CS315-02 RISC-V Emulation Lab03 JAL Mem

Lab03 due tonight 11:59 pm
Project04 published
Lab03 exam probs - coming soon
Exam - 1 note sheet allowed
Extra OH today 4:30 pm - 5:30 pm

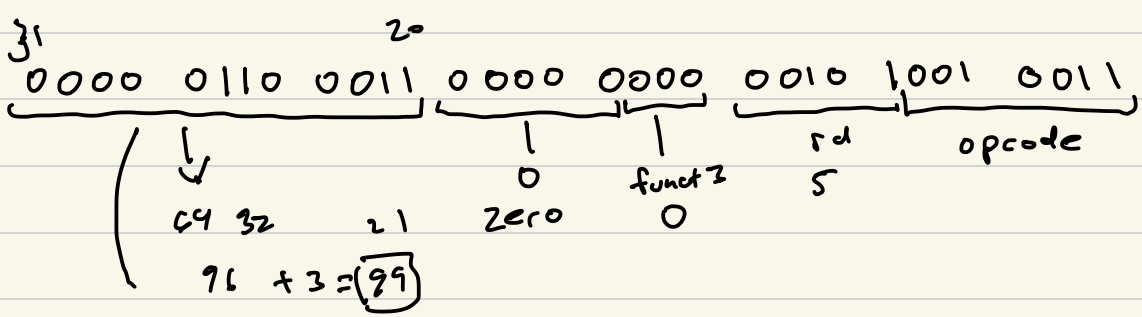
Lab03

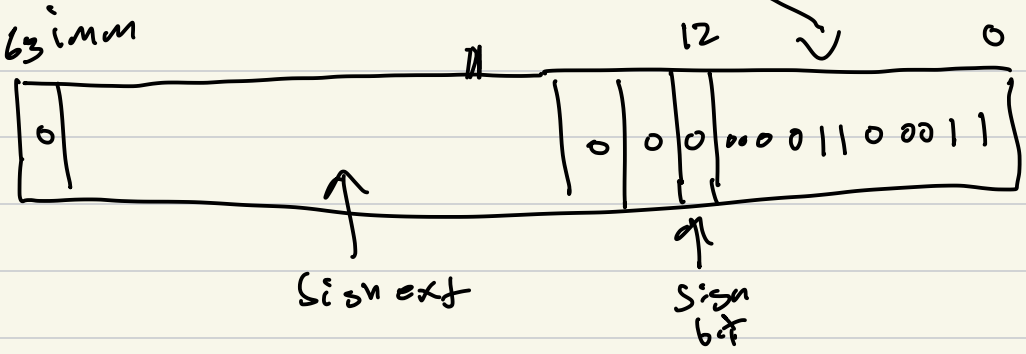
starter	ru_emu.c	131 LOC
solution	ru_emu.c	225 LOC

Adding your own test.

li t0, 99 → addi t0, zero, 99

0x06300293






```
uint64_t imm11_0 = get_bits(iw, 20, 12);

int64_t imm = sign_extend(imm11_0, 11);
```

← shift left

→ shift right (arithmetic)

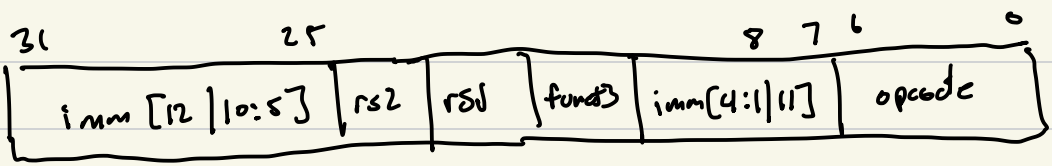
Branches

Extract fields

- Funct3
- rs1
- rs2
- imm

For imm

1) get parts
2) combine parts
3) sign extend.



