

# C Reference Card (ANSI)

## Program Structure/Functions

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

## C Preprocessor

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

## Data Types/Declarations

character (1 byte)	<code>char</code>
integer	<code>int</code>
real number (single, double precision)	<code>float, double</code>
short (16 bit integer)	<code>short</code>
long (32 bit integer)	<code>long</code>
double long (64 bit integer)	<code>long long</code>
positive or negative	<code>signed</code>
non-negative modulo 2 <sup>m</sup>	<code>unsigned</code>
pointer to int, float,...	<code>int*, float*,...</code>
enumeration constant	<code>enum tag {name<sub>1</sub>=value<sub>1</sub>,...};</code>
constant (read-only) value	<code>type const name;</code>
declare external variable	<code>extern</code>
internal to source file	<code>static</code>
local persistent between calls	<code>static</code>
no value	<code>void</code>
structure	<code>struct tag {...};</code>
create new name for data type	<code>typedef type name;</code>
size of an object (type is <code>size_t</code> )	<code>sizeof object</code>
size of a data type (type is <code>size_t</code> )	<code>sizeof (type)</code>

## Initialization

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

## Constants

suffix: long, unsigned, float	65536L, -1U, 3.0F
exponential form	4.2e1
prefix: octal, hexadecimal	0, 0x or 0X
Example. 031 is 25, 0x31 is 49 decimal	
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>	<code>type *name;</code>
declare function returning pointer to <i>type</i>	<code>type *f();</code>
declare pointer to function returning <i>type</i>	<code>type (*pf)();</code>
generic pointer type	<code>void *</code>
null pointer constant	<code>NULL</code>
object pointed to by <i>pointer</i>	<code>*pointer</code>
address of object <i>name</i>	<code>&amp;name</code>
array	<code>name[dim]</code>
multi-dim array	<code>name[dim<sub>1</sub>][dim<sub>2</sub>]...</code>

### Structures

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

## Operators (grouped by precedence)

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

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

## Flow of Control

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

### Flow Constructions

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

## ANSI Standard Libraries

<code>&lt;assert.h&gt;</code>	<code>&lt;ctype.h&gt;</code>	<code>&lt;errno.h&gt;</code>	<code>&lt;float.h&gt;</code>	<code>&lt;limits.h&gt;</code>
<code>&lt;locale.h&gt;</code>	<code>&lt;math.h&gt;</code>	<code>&lt;setjmp.h&gt;</code>	<code>&lt;signal.h&gt;</code>	<code>&lt;stdarg.h&gt;</code>
<code>&lt;stddef.h&gt;</code>	<code>&lt;stdio.h&gt;</code>	<code>&lt;stdlib.h&gt;</code>	<code>&lt;string.h&gt;</code>	<code>&lt;time.h&gt;</code>

## Character Class Tests <ctype.h>

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

## String Operations <string.h>

<code>s</code> is a string; <code>cs, ct</code> are constant strings	
length of <code>s</code>	<code>strlen(s)</code>
copy <code>ct</code> to <code>s</code>	<code>strcpy(s,ct)</code>
concatenate <code>ct</code> after <code>s</code>	<code>strcat(s,ct)</code>
compare <code>cs</code> to <code>ct</code>	<code>strcmp(cs,ct)</code>
only first <code>n</code> chars	<code>strncmp(cs,ct,n)</code>
pointer to first <code>c</code> in <code>cs</code>	<code>strchr(cs,c)</code>
pointer to last <code>c</code> in <code>cs</code>	<code>strrchr(cs,c)</code>
copy <code>n</code> chars from <code>ct</code> to <code>s</code>	<code>memcpy(s,ct,n)</code>
copy <code>n</code> chars from <code>ct</code> to <code>s</code> (may overlap)	<code>memmove(s,ct,n)</code>
compare <code>n</code> chars of <code>cs</code> with <code>ct</code>	<code>memcmp(cs,ct,n)</code>
pointer to first <code>c</code> in first <code>n</code> chars of <code>cs</code>	<code>memchr(cs,c,n)</code>
put <code>c</code> into first <code>n</code> chars of <code>s</code>	<code>memset(s,c,n)</code>

# C Reference Card (ANSI)

## Input/Output <stdio.h>

### Standard I/O

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

### File I/O

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

### 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 (printf) <i>e, E</i> exponential
<i>f</i>	float (scanf) <i>lf</i> double (scanf)
<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	va_list <i>ap</i> ;
initialization of argument pointer	va_start( <i>ap</i> , <i>lastarg</i> );
<i>lastarg</i> is last named parameter of the function	
access next unnamed arg, update pointer	va_arg( <i>ap</i> , <i>type</i> )
call before exiting function	va_end( <i>ap</i> );

