

BLITZ Tools: Help Information

blitz -h

```
=====
=====
===== The BLITZ Machine Emulator =====
=====
=====
```

Copyright 2001-2007, Harry H. Porter III

```
=====
Original Author:
02/05/01 - Harry H. Porter III
```

Command Line Options

```
=====
These command line options may be given in any order.
```

```
filename
    The input executable file.  If missing, "a.out" will be used.
-h
    Print this help info.  Ignore other options and exit.
-d filename
    Disk file name.  If missing, "DISK" will be used.
-g
    Automatically begin emulation of the a.out program, bypassing
    the command line interface.
-i filename
    Terminal input file name.  If missing, "stdin" will be used.
-o filename
    Terminal output file name.  If missing, "stdout" will be used.
-r integer
    Set the random seed to the given integer, which must be > 0.
-raw
    User input for BLITZ terminal I/O will be in "raw" mode; the
    default is "cooked", in which case the running BLITZ code
    is relieved from echoing keystrokes, processing backspaces, etc.
-wait
    This option applies only when input is coming from an interactive
    terminal and a 'wait' instruction is executed with no other pending
    interrupts.  Without this option, execution will halt; with it the
    emulator will wait for input.
```

BLITZ Tools: Help Information

kpl -h

```
=====
=====
===== The KPL Compiler =====
=====
=====
```

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```
=====
```

Original Author:
06/15/02 - Harry H. Porter III
Modifications by:
03/15/06 - Harry H. Porter III

Command Line Options

```
=====
```

Command line options may be given in any order.

-h

Print this help info. All other options are ignored.

packageName

Compile the package with this name. The input will come from the files called "packageName.h" and "packageName.c". No extension should be given on the command line. Only one package may be compiled at once. The packageName is required.

-d directoryPrefix

When looking for header and code files, the default is to look in the current directory. With this option, the current directory is first searched. If that fails, then the directoryPrefix is prepended to the file name and the resulting file name is used. For example:

```
kpl myPack -d ~harry/BlitzLib/
```

will first try to open "myPack.h" and, if that fails, will try to open "~harry/BlitzLib/myPack.h".

-unsafe

Allow unsafe language constructs.

-o filename

If there are no errors, an assembly code file will be created. This option can be used to give the output file a specific name. If missing, the name of the output file will be computed from the name of the package and appending ".s". For example:

```
myPackage --> myPackage.s
```

COMPILER DEBUGGING: If packageName and output filename are missing, stdout will be used.

-testLexer

COMPILER DEBUGGING: Scan tokens only, and print tokens out. Input may come from stdin.

-testParser

COMPILER DEBUGGING: Parse program only, and print data structures out. Input may come from stdin.

-s

COMPILER DEBUGGING: Print the symbol table on stdout.

-p

COMPILER DEBUGGING: Pretty-print the AST.

-ast

COMPILER DEBUGGING: Dump the full AST.

BLITZ Tools: Help Information

asm -h

```
=====
=====
===== The BLITZ Assembler =====
=====
=====
```

Copyright 2000-2007, Harry H. Porter III

```
=====
```

Original Author:

11/12/00 - Harry H. Porter III

Modifications by:

03/15/06 - Harry H. Porter III

04/25/07 - Harry H. Porter III - Support for little endian added

Command Line Options

```
=====
```

Command line options may be given in any order.

filename

The input source will come from this file. (Normally this file will end with ".s".) If an input file is not given on the command line, the source must come from stdin. Only one input source is allowed.

-h

Print this help info. All other options are ignored.

-l

Print a listing on stdout.

-s

Print the symbol table on stdout.

-d

Print internal assembler info (for debugging asm.c)

-o filename

If there are no errors, an object file will be created. This option can be used to give the object file a specific name. If this option is not used, then the input .s file must be named on the command line (i.e., the source must not come from stdin.) In this case, the name of the object file will be computed from the name of the input file by removing the ".s" extension, if any, and appending ".o". For example:

```
test.s --> test.o
```

```
foo --> foo.o
```

Lexical issues:

```
=====
```

Identifiers - May contain letters, digits, and underscores. They must begin with a letter or underscore. Case is significant. Identifiers are limited in length to 200 characters.

Integers - May be specified in decimal or in hex.

Integers must range from 0 to 2147483647. Hex notation is, for example, 0x1234abcd. 0x1234ABCD is equivalent. Shorter numbers like 0xFFFF are not sign-extended.

Strings - Use double quotes. The following escape sequences are allowed:

