>
while statement	while ( <i>expr</i> ) <i>statement</i>
for statement	for ( <i>expr<sub>1</sub></i> ; <i>expr<sub>2</sub></i> ; <i>expr<sub>3</sub></i> ) <i>statement</i>
do statement	do <i>statement</i> while( <i>expr</i> );
switch statement	switch ( <i>expr</i> ) { case <i>const<sub>1</sub></i> : <i>statement<sub>1</sub></i> break; case <i>const<sub>2</sub></i> : <i>statement<sub>2</sub></i> break; default: <i>statement</i> }

## ANSI Standard Libraries

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

## Character Class Tests <ctype.h>

alphanumeric?	isalnum(c)
alphabetic?	isalpha(c)
control character?	iscntrl(c)
decimal digit?	isdigit(c)
printing character (not incl space)?	isgraph(c)
lower case letter?	islower(c)
printing character (incl space)?	isprint(c)
printing char except space, letter, digit?	ispunct(c)
space, formfeed, newline, cr, tab, vtab?	isspace(c)
upper case letter?	isupper(c)
hexadecimal digit?	isxdigit(c)
convert to lower case?	tolower(c)
convert to upper case?	toupper(c)

## String Operations <string.h>

s,t are strings, cs,ct are constant strings

length of s	strlen(s)
copy ct to s	strcpy(s,ct)
up to n chars	strncpy(s,ct,n)
concatenate ct after s	strcat(s,ct)
up to n chars	strncat(s,ct,n)
compare cs to ct	strcmp(cs,ct)
only first n chars	strncmp(cs,ct,n)
pointer to first c in cs	strchr(cs,c)
pointer to last c in cs	strrchr(cs,c)
copy n chars from ct to s	memcpy(s,ct,n)
copy n chars from ct to s (may overlap)	memmove(s,ct,n)
compare n chars of cs with ct	memcmp(cs,ct,n)
pointer to first c in first n chars of cs	memchr(cs,c,n)
put c into first n chars of cs	memset(s,c,n)

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## Input/Output <stdio.h>

### Standard I/O

standard input stream	<code>stdin</code>
standard output stream	<code>stdout</code>
standard error stream	<code>stderr</code>
end of file	<code>EOF</code>
get a character	<code>getchar()</code>
print a character	<code>putchar(<i>chr</i>)</code>
print formatted data	<code>printf("format", <i>arg</i><sub>1</sub>,...)</code>
print to string <i>s</i>	<code>sprintf(<i>s</i>, "format", <i>arg</i><sub>1</sub>,...)</code>
read formatted data	<code>scanf("format", &amp;<i>name</i><sub>1</sub>,...)</code>
read from string <i>s</i>	<code>sscanf(<i>s</i>, "format", &amp;<i>name</i><sub>1</sub>,...)</code>
read line to string <i>s</i> (< <i>max</i> chars)	<code>gets(<i>s</i>, <i>max</i>)</code>
print string <i>s</i>	<code>puts(<i>s</i>)</code>

### File I/O

declare file pointer	<code>FILE *<i>fp</i></code>
pointer to named file	<code>fopen("name", "mode")</code>
modes: <i>r</i> (read), <i>w</i> (write), <i>a</i> (append)	
get a character	<code>getc(<i>fp</i>)</code>
write a character	<code>putc(<i>chr</i>, <i>fp</i>)</code>
write to file	<code>fprintf(<i>fp</i>, "format", <i>arg</i><sub>1</sub>,...)</code>
read from file	<code>fscanf(<i>fp</i>, "format", <i>arg</i><sub>1</sub>,...)</code>
close file	<code>fclose(<i>fp</i>)</code>
non-zero if error	<code>ferror(<i>fp</i>)</code>
non-zero if EOF	<code>feof(<i>fp</i>)</code>
read line to string <i>s</i> (< <i>max</i> chars)	<code>fgets(<i>s</i>, <i>max</i>, <i>fp</i>)</code>
write string <i>s</i>	<code>fputs(<i>s</i>, <i>fp</i>)</code>