## Standard Utility Functions <stdlib.h>

absolute value of int <i>n</i>	abs( <i>n</i> )
absolute value of long <i>n</i>	labs( <i>n</i> )
quotient and remainder of ints <i>n, d</i>	div( <i>n, d</i> )
returns structure with <i>div_t.quot</i> and <i>div_t.rem</i>	
quotient and remainder of longs <i>n, d</i>	ldiv( <i>n, d</i> )
returns structure with <i>ldiv_t.quot</i> and <i>ldiv_t.rem</i>	
pseudo-random integer [0, RAND_MAX]	rand()
set random seed to <i>n</i>	srand( <i>n</i> )
terminate program execution	exit( <i>status</i> )
pass string <i>s</i> to system for execution	system( <i>s</i> )
<b>Conversions</b>	
convert string <i>s</i> to double	atof( <i>s</i> )
convert string <i>s</i> to integer	atoi( <i>s</i> )
convert string <i>s</i> to long	atol( <i>s</i> )
convert prefix of <i>s</i> to double	strtod( <i>s</i> , & <i>endp</i> )
convert prefix of <i>s</i> (base <i>b</i> ) to long	strtoul( <i>s</i> , & <i>endp</i> , <i>b</i> )
same, but unsigned long	

### Storage Allocation

allocate storage	malloc( <i>size</i> ), calloc( <i>nobj</i> , <i>size</i> )
change size of storage	newptr = realloc( <i>ptr</i> , <i>size</i> );
deallocate storage	free( <i>ptr</i> );

### Array Functions

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

## Time and Date Functions <time.h>

processor time used by program	clock()
Example. clock()/CLOCKS_PER_SEC is time in seconds	
current calendar time	time()
<i>time</i> <sub>2</sub> - <i>time</i> <sub>1</sub> in seconds (double)	difftime( <i>time</i> <sub>2</sub> , <i>time</i> <sub>1</sub> )
arithmetic types representing times	clock_t, time_t
structure type for calendar time comps	struct tm
tm_sec	seconds after minute
tm_min	minutes after hour
tm_hour	hours since midnight
tm_mday	day of month
tm_mon	months since January
tm_year	years since 1900
tm_wday	days since Sunday
tm_yday	days since January 1
tm_isdst	Daylight Savings Time flag
convert local time to calendar time	mktime( <i>tp</i> )
convert time in <i>tp</i> to string	asctime( <i>tp</i> )
convert calendar time in <i>tp</i> to local time	ctime( <i>tp</i> )
convert calendar time to GMT	gmtime( <i>tp</i> )
convert calendar time to local time	localtime( <i>tp</i> )
format date and time info	strftime( <i>s</i> , <i>smax</i> , "format", <i>tp</i> )
<i>tp</i> is a pointer to a structure of type tm	

## Mathematical Functions <math.h>

Arguments and returned values are double

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

## Integer Type Limits <limits.h>

The numbers given in parentheses are typical values for the constants on a 32-bit Unix system, followed by minimum required values (if significantly different).

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

## Float Type Limits <float.h>

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

FLT_RADIX	radix of exponent rep	(2)
FLT_ROUNDS	floating point rounding mode	
FLT_DIG	decimal digits of precision	(6)
FLT_EPSILON	smallest <i>x</i> so 1.0f + <i>x</i> ≠ 1.0f	(1.1E - 7)
FLT_MANT_DIG	number of digits in mantissa	
FLT_MAX	maximum float number	(3.4E38)
FLT_MAX_EXP	maximum exponent	
FLT_MIN	minimum float number	(1.2E - 38)
FLT_MIN_EXP	minimum exponent	
DBL_DIG	decimal digits of precision	(15)
DBL_EPSILON	smallest <i>x</i> so 1.0 + <i>x</i> ≠ 1.0	(2.2E - 16)
DBL_MANT_DIG	number of digits in mantissa	
DBL_MAX	max double number	(1.8E308)
DBL_MAX_EXP	maximum exponent	
DBL_MIN	min double number	(2.2E - 308)
DBL_MIN_EXP	minimum exponent	

January 2007 v2.2. Copyright © 2007 Joseph H. Silverman

Permission is granted to make and distribute copies of this card provided the copyright notice and this permission notice are preserved on all copies.

Send comments and corrections to J.H. Silverman, Math. Dept., Brown Univ., Providence, RI 02912 USA. (jhs@math.brown.edu)