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展ピ

MIPS 指令集(共31条)

101011 rs

immediate

转载 白手起家的亿万富翁 最后发布于2018-08-31 15:22:24 阅读数 24773 ☆ 收藏

| 助记符 指令格等 3126 R-type op add 000000 addu 000000 sub 000000 and 000000 or 000000 nor 000000 slt 000000 slt 000000 slt 000000 srl 0000000 srl 000000 srl 000000 srl 000000 srl 0000000 srl 0000000000 | 2521 rs | 2016 rt rt rt rt rt rt rt rt rt | 1511 rd | 106 shamt 00000 00000 00000 00000 00000 00000 0000 | 50 func 100000 100001 100010 100011 100100 100101 100110 101010 | 示例 add \$1,\$2,\$3 addu \$1,\$2,\$3 sub \$1,\$2,\$3 subu \$1,\$2,\$3 or \$1,\$2,\$3 xor \$1,\$2,\$3 nor \$1,\$2,\$3 situ \$1,\$2,\$3 | 示例含义 \$1=\$2+\$3 \$1=\$2+\$3 \$1=\$2-\$3 \$1=\$2-\$3 \$1=\$2 & \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$1 else \$1=0 if(\$2<\$3) \$1=1 else | 操作及其解释 rd <- rs + rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs + rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs & rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs xor rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rot(rs rt) ; 其中rs = \$2, rt = \$3, rd = \$1(剪束) rd <- not(rs rt) ; 其中rs = \$2, rt = \$3, rd = \$1(剪束) if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 (无符号数) |
|---|--|----------------------------------|---|--|--|--|--|---|
| R-type op add 000000 addu 000000 sub 000000 and 000000 or 000000 and 0000000 and 0000000 and 000000000 and 0000000000 | rs | rt | rd r | shamt 00000 00000 00000 00000 00000 00000 0000 | func 100000 100001 100010 100011 100100 100101 100110 100111 | addu \$1,\$2,\$3 sub \$1,\$2,\$3 subu \$1,\$2,\$3 and \$1,\$2,\$3 or \$1,\$2,\$3 xor \$1,\$2,\$3 sit \$1,\$2,\$3 | \$1=\$2+\$3 \$1=\$2-\$3 \$1=\$2-\$3 \$1=\$2 & \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1==(\$2 \$3) if(\$2<\$3) \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | rd <- rs + rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs & rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs xor rt ; 其中rs = \$2, rt = \$3, rd = \$1(异或) rd <- not(rs rt) ; 其中rs = \$2, rt = \$3, rd = \$1(或非) if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 |
| add 000000 addu 000000 addu 000000 addu 000000 and 000000 | rs | rt | rd | 00000 00000 00000 00000 00000 00000 0000 | 100000 100001 100010 100011 100100 100101 100110 100111 | addu \$1,\$2,\$3 sub \$1,\$2,\$3 subu \$1,\$2,\$3 and \$1,\$2,\$3 or \$1,\$2,\$3 xor \$1,\$2,\$3 sit \$1,\$2,\$3 | \$1=\$2+\$3 \$1=\$2-\$3 \$1=\$2-\$3 \$1=\$2 & \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1==(\$2 \$3) if(\$2<\$3) \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | rd <- rs + rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs & rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs xor rt ; 其中rs = \$2, rt = \$3, rd = \$1(异或) rd <- not(rs rt) ; 其中rs = \$2, rt = \$3, rd = \$1(或非) if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 |
| addu 000000 sub 000000 sub 000000 and 0000000 and 0000000 and 0000000 and 0000000 and 0000000 and 0000000 and 000000000000000000000000000000000000 | rs | rt rt rt rt rt rt rt rt rt | rd | 00000 00000 00000 00000 00000 00000 | 100001 100010 100011 100100 100101 100110 100111 | addu \$1,\$2,\$3 sub \$1,\$2,\$3 subu \$1,\$2,\$3 and \$1,\$2,\$3 or \$1,\$2,\$3 xor \$1,\$2,\$3 sit \$1,\$2,\$3 | \$1=\$2+\$3 \$1=\$2-\$3 \$1=\$2-\$3 \$1=\$2 & \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1=\$2 \$3 \$1==(\$2 \$3) if(\$2<\$3) \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | rd <- rs + rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs & rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs xor rt ; 其中rs = \$2, rt = \$3, rd = \$1(异或) rd <- not(rs rt) ; 其中rs = \$2, rt = \$3, rd = \$1(或非) if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 |
