

CS 315-01 RISC-V Emu Imm JAL Mem

Lab 06 due Wed Oct 1 11:59pm

Extra OH today 4:30pm - 5:30pm

Project 04 published due Oct 7 11:59pm

Project 04 IG on Oct 8

Lab 07 Exam-like problems

I will provide the Fall 2024 CS 315 Midterm

Midterm Thu Oct 9

Lab 06

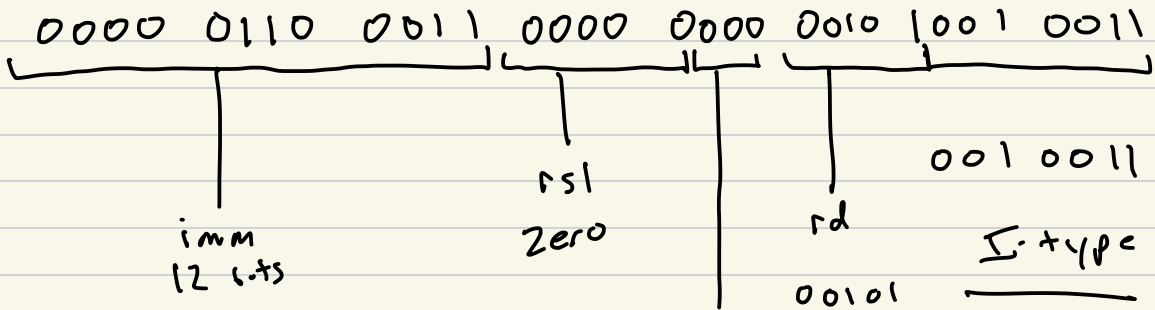
starter	rv-emu.c	131	loc
solution	rv-emu.c	225	loc

Immediates

li t0, 99 → addi t0, zero, 99



0x06306293



$$64 + 32 + 2 + 1$$

$$96 + 3$$

$$= \boxed{99}$$

funct3 5

000

addi

get_rd(iw)

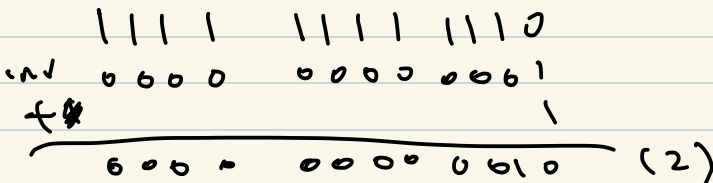
get_rs1(iw)

get_funct3(iw)

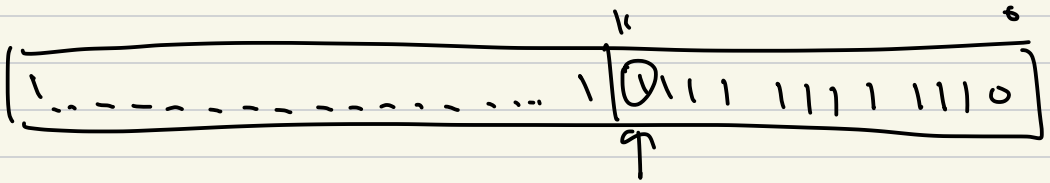
[vint64_t imm12 = get_bits(iw, 20, 12);

li t0, -2 → addi t0, zero, $\boxed{-2}$

0x FFE0 0293

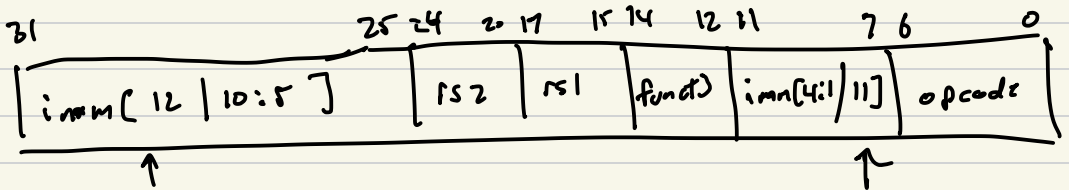


int64_t imm = sign_extend(imm11, 11)



Branches

Extract fields



opcode

funct3

rs1

rs2

imm

imm[12] imm[11] imm[10:5] imm[4:1] 0

1) get parts

`uint32_t imm12 = get_bits(iw, 31, 1);`

`uint32_t imm10_5 = get_bits(iw, 25, 6);`

`uint32_t imm4_1 = get_bits(iw, 7, 4);`

`uint32_t imm11 = get_bits(imm, 7, 1);`

2) combine parts

`uint64_t imm;`

$$\text{imm} = (\text{imm}_{12} \ll 12) \mid (\text{imm}_{11} \ll 11) \\ \mid (\text{imm}_{10-5} \ll 5) \mid (\text{imm}_{4-1} \ll 1) \mid 0$$

3) sign extend

`int64_t imm = sign_extend(imm, 12);`

4) branch logic

If you take the branch offset

$$PC = PC + \text{imm}$$

else

$$PC = PC + 4$$

5) branch conditions

```
if (func3 == 0x0) {
```

```
    if (rsp->regs[rs1] == rsp->regs[rs2]) {  
        take = true;  
    }
```

```
}
```

```
bool take;
```

```
take = rsp->regs[rs1] == rsp->regs[rs2];
```

JAL Jump and Link (call)

call $\rightarrow$ jal jal ra, imm(offset)

j $\rightarrow$ jal jal zero, imm(offset)

Memory instructions - Loads & Stores
- i-type

lw $t_0, \text{offset}(a_0)$ $\rightarrow$ $\text{lw } t_0, 8(a_0)$

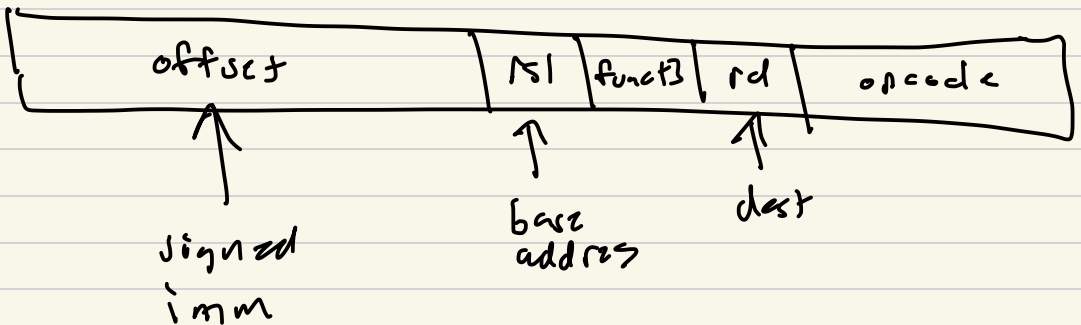
$t_0 = * (a_0 + \text{offset})$
 $\uparrow$ $\uparrow$
 int / uint

$t_0 = * (\underline{(\text{uint32_t} *)} (a_0 + \text{offset}))$

Target address

$TA = a_0 + \text{offset}$

$rd = * (\text{uint32_t} *) TA);$



lb - vint8-t *

lw - vint32-t *

ld - vint64-t *

stores → S-type

sw t_0 , offset(a0) * $(a0 + \text{offset}) = t_0$