```
\0 \a \b \t \n \v \f \r \" \' \\ \xHH
```

where HH are any two hex digits. Strings may not contain newlines directly; in other words, a string may not span multiple lines. The source file may not contain unprintable ASCII characters; use the escape sequences if you wish to include unprintable characters in string or character constants.

String constants are limited in length to 200 characters.

Characters - Use single quotes. The same escape sequences are allowed.

Comments - Begin with the exclamation mark (!) and extend thru end-of-line.

Punctuation symbols - The following symbols have special meaning:

```
, [ ] : . + ++ - -- * / << >> >>> & | ^ ~ ( ) =
```

Keywords - The following classes of keywords are recognized:

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BLITZ instruction op-codes (e.g., add, sub, syscall, ...)

Synthetic instructions (e.g., mov, set, ...)

Assembler pseudo-ops (e.g., .text, .import, .byte, ...)

Registers (r0, r1, ... r15)

White space - Tabs and space characters may be used between tokens.

End-of-line - The EOL (newline) character is treated as a token, not as white space; the EOL is significant in syntax parsing.

Assembler pseudo-ops

=====

.text The following instructions and data will be placed in the "text" segment, which will be read-only during execution.

.data The following instructions and data will be placed in the "data" segment, which will be read-write during execution.

.bss The following bytes will be reserved in the "bss" segment, which will be initialized to zero at program load time.

.ascii This operand expects a single string operand. These bytes will be loaded into memory. Note that no terminating NULL ('\0') character will be added to the end of the string.

.byte This pseudo-op expects a single expression as an operand. This expression will be evaluated at assembly time, the value will be truncated to 8 bits, and the result used to initialize a single byte of memory.

.word This pseudo-op expects a single expression as an operand. This expression will be evaluated at assembly time to a 32 bit value, and the result used to initialize four bytes of memory. The assembler does not require alignment for .word.

.double This pseudo-op expects a single floating-point constant as an operand. Examples include 1.2, -3.4E-21, and +4.5e+21.

.export This pseudo-op expects a single symbol as an operand. This symbol must be given a value in this file. This symbol with its value will be placed in the object file and made available during segment linking.

.import This pseudo-op expects a single symbol as an operand. This symbol must not be given a value in this file; instead it will receive its value from another .s file during segment linking. All uses of this symbol in this file will be replaced by that value at segment-link time.

.skip This pseudo-op expects a single expression as an operand. This expression must evaluate to an absolute value. The indicated number of bytes will be skipped in the current segment.

.align This instruction will insert 0, 1, 2, or 3 bytes into the current segment as necessary to bring the location up to an even multiple of 4. No operand is used with .align.

= Symbols may be given values with a line of the following format:

symbol = expression

These are called "equates". Equates will be processed during the first pass, if possible. If not, they will be processed after the program has been completely read in. The expression may use symbols that are defined later in the file, but this may cause the equate to be given a value slightly later in the assembly. After the first pass, an attempt will be made to evaluate all the equates. At this time, errors may be generated. After the equates have been processed, the machine code can be generated in the final pass.

Segments

=====

This assembler is capable of assembling BLITZ instructions and data and placing them in one of three "segments":

.text
.data
.bss

At run-time, the bytes placed in the .text segment will be read-only.

At run-time, the bytes placed in the .data segment will be read-write.

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At run-time, the bytes places in the .bss segment will be read-write. The read-only nature of the bytes in the .text segment may or may not be enforced by the operating system at run-time.

Instructions and data may be placed in either the .text or .data segment. No instructions or data may be placed in the .bss segment. The only things that may follow the .bss pseudo-op are the following pseudo-ops:

- .skip
- .align

The assembler may reserve bytes in the .bss segment but no initial values may be placed in these locations. Instead, all bytes of the .bss segment will be initialized to zeros at program-load time. These addresses may be initialized and modified during program execution.

Segment control is done using the following pseudo-ops:

- .text
- .data
- .bss

After any one of these pseudo-ops, all following instructions and data will be placed in the named segment. A "location counter" for each of the three segments is maintained by the assembler. If, for example, a .text pseudo-op has been used to switch to the ".text" segment, then all subsequent instructions will be placed in the ".text" segment. Any labels encountered will be given values relative to the ".text" segment. As each instruction is encountered, the location counter for the ".text" segment will be incremented. If a .data pseudo-op is encountered, all subsequent instructions will be placed in the ".data" segment. The location counters are not reset; if a .text pseudo-op is again encountered, subsequent instructions will be placed in the ".text" segment following the instructions encountered earlier, before the .data pseudo-op was seen. Thus, we can "pick up" in the .text segment where we left off.

Symbols

=====

The assembler builds a symbol table, mapping identifiers to values. Each symbol is given exactly one value: there is no notion of scope or lexical nesting levels, as in high-level languages. Each symbol is given a value which will be either:

- absolute
- relative
- external

An absolute value consists of a 32-bit quantity. A relative value consists of a 32-bit (signed) offset relative to either a segment or to an external symbol. An external symbol will have its value assigned in some other assembly file and its value will not be available to the code in this file until segment-linking time. However, an external symbol may be used in expressions within this file; the actual data will not be filled in until segment-linking time.

Symbols may be defined internally or externally. If a symbol is used in this file, but not defined, then it must be "imported" using the .import pseudo-op. If a symbol is defined in this file and used in other files, then it must be "exported" using an .export pseudo-op. If a symbol is not exported, then its value will not be known to the linker; if this same symbol is imported in other files, then an "undefined symbol" error will be generated at segment-linking time.

Symbols may be defined in either of two ways:

- labels
- = equates

If a symbol is defined by being used as a label, then it is given a value which consists of an offset relative to the beginning of whichever segment is current when the label is encountered. This is determined by whether a .text, .data, or .bss pseudo-op was seen last, before the label was encountered. Each label occurs in a segment and names a location in

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memory. At segment-link time, the segments are placed in their final positions in memory. Only at segment-link time does the actual address of the location in memory become known. At this time, the label is assigned an absolute value.

Expression Evaluation

=====

Instructions and pseudo-ops may contain expressions in their operands. Expressions have the form given by the following Context-Free Grammar. (In this grammar, the following meta-notation is used: characters enclosed in double quotes are terminals. The braces { } are used to mean "zero or more" occurrences. The vertical bar | is used to mean alternation. Parentheses are used for grouping. The start symbol is "expr".)

