

# C Reference Card (ANSI)

## Program Structure/Functions

<code>type fnc(type<sub>1</sub>,...)</code>	function declarations
<code>type name</code>	external variable declarations
<code>main() {</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>main(int argc, char *argv[])</code>	main with args
<code>exit(arg)</code>	terminate execution

## C Preprocessor

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

## Data Types/Declarations

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

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 <code>type</code>	<code>type *name</code>
declare function returning pointer to <code>type</code>	<code>type *f()</code>
declare pointer to function returning <code>type</code>	<code>type (*pf)()</code>
generic pointer type	<code>void *</code>
null pointer	<code>NULL</code>
object pointed to by <code>pointer</code>	<code>*pointer</code>
address of object <code>name</code>	<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>
<code>Example. (*p).x and p-&gt;x are the same</code>	
single value, multiple type structure	<code>union</code>
bit field with <code>b</code> bits	<code>member : b</code>

## Operators (grouped by precedence)

structure member operator	<code>name.member</code>
structure 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>
comparisons	<code>&gt;, &gt;=, &lt;, &lt;=</code>
comparisons	<code>==, !=</code>
bitwise and	<code>&amp;</code>
bitwise exclusive or	<code>^</code>
bitwise or (incl)	<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 <code>switch, while, do, for</code>	<code>break</code>
next iteration of <code>while, do, for</code>	<code>continue</code>
go to	<code>goto label</code>
label	<code>label:</code>
return value from function	<code>return expr</code>

### Flow Constructions

<code>if statement</code>	<code>if (expr) statement</code> <code>else if (expr) statement</code> <code>else statement</code>
<code>while statement</code>	<code>while (expr)</code> <code>statement</code>
<code>for statement</code>	<code>for (expr<sub>1</sub>; expr<sub>2</sub>; expr<sub>3</sub>)</code> <code>statement</code>
<code>do statement</code>	<code>do statement</code> <code>while(expr);</code>
<code>switch statement</code>	<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>

`s,t` are strings, `cs,ct` 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>
up to <code>n</code> chars	<code>strncpy(s,ct,n)</code>
concatenate <code>ct</code> after <code>s</code>	<code>strcat(s,ct)</code>
up to <code>n</code> chars	<code>strncat(s,ct,n)</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>cs</code>	<code>memset(s,c,n)</code>

# C Reference Card (ANSI)

## 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(chr)</code>
print formatted data	<code>printf("format", arg1, ...)</code>
print to string <i>s</i>	<code>sprintf(s, "format", arg1, ...)</code>
read formatted data	<code>scanf("format", &amp;name1, ...)</code>
read from string <i>s</i>	<code>sscanf(s, "format", &amp;name1, ...)</code>
read line to string <i>s</i> (< max chars)	<code>gets(s, max)</code>
print string <i>s</i>	<code>puts(s)</code>

### File I/O

declare file pointer	<code>FILE *fp</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(fp)</code>
write a character	<code>putc(chr, fp)</code>
write to file	<code>fprintf(fp, "format", arg1, ...)</code>
read from file	<code>fscanf(fp, "format", arg1, ...)</code>
close file	<code>fclose(fp)</code>
non-zero if error	<code>ferror(fp)</code>
non-zero if EOF	<code>feof(fp)</code>
read line to string <i>s</i> (< max chars)	<code>fgets(s, max, fp)</code>
write string <i>s</i>	<code>fputs(s, fp)</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 name;</code>
initialization of argument pointer	<code>va_start(name, lastarg)</code>
<i>lastarg</i> is last named parameter of the function	
access next unnamed arg, update pointer	<code>va_arg(name, type)</code>
call before exiting function	<code>va_end(name)</code>

## Standard Utility Functions <stdlib.h>

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

### Conversions

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

### Storage Allocation

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

### Array Functions

search array for key	<code>bsearch(key, array, n, size, cmp())</code>
sort array ascending order	<code>qsort(array, n, size, cmp())</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>
<code>time2-time1</code> in seconds (double)	<code>difftime(time2, time1)</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(tp)</code>
convert time in <i>tp</i> to string	<code>asctime(tp)</code>
convert calendar time in <i>tp</i> to local time	<code>ctime(tp)</code>
convert calendar time to GMT	<code>gmtime(tp)</code>
convert calendar time to local time	<code>localtime(tp)</code>
format date and time info	<code>strftime(s, smax, "format", tp)</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(x), cos(x), tan(x)</code>
inverse trig functions	<code>asin(x), acos(x), atan(x)</code>
arctan( <i>y/x</i> )	<code>atan2(y, x)</code>
hyperbolic trig functions	<code>sinh(x), cosh(x), tanh(x)</code>
exponentials & logs	<code>exp(x), log(x), log10(x)</code>
exponentials & logs (2 power)	<code>ldexp(x, n), frexp(x, *e)</code>
division & remainder	<code>modf(x, *ip), fmod(x, y)</code>
powers	<code>pow(x, y), sqrt(x)</code>
rounding	<code>ceil(x), floor(x), fabs(x)</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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Send comments and corrections to J.H. Silverman, Math. Dept., Brown Univ., Providence, RI 02912 USA. (jhs@math.brown.edu)