

4 Hex Dump & Disassembly

Show me how to turn my ELF into a raw hex and to disassemble it with objdump. What do each columns mean?

Response

Step 1: Convert ELF to Hex

Run this command:

```
riscv32-unknown-elf-objcopy -O ihex hello.elf hello.hex
```

-O ihex → output format is Intel HEX.

hello.elf → your input ELF binary.

hello.hex → output hex file you can flash to memory (used by emulators or bootloaders).

You can also generate binary raw output:

```
riscv32-unknown-elf-objcopy -O binary hello.elf hello.bin
```

Step 2: Disassemble the ELF

Run this command:

```
riscv32-unknown-elf-objdump -d hello.elf > hello.dump
```

-d → disassemble all executable sections (like .text).

> hello.dump → save disassembly to a file.

Step 3: Understand the Disassembly Output

Example output:

```
asm  
80000000 <main>:  
80000000: 1141      addi    sp,sp,-16  
80000002: c606      sw      ra,12(sp)  
80000004: 00000517    auipc   a0,0x0  
80000008: 00850513    addi    a0,a0,8  
8000000c: 00000073    ecall
```

🧠 Explanation of Columns:

Column	Example	Description
Address	80000000:	Memory address of the instruction in ELF
Machine Code	1141	Raw instruction encoding (in hex, 16/32 bits)
Mnemonic	addi	Instruction name (operation type)
Operands	sp,sp,-16	Arguments the instruction operates on

So:

yaml

80000000: 1141 addi sp,sp,-16

Means:

At address 0x80000000 The 16-bit machine code 0x1141 encodes:

The RISC-V instruction addi sp, sp, -16

```

yogesh@DESKTOP-PB6A9OR: ~ + 
GNU nano 7.2                                     hello.dump

hello.elf:      file format elf32-littleriscv

Disassembly of section .text:
80000000 <main>:
80000000: 1101 [REDACTED] addi    sp,sp,-32
80000002: ce06 [REDACTED] sw      ra,28(sp)
80000004: cc22 [REDACTED] sw      s0,24(sp)
80000006: 1000 [REDACTED] addi    s0,sp,32
80000008: 100007b7 [REDACTED] lui     a5,0x10000
8000000c: fef42423 [REDACTED] sw      a5,-24($0)
80000010: 800007b7 [REDACTED] lui     a5,0x80000
80000014: 04c78793 [REDACTED] addi    a5,a5,76 # 8000004c <main+0x4c>
80000018: fef42623 [REDACTED] sw      a5,-20($0)
8000001c: a829 [REDACTED] j       80000036 <main+0x36>
8000001e: fec42783 [REDACTED] lw      a5,-20($0)
80000022: 00178713 [REDACTED] addi    a4,a5,1
80000026: fee42623 [REDACTED] sw      a4,-20($0)
8000002a: 0007c703 [REDACTED] lbu    a4,0($5)
8000002e: fe842783 [REDACTED] lw      a5,-24($0)
80000032: 00e788023 [REDACTED] sb      a4,0($5)
80000036: fec42783 [REDACTED] lw      a5,-20($0)
8000003a: 0007c783 [REDACTED] lbu    a5,0($5)
8000003e: f3e5 [REDACTED] bnez   a5,8000001e <main+0x1e>
80000040: 4781 [REDACTED] li      a5,0
80000042: 853e [REDACTED] mv      a0,a5
80000044: 40f2 [REDACTED] lw      ra,28(sp)

[Read 32 lines]

```

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GNU nano 7.2

hello.dump

hello.elf: file format elf32-littleriscv

Disassembly of section .text:

30000000 <main>:		
30000000:	1101	addi sp,sp,-32
30000002:	ce06	sw ra,28(sp)
30000004:	cc22	sw s0,24(sp)
30000006:	1000	addi s0,sp,32
30000008:	100007b7	lui a5,0x10000
3000000c:	fe f 42423	sw a5,-24(s0)
30000010:	800007b7	lui a5,0x80000
30000014:	04c78793	addi a5,a5,76 # 8000004c <main+0
30000018:	fe f 42623	sw a5,-20(s0)
3000001c:	a829	j 80000036 <main+0x36>
3000001e:	fec42783	lw a5,-20(s0)
30000022:	00178713	addi a4,a5,1
30000026:	fee42623	sw a4,-20(s0)
3000002a:	0007c703	lbu a4,0(a5)
3000002e:	fe842783	lw a5,-24(s0)
30000032:	00e78023	sb a4,0(a5)
30000036:	fec42783	lw a5,-20(s0)
3000003a:	0007c783	lbu a5,0(a5)
3000003e:	f3e5	bnez a5,8000001e <main+0x1e>
30000040:	4781	li a5,0
30000042:	853e	mv a0,a5
30000044:	40f2	lw ra,28(sp)

↑ Read 32 lines ↑