```
expr ::= expr1 { "|" expr1 }
expr1 ::= expr2 { "^" expr2 }
expr2 ::= expr3 { "&" expr3 }
expr3 ::= expr4 { ( "<<" | ">>" | ">>>" ) expr4 }
expr4 ::= expr5 { ( "+" | "-" ) expr5 }
expr5 ::= expr6 { ( "*" | "/" | "%" ) expr6 }
expr6 ::= "+" expr6 | "-" expr6 | "~" expr6
        | ID | INTEGER | STRING | "(" expr ")"
```

This syntax results in the following precedences and associativities:

highest:	unary+	unary-	~	(right associative)
	*	/	%	(left associative)
	+	-		(left associative)
	<<	>>	>>>	(left associative)
	&			(left associative)
	^			(left associative)
lowest:				(left associative)

If a string is used in an expression, it must have exactly 4 characters. The string will be interpreted as a 32 bit integer, based on the ASCII values of the 4 characters. ("Big Endian" order is used: the first character will determine the most significant byte.)

The following operators are recognized in expressions:

unary+	nop
unary-	32-bit signed arithmetic negation
~	32-bit logical negation (NOT)
*	32-bit multiplication
/	32-bit integer division with 32-bit integer result
%	32-bit modulo, with 32-bit result
binary+	32-bit signed addition
binary-	32-bit signed subtraction
<<	left shift logical (i.e., zeros shifted in from right)
>>	right shift logical (i.e., zeros shifted in from left)
>>>	right shift arithmetic (i.e., sign bit shifted in on left)
&	32-bit logical AND
^	32-bit logical Exclusive-OR
	32-bit logical OR

With the shift operators (<<, >>, and >>>) the second operand must evaluate to an integer between 0 and 31. With the division operators (/ and %), the first operand must be non-negative and the second operand must be positive, since these operators are implemented with "C" operators, which are machine-dependent with negative operands.

All operators except addition and subtraction require both operands to evaluate to absolute values. All arithmetic is done with signed 32-bit values. The addition operator + requires that at least one of the operands evaluates to an absolute value. If one operand is relative, then the result will be relative to the same location. The subtraction operator requires that the second operand evaluates to an absolute value. If the first operand is relative, then the result will be relative to the same location. Only absolute values can be negated.

All expressions are evaluated at assembly-time. An expression may

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evaluate to either an absolute 32-bit value, or may evaluate to a relative value. A relative value is a 32-bit offset relative to some symbol. The offset will be relative to the beginning of the .text segment, the .data segment, or the .bss segment, or the offset will be relative to some external symbol. If the expression evaluates to a relative value, its value will not be determined until segment-link time. At this time, the absolute locations of the .text, .data, and .bss segments will be determined and the absolute values of external symbols will be determined. At segment-link time, the final, absolute values of all expressions will be determined by adding the values of the symbols (or locations of the segments) to the offsets.

Expressions may be used in:

- .byte
- .word
- .skip
- =

various BLITZ instructions

The .skip pseudo-op requires the expression evaluates to an absolute value. In the case of an = (equate) pseudo-op, the expression may evaluate to either a relative or absolute value. In either case, the equated symbol will be given a relative or absolute value (respectively). At segment-linking time, when the actual value is determined, the value will be filled in in the byte, word, or appropriate field in the instruction.

Instruction Syntax

=====

Each line in the assembly source file has the following general syntax:

