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CSc 340

Foundations of Computer Systems

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MIPS Instruction Set

MIPS Instructions

The MIPS instruction set is covered in detail in the SPIM handout. In all instructions Src2 can either be a register or a 16-bit immediate value. I left out the immediate forms because the MIPS assembler takes care of converting the general forms into the immediate forms when appropriate.

Logical operations `and, or, xor, nor`.

Syntax: `op Rdest, Rsrc1, Src2`.

Unary operations `abs, neg, not`.

Syntax: `op Rdest, Rsrc`.

MIPS Instructions ...

Shift/rotate `sll, srl, sra, rol, ror`.

Syntax: `op Rdest, Rsrc1, Src2`.

Arithmetic `add, addu, sub, subu`.

Syntax: `op Rdest, Rsrc1, Src2`.

MIPS Instructions ...

Multiplication

`mult, multu`. Syntax: `op Rsrc1, Rsrc2`.

- Multiplies the contents of the two registers, putting the low-order word of the result in the register ⌜`lo`⌝, and the high-order word in ⌜`hi`⌝.

`mul, mulo, mulou`.

Syntax: `op Rdest, Rsrc1, Rsrc2`.

- Multiplies `Rsrc1` by `Rsrc2` and stores the result in `Rdest`. These are synthetic instruction.

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MIPS Instructions . . .

Division

`div`, `divu`. Syntax: `op Rsrc1, Rsrc2`.

- Divides the contents of Rsrc1 by Rsrc2, and leaves the quotient in ⌜`lo`⌝ and the remainder in ⌜`hi`⌝.

`div`, `divu`. Syntax: `op Rdest, Rsrc1, Rsrc2`.

- Divides the contents of `Rsrc1` by `Rsrc2`, and leaves the quotient in `Rdest`.

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Load/Store Instructions

- `lw` Syntax: `ld Rdest, address`
- address can be one of:
  1. (register)
  2. imm
  3. imm(register)
  4. symbol
  5. symbol±imm
  6. symbol±imm(register).

  We'll cover addressing modes in more detail in a later topic.

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Load/Store Instructions . . .

- The `lw` instruction, and its variants, load a value from memory into register `Rdest`. The memory address can be specified in one of the ways shown above.
- A load instruction affects the entire register, even if you only load a byte into it (for example). The high-order bytes are either
  1. cleared to zero (for an unsigned load), or
  2. sign-extended (for a signed load).

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Load/Store Instructions . . .

- `sw`
  Syntax: `ld Rsrc, address`
- Stores the value in register `Rsrc` into memory at the specified address.
- Note that if you store one byte, only that byte of memory is affected. Stores have different behavior from loads in that sense.

Branch and Jump Instructions

- The syntax varies for different branch instructions:
  1. Some, like ⌜`b`⌝, have a single label argument and always branches to that label.
  2. Others compare two registers and branch if the comparison is true.
  3. Some test a single register and branch if the test is true.

Misc. Instructions

- ⌜`move Rdest, Rsrc`⌝ sets Rdest to Rsrc.
- ⌜`la Rdest, address`⌝ Loads the value of address into `Rdest`, not the contents of memory at that address.
- The following instructions Moves into and out of the ⌜`hi`⌝ and ⌜`lo`⌝ registers:
  1. ⌜`mfhi Rdest`⌝
  2. ⌜`mflo Rdest`⌝
  3. ⌜`mthi Rsrc`⌝
  4. ⌜`mtlo Rsrc`⌝

Misc. Instructions ...

- ⌜`li Rdest, imm`⌝ loads the immediate value imm into `Rdest`.
- ⌜`lui Rdest, imm`⌝ loads the low-order halfword of imm into the high-order halfword of Rdest. The low-order bits of Rdest are set to zero.

Readings and References

- SPIM Manual.