| sub 000000 subu 000000 and 000000 or 000000 or 000000 or 000000 subu 000000 or 0000000 or 00000000 or 0000000 or 0000000 or 0000000 or 0000000 or 0000000 or 00000000 or 0000000 or 00000000 or 0000000 or 000000000 or 00000000 or 000000000 or 0000000000 | rs rs rs rs rs rs rs rs | rt rt rt rt rt rt rt | rd rd rd rd rd rd rd rd | 00000 00000 00000 00000 00000 | 100010 100011 100100 100101 100110 100111 101010 | sub \$1,\$2,\$3 subu \$1,\$2,\$3 and \$1,\$2,\$3 or \$1,\$2,\$3 xor \$1,\$2,\$3 nor \$1,\$2,\$3 | \$1=\$2-\$3 \$1=\$2-\$3 \$1=\$2 & \$3 \$1=\$2 \$3 \$1=\$2 ^ \$3 \$1=~(\$2 \$3) if(\$2<\$3) \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs & rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs xor rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs xor rt ; 其中rs = \$2, rt = \$3, rd = \$1(异或) rd <- not(rs rt) ; 其中rs = \$2, rt = \$3, rd = \$1(或非) if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 |
| ubu 000000 nd 000000 r 000000 or 000000 lt 000000 lt 000000 rl 000000 rl 000000 lt 000000 lt 0000000 rl 0000000 rl 0000000 | rs rs rs rs rs rs | rt rt rt rt rt rt | rd rd rd rd rd rd rd | 00000 00000 00000 00000 00000 | 100011 100100 100101 100110 100111 101010 | subu \$1,\$2,\$3 and \$1,\$2,\$3 or \$1,\$2,\$3 xor \$1,\$2,\$3 nor \$1,\$2,\$3 | \$1=\$2-\$3 \$1=\$2 & \$3 \$1=\$2 \$3 \$1=\$2 ^ \$3 \$1=~(\$2 \$3) if(\$2<\$3) \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | rd <- rs - rt ; 其中rs = \$2, rt = \$3, rd = \$1,无符号数 rd <- rs & rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs xor rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs xor rt ; 其中rs = \$2, rt = \$3, rd = \$1(异或) rd <- not(rs rt) ; 其中rs = \$2, rt = \$3, rd = \$1(或非) if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 |
| nd 000000 r 000000 or 000000 it 000000 it 000000 rl 000000 rl 000000 rl 000000 rl 000000 | rs rs rs rs rs | rt rt rt rt rt | rd rd rd rd rd | 00000 00000 00000 00000 | 100100 100101 100110 100111 101010 | and \$1,\$2,\$3 or \$1,\$2,\$3 xor \$1,\$2,\$3 nor \$1,\$2,\$3 | \$1=\$2 & \$3 \$1=\$2 \$3 \$1=\$2 ^ \$3 \$1=~(\$2 \$3) if(\$2<\$3) \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | rd <- rs & rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs rt ; 其中rs = \$2, rt = \$3, rd = \$1 rd <- rs xor rt ; 其中rs = \$2, rt = \$3, rd = \$1(异或) rd <- not(rs rt) ; 其中rs = \$2, rt = \$3, rd = \$1(或非) if (rs < rt) rd = 1 else rd = 0 ; 其中rs = \$2, rt = \$3, rd = \$1 if (rs < rt) rd = 1 else rd = 0 ; 其中rs = \$2, rt = \$3, rd = \$1 |
| r 000000 or 000000 or 000000 lit 000000 lit 000000 rl 000000 rrl 000000 rra 000000 | rs rs rs rs | rt rt rt rt | rd rd rd | 00000 00000 00000 | 100101 100110 100111 101010 | or \$1,\$2,\$3 xor \$1,\$2,\$3 nor \$1,\$2,\$3 sit \$1,\$2,\$3 | \$1=\$2 \$3 \$1=\$2 ^ \$3 \$1=~(\$2 \$3) if(\$2<\$3) \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | rd <- rs rt ; 其中rs=\$2, rt=\$3, rd=\$1 rd <- rs xor rt ; 其中rs=\$2, rt=\$3, rd=\$1(异或) rd <- not(rs rt) ; 其中rs=\$2, rt=\$3, rd=\$1(或非) if (rs < rt) rd=1 else rd=0; 其中rs=\$2, rt=\$3, rd=\$1 if (rs < rt) rd=1 else rd=0; 其中rs=\$2, rt=\$3, rd=\$1 |