```
[ label: ] [ opcode operands ] [ !" comment ] EOL
```

The label is optional. It need not begin in column one. It must be followed by a colon token. A label may be on a line by itself. If so, it will be given an offset from the current value of the location counter, relative to the current segment.

The opcode must be a legal BLITZ instruction. The opcode is given in lowercase. The exact format of the operands depends on the instruction; some BLITZ instructions take no operands while some require several operands. Operands are separated by commas.

A comment is optional and extends to the end of the line if present.

Each line is independent. End-of-line (EOL) is a separate token. An instruction must be on only one line, although lines may be arbitrarily long.

Assembler pseudo-ops have the same general syntax. Some permit labels and others forbid labels.

The following formatting and spacing conventions are recommended:

- Labels should begin in column 1.
- The op-code should be indented by 1 tab stop.
- The operands, if any, should be indented by 1 additional tab stop.
- Each BLITZ instruction should be commented.
- The comment should be indented by 2 additional tab stops.
- A single space should follow the ! comment character.
- Block comments should occur before each routine.
- Comments should be indented with 2 spaces to show logical organization.

Here is an example of the recommended style for BLITZ assembly code. (The first line shows standard tab stops.)

```
1      t      t      t      t      t      t
! main ()
!
! This routine does such and such.
!
      .text
      .export main
```

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```
main:  push    r1          ! Save registers
       push    r2          ! .
loop:   ! LOOP
       cmp     r1,10       ! IF r1>10 THEN
       ble    endif       ! .
       sub    r2,1,r2     !   r2--
endif:  ! ENDIF
       sub    r1,r2,r3    !   r3 := r1-r2
       ...
```

Labels

=====

A label must be followed by a colon token, but the colon is not part of the label. A label may appear on a line by itself or the label may appear on a line containing a BLITZ instruction or one of the following pseudo-ops:

```
.ascii .byte .word .skip
```

Labels are not allowed on any other assembler pseudo-ops.

The label will define a new symbol, and the symbol will be given an offset relative to the beginning of the current segment. Labels defined in the current file may be exported and labels defined in other files may be imported. A label will name an address in memory, and as such a label cannot be given a final value until segment-linking time. During the assembly of the current file, labels in the file are given offsets relative to either the beginning of the .text, .data, or .bss segments.

Operand Syntax

=====

See the BLITZ instruction reference manual for details about what operands each instruction requires. Operands are separated by commas. Registers are specified in lowercase (e.g., r4). A memory reference may be in one of the following forms, although not all forms are allowed in all instructions. (Here "R" stands for any register.)

```
[R]
[R+R]
[R+expr]
[expr]
[--R]
[R++]
```

Some instructions allow data to be included directly; in such cases the operand will consist of an expression. The expression may evaluate to an absolute or relative value. Certain instructions (like jmp, call, and the branch instructions) require the operand to be relative to the segment in which the instruction occurs.

Here are several sample instructions to illustrate operand syntax:

```
add    r3,r4,r5
mul    r7,size,r7
sub    r1, ((x*23) << (y+1)), r1
call   foo
push   r6,[--r14]
pop    [r14++],r6
load   [r3],r9
load   [r3+r4],r9
load   [r3+arrayBase],r9
load   [x],r9
jmp    r3
bne    loop
set    0x12ab34cd,r8
syscall 3
reti
tset   [r4],r9
ldptbr r5
```

Note that whenever an instruction reads or writes memory, brackets are used.

