

dlx user manual

Title	dlx (DLX functional model for ArchC)
Author	Nikolaos Kavvadias 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014
Contact	nikos@nkavvadias.com
Website	http://www.nkavvadias.com
Release Date	30 October 2014
Version	0.1.2
Rev. history	
v0.1.2	2014-10-23 Documentation corrections.
v0.1.1	2014-10-23 <ul style="list-style-type: none">• Fixed wrong reference to memory MEM (correct is DM).• The simulator binary (<code>dlx.x</code>) is now correctly generated.
v0.1.0	2014-10-22 <ul style="list-style-type: none">• Updated documentation as README.rst.• Changed <code>func</code> from <code>0x06</code> to <code>0x09</code> for <code>multu</code>.• Removed <code>sequ</code>, <code>sneu</code>.• Changed <code>func</code> for <code>div</code> (<code>0x19</code>) and <code>divu</code> (<code>0x1A</code>).• Newly added files: <code>defines_gdb</code>, <code>modifiers</code>.• Updated <code>dlx_opcode_map.xls</code>.
v0.0.4	2006-11-15 <ul style="list-style-type: none">• Added <code>pcount</code> instruction for basic-block profiling.

v0.0.3	<p>2006-07-01</p> <ul style="list-style-type: none"> • Corrected optimization instruction methods for <code>j</code>, <code>jal</code>, <code>jr</code>, <code>jalr</code>, <code>beqz</code>, <code>bnez</code>. • Alternate behaviors for <code>div</code>, <code>divu</code> added. • Fixed copyright notations to manually-written files: • (<code>*.ac</code>, <code>dlx-isa.cpp</code>, <code>dlx_syscall.cpp</code>, <code>dlx_gdb_funcs.cpp</code>). • Behaviors for <code>addui</code>, <code>subui</code> have been corrected.
v0.0.2	<p>2006-01-01</p> <ul style="list-style-type: none"> • Changed behavior of <code>j</code>, <code>jal</code>, <code>beqz</code>, <code>bnez</code> according to what is expected by the binutils DLX port. • Fixed issue with <code>jr</code> instruction. • New encoding for the <code>halt</code> instruction. • Changed register notation to comply to DLX conventions: (<code>r0-r31</code>) and alternate notation: (<code>zero</code>, <code>at</code>, <code>v0-v1</code>, <code>a0-a3</code>, <code>t0-t9</code>, <code>s0-s7</code>, <code>k0-k1</code>, <code>gp</code>, <code>sp</code>, <code>fp</code>, <code>ra</code>) • Both prefixed (by a dollar sign) and unprefixed symbolic register names should be accepted. • Disabled non-standard DLX instructions, along with <code>mvts</code>, <code>mvfs</code>. • The standard <code>mult</code>, <code>multu</code>, <code>div</code>, <code>divu</code> opcodes are now used. • Testsuite directory removed. The <code>acstone</code> benchmarks should be used instead for the purpose of benchmarking the DLX model.

v0.0.1	2005-12-26 <ul style="list-style-type: none"> • First public version. • Most integer instruction set functionality has been added. • Very few applications have been tested: <ol style="list-style-type: none"> 1. <code>fib.s</code> (generated by <code>dlxgcc-2.7.2.3</code> and slightly modified) 2. <code>loadi.s</code> (tests load immediate pseudo-instructions)
---------------	---

1. Introduction

This is the DLX ArchC (<http://www.archc.org>) functional model. This model has the system call emulation functions implemented, so it is a good idea to turn on the ABI option.