| or 000000 or 0000000 or 0000000 or 0000000 or 0000000 | rs rs rs | rt rt rt | rd rd | 00000 | 100110 100111 101010 | xor \$1,\$2,\$3 nor \$1,\$2,\$3 sit \$1,\$2,\$3 | \$1=\$2 ^ \$3 \$1=~(\$2 \$3) if(\$2<\$3) \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | rd <- rs xor rt ; 其中rs = \$2, rt = \$3, rd = \$1(异或) rd <- not(rs rt) ; 其中rs = \$2, rt = \$3, rd = \$1(或非) if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 |
| or 000000 It 000000 It 000000 It 000000 It 000000 It 000000 | rs rs | rt rt | rd rd | 00000 | 100111 | nor \$1,\$2,\$3 sit \$1,\$2,\$3 | \$1=~(\$2 \$3) if(\$2<\$3) \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | rd <- not(rs rt) ; 其中rs = \$2, rt = \$3, rd = \$1(或非) if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 if (rs < rt) rd = 1 else rd = 0; 其中rs = \$2, rt = \$3, rd = \$1 |
| It 000000 Itu 000000 II 000000 rl 000000 ra 000000 | rs | rt | rd | 00000 | 101010 | sit \$1,\$2,\$3 | if(\$2<\$3) \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | if (rs < rt) rd=1 else rd=0; 其中rs=\$2,rt=\$3, rd=\$1 if (rs < rt) rd=1 else rd=0; 其中rs=\$2,rt=\$3, rd=\$1 |
| ltu 000000 II 000000 rl 000000 ra 000000 | rs | rt | | | | | \$1=1 else \$1=0 if(\$2<\$3) \$1=1 else | if (rs < rt) rd=1 else rd=0;其中rs=\$2,rt=\$3, rd=\$1 |
| rl 000000 ra 000000 | | | rd | 00000 | 101011 | sltu \$1,\$2,\$3 | \$1=1 else | |
| 000000 000000 000000 0000000 000000000 | 00000 | rt | | | | | \$1=0 | (2013-334) |
| ra 000000 | | | rd | shamt | 000000 | sll \$1,\$2,10 | \$1=\$2<<10 | rd <- rt << shamt ; shamt存放移位的位数, 也就是指令中的立即数,其中rt=\$2, rd=\$1 |
| IIv 000000 | 00000 | rt | rd | shamt | 000010 | srl \$1,\$2,10 | \$1=\$2>>10 | rd <- rt >> shamt; (logical), 其中rt=\$2, rd=\$1 |
| | 00000 | rt | rd | shamt | 000011 | sra \$1,\$2,10 | \$1=\$2>>10 | rd <- rt >> shamt ; (arithmetic) 注意符号位保留 其中rt=\$2, rd=\$1 |
| rlv 000000 | rs | rt | rd | 00000 | 000100 | sllv \$1,\$2,\$3 | \$1=\$2<<\$3 | rd <- rt << rs ; 其中rs=\$3,rt=\$2, rd=\$1 |
| | rs | rt | rd | 00000 | 000110 | srlv \$1,\$2,\$3 | \$1=\$2>>\$3 | rd <- rt >> rs ; (logical)其中rs=\$3,rt=\$2, rd=\$1 |
| rav 000000 | rs | rt | rd | 00000 | 000111 | srav \$1,\$2,\$3 | \$1=\$2>>\$3 | rd <- rt >> rs ; (arithmetic) 注意符号位保留 其中rs=\$3,rt=\$2, rd=\$1 |
| 000000 | rs | 00000 | 00000 | 00000 | 001000 | jr \$31 | goto \$31 | PC <- rs |
| type op | rs | rt | immediate | | | | | |
| ddi 001000 | rs | rt | immediate | | addi \$1,\$2,100 | \$1=\$2+100 | rt <- rs + (sign-extend)immediate; 其中rt=\$1,rs=\$2 | |
| ddiu 001001 | rs | rt | immediate | | addiu \$1,\$2,100 | \$1=\$2+100 | rt <- rs + (zero-extend)immediate; 其中rt=\$1,rs=\$2 | |
| ndi 001100 | rs | rt | immediate | | | andi \$1,\$2,10 | \$1=\$2 & 10 | rt <- rs & (zero-extend)immediate; 其中rt=\$1,rs=\$2 |
| ri 001101 | rs | rt | immediate | | | andi \$1,\$2,10 | \$1=\$2 10 | rt <- rs (zero-extend)immediate; 其中rt=\$1,rs=\$2 |
| ori 001110 | rs | rt | immediate | | | andi \$1,\$2,10 | \$1=\$2 ^ 10 | rt <- rs xor (zero-extend)immediate; 其中rt=\$1,rs=\$2 |
| ui 001111 | 00000 | rt | immediate | | | lui \$1,100 | \$1=100*65536 | rt <- immediate*65536;将16位立即数放到目标寄存器高16 位,目标寄存器的低16位填0 |