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lddd -h

```
=====
=====
===== The BLITZ Linker =====
=====
=====
```

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```
=====
```

Original Author:

12/29/00 - Harry H. Porter III

Modifications by:

03/15/06 - Harry H. Porter III

04/27/07 - Harry H. Porter III - Support for little endian added

Command Line Options

```
=====
```

These command line options may be given in any order.

filename1 filename2 filename3 ...

The input object files, which will normally end with ".o".

There must be at least one input file.

-h

Print this help info. Ignore other options and exit.

-o filename

If there are no errors, an executable file will be created. This option can be used to give the object file a specific name.

If this option is not used, then the output file will be named "a.out".

-l

Print a listing on stdout.

-s

Print the symbol table on stdout.

-p integer

The page size. The integer must be a multiple of 4 greater than zero. (The default is 8192 = 8K.)

-a integer

The logical address at which to load the program at run-time.

The integer must be a non-negative multiple of the page size.

(The default is 0.)

BLITZ Tools: Help Information

dumpObj -h

```
=====
=====
===== The BLITZ Object File Dump Program =====
=====
=====
```

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```
=====
```

Original Author:

11/12/00 - Harry H. Porter III

Modifications by:

03/15/06 - Harry H. Porter III

04/30/07 - Harry H. Porter III - Support for little endian added

Overview

```
=====
```

This program prints out a BLITZ ".o" or "a.out" file in human-readable form. This program does some (very limited) error checking on the file.

Command Line Options

```
=====
```

Command line options may be given in any order.

-h

Print this info. The input source is ignored.

filename

The input source will come from this file. (This file should be a ".o" or "a.out" file.) If an input file is not named on the command line, the source must come from stdin. Only one input source is allowed.

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diskUtil -h

```
=====
=====
===== The BLITZ Disk Utility =====
=====
=====
```

Copyright 2004-2007, Harry H. Porter III

```
=====
Original Author:
  10/07/04 - Harry H. Porter III
Modifications by:
  04/30/07 - Harry H. Porter III - Support for little endian added
```

This command can be used to manipulate the BLITZ "DISK" file.

The BLITZ emulator simulates the BLITZ disk using a Unix file on the host machine. This program allows that file to be manipulated. For example, it can be used to copy an executable file containing a user program to the BLITZ disk so that the BLITZ OS kernel can then access, load, and run it.

The BLITZ DISK is organized as follows. The disk contains a single directory and this is kept in sector 0. The files are placed sequentially on the disk, one after the other. Each file will take up an integral number of sectors. Each file has an entry in the directory. Each entry contains

- (1) The starting sector
- (2) The file length, in bytes (possibly zero)
- (3) The number of characters in the file name
- (4) The file name

The directory begins with three numbers:

- (1) Magic Number (0x73747562 = "stub")
- (2) Number of files (possibly zero)
- (3) Number of the next free sector

These are followed by the entries for each file.

Once created, a BLITZ file may not have its size increased. When a file is removed, the free sectors become unusable; there is no compaction or any attempt to reclaim the lost space.

Each time this program is run, it performs one of the following functions:

Initialize	set up a new file system on the BLITZ disk
List	list the directory on the BLITZ disk
Create	create a new file of a given size
Remove	remove a file
Add	copy a file from Unix to BLITZ
Extract	copy a file from BLITZ to Unix
Write	write sectors from a Unix file to the BLITZ disk

The following command line options tell which function is to be performed:

```
-h      Print this help info. Ignore other options and exit.
-d DiskFileName
      The file used to emulate the BLITZ disk. If missing, "DISK" will be used.
-i
      Initialize the file system on the BLITZ "DISK" file. This will
      effectively remove all files on the BLITZ disk and reclaim all available
      space.
-l
      List the directory on the BLITZ disk.
-c BlitzFileName SizeInBytes
      Create a file of the given size on the BLITZ disk. The BLITZ
```

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disk must not already contain a file with this name. Only the directory will be modified; the actual data in the file will be whatever bytes happened to be on the disk already.

- r BlitzFileName
Remove the file with the given name from the directory on the BLITZ disk.
- a UnixFilename BlitzFileName
Copy a file from Unix to the BLITZ disk. If BlitzFileName already exists, it must be large enough to accomodate the new data.
- e BlitzFileName UnixFileName
Extract a file from the BLITZ disk to Unix. This command will copy the data from the BLITZ disk to a Unix file. The Unix file may or may not already exist; its size will be shortened or lengthened as necessary.
- w UnixFileName SectorNumber
The UnixFileName must be an existing Unix file. The SectorNumber is an integer. The Unix file data will be written to the BLITZ disk, starting at sector SectorNumber. The directory will not be modified.
- v
Verbose; print lots of messages.

Only one of -i, -l, -c, -r, -a, -e, or -w may be used at a time.