### Codes for Formatted I/O: "%-+ 0w.pmc"

-	left justify
+	print with sign
<i>space</i>	print space if no sign
0	pad with leading zeros
<i>w</i>	min field width
<i>p</i>	precision
<i>m</i>	conversion character:
<i>h</i>	short,
<i>l</i>	long,
<i>L</i>	long double
<i>c</i>	conversion character:
<i>d, i</i>	integer
<i>u</i>	unsigned
<i>c</i>	single char
<i>s</i>	char string
<i>f</i>	double
<i>e, E</i>	exponential
<i>o</i>	octal
<i>x, X</i>	hexadecimal
<i>p</i>	pointer
<i>n</i>	number of chars written
<i>g, G</i>	same as <i>f</i> or <i>e, E</i> depending on exponent

## Variable Argument Lists <stdarg.h>

declaration of pointer to arguments	<code>va_list <i>name</i>;</code>
initialization of argument pointer	<code>va_start(<i>name</i>, <i>lastarg</i>)</code>
<i>lastarg</i> is last named parameter of the function	
access next unnamed arg, update pointer	<code>va_arg(<i>name</i>, <i>type</i>)</code>
call before exiting function	<code>va_end(<i>name</i>)</code>

## Standard Utility Functions <stdlib.h>

absolute value of <i>int n</i>	<code>abs(<i>n</i>)</code>
absolute value of <i>long n</i>	<code>labs(<i>n</i>)</code>
quotient and remainder of <i>ints n,d</i>	<code>div(<i>n</i>, <i>d</i>)</code>
returns structure with <code>div_t.quot</code> and <code>div_t.rem</code>	
quotient and remainder of <i>longs n,d</i>	<code>ldiv(<i>n</i>, <i>d</i>)</code>
returns structure with <code>ldiv_t.quot</code> and <code>ldiv_t.rem</code>	
pseudo-random integer [ <i>0, RAND_MAX</i> ]	<code>rand()</code>
set random seed to <i>n</i>	<code>srand(<i>n</i>)</code>
terminate program execution	<code>exit(<i>status</i>)</code>
pass string <i>s</i> to system for execution	<code>system(<i>s</i>)</code>

### Conversions

convert string <i>s</i> to double	<code>atof(<i>s</i>)</code>
convert string <i>s</i> to integer	<code>atoi(<i>s</i>)</code>
convert string <i>s</i> to long	<code>atol(<i>s</i>)</code>
convert prefix of <i>s</i> to double	<code>strtod(<i>s</i>, <i>endp</i>)</code>
convert prefix of <i>s</i> (base <i>b</i> ) to long	<code>strtol(<i>s</i>, <i>endp</i>, <i>b</i>)</code>
same, but unsigned long	<code>strtoul(<i>s</i>, <i>endp</i>, <i>b</i>)</code>

### Storage Allocation

allocate storage	<code>malloc(<i>size</i>), calloc(<i>nobj</i>, <i>size</i>)</code>
change size of object	<code>realloc(<i>pts</i>, <i>size</i>)</code>
deallocate space	<code>free(<i>ptr</i>)</code>

### Array Functions

search array for key	<code>bsearch(<i>key</i>, <i>array</i>, <i>n</i>, <i>size</i>, <i>cmp</i>())</code>
sort array ascending order	<code>qsort(<i>array</i>, <i>n</i>, <i>size</i>, <i>cmp</i>())</code>

## Time and Date Functions <time.h>

processor time used by program	<code>clock()</code>
Example. <code>clock()/CLOCKS_PER_SEC</code> is time in seconds	
current calendar time	<code>time()</code>
<i>time</i> <sub>2</sub> - <i>time</i> <sub>1</sub> in seconds (double)	<code>difftime(<i>time</i><sub>2</sub>, <i>time</i><sub>1</sub>)</code>
arithmetic types representing times	<code>clock_t, time_t</code>
structure type for calendar time comps	<code>tm</code>
<i>tm_sec</i>	seconds after minute
<i>tm_min</i>	minutes after hour
<i>tm_hour</i>	hours since midnight
<i>tm_mday</i>	day of month
<i>tm_mon</i>	months since January
<i>tm_year</i>	years since 1900
<i>tm_wday</i>	days since Sunday
<i>tm_yday</i>	days since January 1
<i>tm_isdst</i>	Daylight Savings Time flag

convert local time to calendar time	<code>mktime(<i>tp</i>)</code>
convert time in <i>tp</i> to string	<code>asctime(<i>tp</i>)</code>
convert calendar time in <i>tp</i> to local time	<code>ctime(<i>tp</i>)</code>
convert calendar time to GMT	<code>gmtime(<i>tp</i>)</code>
convert calendar time to local time	<code>localtime(<i>tp</i>)</code>
format date and time info	<code>strftime(<i>s</i>, <i>smax</i>, "format", <i>tp</i>)</code>
<i>tp</i> is a pointer to a structure of type <code>tm</code>	