memory[\$2+10]

=\$1

sw \$1,10(\$2)

 $memory[rs + (sign-extend)immediate] <- rt \; ; \; rt=\$1, rs=\$2$

| beq | 000100 | rs | rt | immediate | beq \$1,\$2,10 | if(\$1==\$2) goto PC+4+40 | if (rs == rt) PC <- PC+4 + (sign-extend)immediate<<2 | |
|--------------|--------|---------|-----------|------------------|---------------------|--|---|----|
| bne | 000101 | rs | rt | immediate | bne \$1,\$2,10 | if(\$1!=\$2) goto PC+4+40 | if (rs != rt) PC <- PC+4 + (sign-extend)immediate<<2 | 12 |
| | | | | | if(\$2<10) | if (rs <(sign-extend)immediate) rt=1 else rt=0 ; | ď | |
| slti 001010 | rs | rt | immediate | slti \$1,\$2,10 | \$1=1 else \$1=0 | 其中rs=\$2,rt=\$1 | | |
| | | | | | | if(\$2<10) | if (rs <(zero-extend)immediate) rt=1 else rt=0 ; | ☆ |
| sltiu 001011 | rs rt | | immediate | sltiu \$1,\$2,10 | \$1=1 else \$1=0 | 其中rs=\$2,rt=\$1 | | |
| J-type | ор | address | | | | | | < |
| j | 000010 | address | | | j 10000 | goto 10000 | PC <- (PC+4)[3128],address,0,0 ; address=10000/4 | > |
| jal | 000011 | address | | | jal 10000 | \$31<-PC+4; goto 10000 | \$31<-PC+4; PC <- (PC+4)[3128],address,0,0 ; address=10000/4 | |

注意:因为MIPS16只有16个16位的寄存器,所以JAL指令中\$31改成\$15,所有立即数均无需扩展,LUI指令直接就是将立即数付给RT寄存器。