

# C Reference Card (ANSI)

## Program Structure/Functions

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

## C Preprocessor

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

## Data Types/Declarations

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

## Initialization

|                        |   |
|------------------------|---|
| initialize variable    | <i>type name</i> = <i>value</i>                         |
| initialize array       | <i>type name</i> [] = { <i>value</i> <sub>1</sub> ,...} |
| initialize char string | <b>char</b> <i>name</i> [] = " <i>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</i> * <i>name</i>  |
| declare function returning pointer to <i>type</i> | <i>type</i> *f()   |
| declare pointer to function returning <i>type</i> | <i>type</i> (*pf)()  |
| generic pointer type                              | <b>void</b> *  |
| null pointer                                      | <b>NULL</b>  |
| object pointed to by <i>pointer</i>               | * <i>pointer</i>   |
| address of object <i>name</i>                     | & <i>name</i>  |
| array   | <i>name</i> [ <i>dim</i> ]   |
| multi-dim array                                   | <i>name</i> [ <i>dim</i> <sub>1</sub> ] [ <i>dim</i> <sub>2</sub> ]... |

### Structures

|   |  |
|---|--|
| <b>struct</b> <i>tag</i> {<br><i>declarations</i><br>}; | structure template<br>declaration of members |
| create structure  | <b>struct</b> <i>tag name</i>                |
| member of structure from template                       | <i>name.member</i>                           |
| member of pointed to structure                          | <i>pointer -&gt; member</i>                  |
| <i>Example. (*p).x</i> and <i>p-&gt;x</i> are the same  |  |
| single value, multiple type structure                   | <b>union</b>                                 |
| bit field with <i>b</i> bits                            | <i>member</i> : <i>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                          | <b>sizeof</b>  |
| 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</i> <sub>1</sub> ? <i>expr</i> <sub>2</sub> : <i>expr</i> <sub>3</sub> |
| 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 | <b>break</b>  |
| next iteration of while, do, for | <b>continue</b>   |
| go to                            | <b>goto</b> <i>label</i>  |
| label                            | <i>label</i> :  |
| return value from function       | <b>return</b> <i>expr</i>   |
| <b>Flow Constructions</b>        |   |
| if statement                     | <b>if</b> ( <i>expr</i> ) <i>statement</i><br><b>else if</b> ( <i>expr</i> ) <i>statement</i><br><b>else</b> <i>statement</i>   |
| while statement                  | <b>while</b> ( <i>expr</i> )<br><i>statement</i>  |
| for statement                    | <b>for</b> ( <i>expr</i> <sub>1</sub> ; <i>expr</i> <sub>2</sub> ; <i>expr</i> <sub>3</sub> )<br><i>statement</i>   |
| do statement                     | <b>do</b> <i>statement</i><br><b>while</b> ( <i>expr</i> );   |
| switch statement                 | <b>switch</b> ( <i>expr</i> ) {<br><b>case</b> <i>const</i> <sub>1</sub> : <i>statement</i> <sub>1</sub> <b>break</b> ;<br><b>case</b> <i>const</i> <sub>2</sub> : <i>statement</i> <sub>2</sub> <b>break</b> ;<br><b>default</b> : <i>statement</i><br>} |

## 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?                         | isctrl(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>

|   |   |
|---|---|
| <i>s</i> , <i>t</i> are strings, <i>cs</i> , <i>ct</i> are constant strings |   |
| length of <i>s</i>  | <b>strlen</b> ( <i>s</i> )                          |
| copy <i>ct</i> to <i>s</i>  | <b>strcpy</b> ( <i>s</i> , <i>ct</i> )              |
| up to <i>n</i> chars  | <b>strncpy</b> ( <i>s</i> , <i>ct</i> , <i>n</i> )  |
| concatenate <i>ct</i> after <i>s</i>  | <b>strcat</b> ( <i>s</i> , <i>ct</i> )              |
| up to <i>n</i> chars  | <b>strncat</b> ( <i>s</i> , <i>ct</i> , <i>n</i> )  |
| compare <i>cs</i> to <i>ct</i>  | <b>strcmp</b> ( <i>cs</i> , <i>ct</i> )             |
| only first <i>n</i> chars   | <b>strncmp</b> ( <i>cs</i> , <i>ct</i> , <i>n</i> ) |
| pointer to first <i>c</i> in <i>cs</i>                                      | <b>strchr</b> ( <i>cs</i> , <i>c</i> )              |
| pointer to last <i>c</i> in <i>cs</i>                                       | <b>strrchr</b> ( <i>cs</i> , <i>c</i> )             |
| copy <i>n</i> chars from <i>ct</i> to <i>s</i>                              | <b>memcpy</b> ( <i>s</i> , <i>ct</i> , <i>n</i> )   |
| copy <i>n</i> chars from <i>ct</i> to <i>s</i> (may overlap)                | <b>memmove</b> ( <i>s</i> , <i>ct</i> , <i>n</i> )  |
| compare <i>n</i> chars of <i>cs</i> with <i>ct</i>                          | <b>memcmp</b> ( <i>cs</i> , <i>ct</i> , <i>n</i> )  |
| pointer to first <i>c</i> in first <i>n</i> chars of <i>cs</i>              | <b>memchr</b> ( <i>cs</i> , <i>c</i> , <i>n</i> )   |
| put <i>c</i> into first <i>n</i> chars of <i>cs</i>                         | <b>memset</b> ( <i>s</i> , <i>c</i> , <i>n</i> )    |