2. File listing

The `dlx` distribution includes the following files:

<code>/dlx</code>	Top-level directory
<code>AUTHORS</code>	List of <code>dlx</code> authors.
<code>LICENSE</code>	The modified BSD license governs <code>dlx</code> .
<code>README.html</code>	HTML version of README.
<code>README.pdf</code>	PDF version of README.
<code>README.rst</code>	This file.
<code>VERSION</code>	Current version of the project sources.
<code>bp_conf.ac</code>	Branch predictor description (only for <code>archc-1.5.1.bp2</code>).
<code>defines_gdb</code>	Macro definitions for GDB integration.
<code>dlx.ac</code>	Register, memory and cache model for <code>dlx</code> .
<code>dlx_gdb_funcs.cpp</code>	GDB support for the DLX simulator.
<code>dlx_isa.ac</code>	Instruction encodings and assembly formats.
<code>dlx_opcode_map.vsd</code>	Incomplete MS Visio drawing of the DLX opcode map.
<code>dlx_opcode_map.xls</code>	Excel spreadsheet containing the DLX opcode map.
<code>dlx_syscall.cpp</code>	OS call emulation support for DLX.
<code>dlx_isa.cpp</code>	Instruction behaviors.
<code>modifiers</code>	Instruction encoding and decoding modifiers.

rst2docs.sh	Bash script for generating the HTML and PDF versions of the documentation (README).
-------------	---

3. Usage

To generate the interpreted simulator, the `acsim` executable is ran:

```
$ acsim dlx.ac [-g -abi -gdb]      # (create the simulator)
$ make -f Makefile.archc          # (compile)
$ ./dlx.x --load=<file-path> [args] # (run an application)
```

To generate the compiled application simulator, the `accsim` executable is ran:

```
$ accsim dlx.ac <file-path>      # (create specialized simulator)
$ make -f Makefile.archc        # (compile)
$ ./dlx.x [args]                # (run the application)
```

The `[args]` are optional arguments for the application.

There are two formats recognized for application `<file-path>`:

- ELF binary matching ArchC specifications
- hexadecimal text file for ArchC

In order to generate the binary utilities port (`binutils` port), the `acbingen.sh` driver script must be used. This should be called as follows:

```
$ acbingen.sh -adlx -i `pwd`/ ../dlx-tools/ dlx.ac
```

for generating the `binutils` port executables. This includes the following tools:

- `addr2line`
- `ar`
- `as`
- `c++filt`
- `gdb` (the GDB port is also generated in the same directory)
- `gdbtui`
- `ld`
- `nm`
- `objcopy`
- `objdump`
- `ranlib`
- `readelf`

- `size`
- `strings`
- `strip`

4. General observations

1. Some non-classical DLX instructions (available in the DLX binutils target) might be added in the future. These are:
 - `bswap` (BSWAPF) --> A byte swap instruction
 - `ldstbu` (LSBUOP) --> Atomic load-store byte unsigned
 - `ldsthu` (LSHUOP) --> Atomic load-store halfword unsigned
 - `ldstw` (LSWOP) --> Atomic load-store word
2. `mult`, `multu`, `div`, `divu` instructions have different opcodes to the binutils DLX. Also, `div`, `divu` produce a single 32-bit result (the quotient). Probably, `rem`, `remu` instructions will be added to produce the remainder of a division. For 64-bit result multiplication maybe a good choice is to provide `multl`, `multlu` primitives, for which results are written in two consecutive registers (integer registers).
3. There are no HI/LO registers (I think this is the actual intent in the Patterson book).
4. Multiplication and division DONNOT use the floating-point register file. For this reason, `mvts`, `mvfs` instructions are currently unimplemented.
5. Loading 32-bit constants will be available via appropriate pseudo- instructions not requiring the HI/LO registers, and for the following formats:

```
li    %dest, #hi-16bit-constant, #lo-16bit-constant
li    %dest, #32bit-constant
```

6. For future provision of a coprocessor (maybe this is an overkill for the DLX?) some opcodes MIGHT be moved, e.g.:
 - Move `opcode(J)=0x02`, `opcode(JAL)=0x03` to e.g. `0x06,0x07`, respectively. (PREFERRED)
 - Move `opcode(BEQZ)`, `opcode(BNEZ)` to `0x16, 0x17`.
 - Then the `0x01-0x04` primary opcodes would be used for 4 optional coprocessors.