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, 8, 4);
uint32_t imm11 = get_bits(iw, 7, 1);
```

2) combine parts

```
uint64_t uimm;

uimm = (imm12 << 12) | (imm_11 << 11)
     | (imm10_5 << 5) | (imm4_1 << 1) | 0;
```

3) sign_extend

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

Determine if you need to take the branch

beq
bne
blt
bge
] signed values

```
bool take_branch
```

if taken_branch

PC = PC + imm (offset)

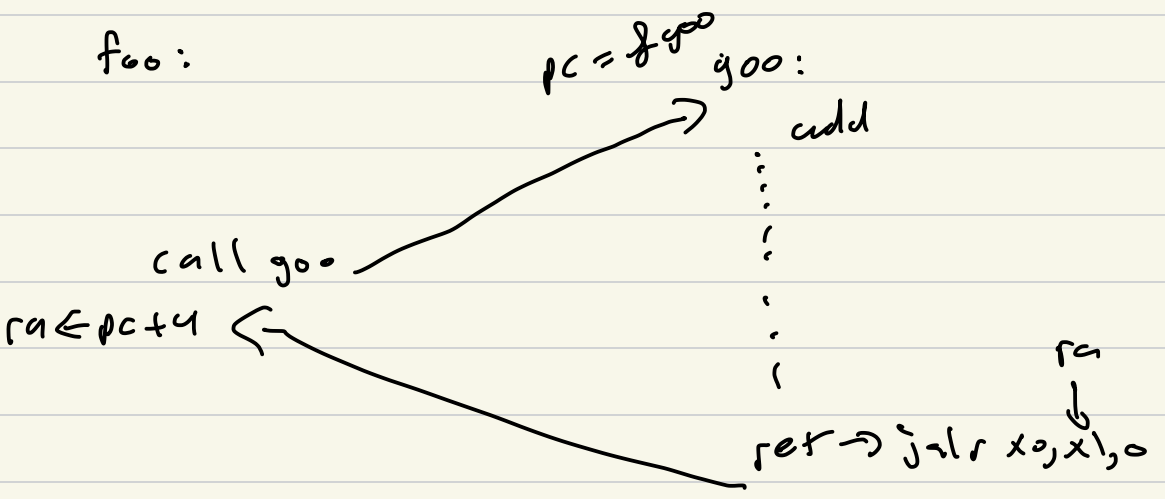
else

PC = PC + 4

JAL Jump and Link

call	jal x1, offset	jal ra, offset
j (jump)	jal x0, offset	jal zero, offset

4 0 1100
3 0 0 1 1
2 0 0 1 0
1 0 0 0 1
0 0 0 0 0



Mem instructions - Loads & Stores

Loads - i-type

lw t0, offset(a0) → lw t0, 8(a0)

t0 = *(a0 + offset)

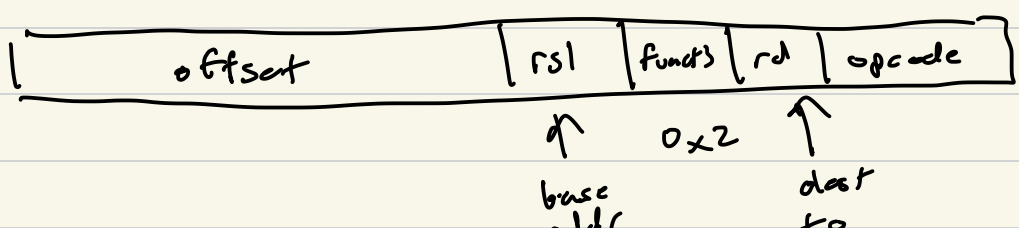
t0 = *((uint32_t *)(a0 + offset))

Target Address

TA = a0 + offset

rd = *((uint32_t *) TA);

i-type



lb → uint8_t * sb

lw → uint32_t * sw

ld → uint64_t * sd

Stores → S-type

sw t0, offset(a0)

*(a0 + offset) = t

TA = (uint32_t *)(a0 + offset)

*TA = rs2