# 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                                | 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> ,...) |
| read line to string <i>s</i> (< max chars) | gets( <i>s</i> ,max)  |
| 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)     |   |
| 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> ,...)  |
| close file                                 | fclose( <i>fp</i> )   |
| non-zero if error                          | ferror( <i>fp</i> )   |
| non-zero if EOF                            | feof( <i>fp</i> )   |
| read line to string <i>s</i> (< max chars) | fgets( <i>s</i> ,max, <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                        |
| space | print space if no sign                 |
| 0     | pad with leading zeros                 |
| w     | min field width                        |
| p     | precision                              |
| m     | conversion character:                  |
| h     | short, l long, L long double           |
| c     | conversion character:                  |
| d,i   | integer u unsigned                     |
| c     | single char s char string              |
| f     | double e,E exponential                 |
| o     | octal x,X hexadecimal                  |
| p     | pointer n number of chars written      |
| g,G   | same as f or e,E depending on exponent |

## Variable Argument Lists <stdarg.h>

|  |  |
|--|--|
| declaration of pointer to arguments                    | va_list <i>name</i> ;                    |
| initialization of argument pointer                     | va_start( <i>name</i> , <i>lastarg</i> ) |
| <i>lastarg</i> is last named parameter of the function |  |
| access next unnamed arg, update pointer                | va_arg( <i>name</i> , <i>type</i> )      |
| call before exiting function                           | va_end( <i>name</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</i> , <i>d</i> )  |
| returns structure with div_t.quot and div_t.rem   |                             |
| quotient and remainder of longs <i>n,d</i>        | ldiv( <i>n</i> , <i>d</i> ) |
| returns structure with ldiv_t.quot and ldiv_t.rem |                             |
| 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> )          |

### Conversions

|   |                                     |
|---|-------------------------------------|
| 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> ,endp)             |
| convert prefix of <i>s</i> (base <i>b</i> ) to long | strtol( <i>s</i> ,endp, <i>b</i> )  |
| same, but unsigned long                             | strtoul( <i>s</i> ,endp, <i>b</i> ) |

### Storage Allocation

|                       |                                 |
|-----------------------|---------------------------------|
| allocate storage      | malloc(size), calloc(nobj,size) |
| change size of object | realloc(pts,size)               |
| deallocate space      | free(ptr)                       |

### Array Functions

|                            |                                 |
|----------------------------|---------------------------------|
| search array for key       | bsearch(key,array,n,size,cmp()) |
| sort array ascending order | qsort(array,n,size,cmp())       |

## 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()  |
| time <sub>2</sub> -time <sub>1</sub> in seconds (double) | difftime(time <sub>2</sub> ,time <sub>1</sub> ) |
| arithmetic types representing times                      | clock_t,time_t                                  |
| structure type for calendar time comps                   | 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(tp)                            |
| convert time in <i>tp</i> to string              | asctime(tp)                           |
| convert calendar time in <i>tp</i> to local time | ctime(tp)                             |
| convert calendar time to GMT                     | gmtime(tp)                            |
| convert calendar time to local time              | localtime(tp)                         |
| format date and time info                        | strftime( <i>s</i> ,smax,"format",tp) |
| <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</i> , <i>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,n), frexp(x,*e)         |
| division & remainder          | modf(x,*ip), 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.

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

## Float Type Limits <float.h>

|              |   |                      |
|--------------|---|----------------------|
| 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 1.0 + <i>x</i> ≠ 1.0 | (10 <sup>-5</sup> )  |
| FLT_MANT_DIG | number of digits in mantissa              |                      |
| FLT_MAX      | maximum floating point number             | (10 <sup>37</sup> )  |
| FLT_MAX_EXP  | maximum exponent                          |                      |
| FLT_MIN      | minimum floating point number             | (10 <sup>-37</sup> ) |
| FLT_MIN_EXP  | minimum exponent                          |                      |
| DBL_DIG      | decimal digits of precision               | (10)                 |
| DBL_EPSILON  | smallest <i>x</i> so 1.0 + <i>x</i> ≠ 1.0 | (10 <sup>-9</sup> )  |
| DBL_MANT_DIG | number of digits in mantissa              |                      |
| DBL_MAX      | max double floating point number          | (10 <sup>37</sup> )  |
| DBL_MAX_EXP  | maximum exponent                          |                      |
| DBL_MIN      | min double floating point number          | (10 <sup>-37</sup> ) |
| DBL_MIN_EXP  | minimum exponent                          |                      |

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