## Mathematical Functions <math.h>

Arguments and returned values are double

trig functions	<code>sin(<i>x</i>), cos(<i>x</i>), tan(<i>x</i>)</code>
inverse trig functions	<code>asin(<i>x</i>), acos(<i>x</i>), atan(<i>x</i>)</code>
arctan( <i>y/x</i> )	<code>atan2(<i>y</i>, <i>x</i>)</code>
hyperbolic trig functions	<code>sinh(<i>x</i>), cosh(<i>x</i>), tanh(<i>x</i>)</code>
exponentials & logs	<code>exp(<i>x</i>), log(<i>x</i>), log10(<i>x</i>)</code>
exponentials & logs (2 power)	<code>ldexp(<i>x</i>, <i>n</i>), frexp(<i>x</i>, *<i>e</i>)</code>
division & remainder	<code>modf(<i>x</i>, *<i>ip</i>), fmod(<i>x</i>, <i>y</i>)</code>
powers	<code>pow(<i>x</i>, <i>y</i>), sqrt(<i>x</i>)</code>
rounding	<code>ceil(<i>x</i>), floor(<i>x</i>), fabs(<i>x</i>)</code>

## Integer Type Limits <limits.h>

The numbers given in parentheses are typical values for the constants on a 32-bit Unix system.

<code>CHAR_BIT</code>	bits in char	(8)
<code>CHAR_MAX</code>	max value of char	(127 or 255)
<code>CHAR_MIN</code>	min value of char	(-128 or 0)
<code>INT_MAX</code>	max value of int	(+32,767)
<code>INT_MIN</code>	min value of int	(-32,768)
<code>LONG_MAX</code>	max value of long	(+2,147,483,647)
<code>LONG_MIN</code>	min value of long	(-2,147,483,648)
<code>SCHAR_MAX</code>	max value of signed char	(+127)
<code>SCHAR_MIN</code>	min value of signed char	(-128)
<code>SHRT_MAX</code>	max value of short	(+32,767)
<code>SHRT_MIN</code>	min value of short	(-32,768)
<code>UCHAR_MAX</code>	max value of unsigned char	(255)
<code>UINT_MAX</code>	max value of unsigned int	(65,535)
<code>ULONG_MAX</code>	max value of unsigned long	(4,294,967,295)
<code>USHRT_MAX</code>	max value of unsigned short	(65,536)

## Float Type Limits <float.h>

<code>FLT_RADIX</code>	radix of exponent rep	(2)
<code>FLT_ROUNDS</code>	floating point rounding mode	
<code>FLT_DIG</code>	decimal digits of precision	(6)
<code>FLT_EPSILON</code>	smallest <i>x</i> so $1.0 + x \neq 1.0$	( $10^{-5}$ )
<code>FLT_MANT_DIG</code>	number of digits in mantissa	
<code>FLT_MAX</code>	maximum floating point number	( $10^{37}$ )
<code>FLT_MAX_EXP</code>	maximum exponent	
<code>FLT_MIN</code>	minimum floating point number	( $10^{-37}$ )
<code>FLT_MIN_EXP</code>	minimum exponent	
<code>DBL_DIG</code>	decimal digits of precision	(10)
<code>DBL_EPSILON</code>	smallest <i>x</i> so $1.0 + x \neq 1.0$	( $10^{-9}$ )
<code>DBL_MANT_DIG</code>	number of digits in mantissa	
<code>DBL_MAX</code>	max double floating point number	( $10^{37}$ )
<code>DBL_MAX_EXP</code>	maximum exponent	
<code>DBL_MIN</code>	min double floating point number	( $10^{-37}$ )
<code>DBL_MIN_EXP</code>	minimum exponent	

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