

3 From C to Assembly

How do I generate the .s file and explain the prologue/epilogue of the main function?

Response



You want to:

1. Generate the assembly (.s) file from your C code.
 2. Understand the prologue and epilogue of the main function.
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Run this in your terminal:

bash

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```
riscv32-unknown-elf-gcc -S -O0 -march=rv32imc -mabi=ilp32 hello.c
```

- `-S` → generates assembly code instead of an ELF binary.
 - `-O0` → disables optimizations (for easier understanding).
 - Result: You'll get a file called `hello.s`.
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Open `hello.s` and find this (example output):

asm

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main:

```
addi sp,sp,-16    # Step 1
sw   ra,12(sp)    # Step 2
...
lw   ra,12(sp)    # Step 3
addi sp,sp,16      # Step 4
ret            # Step 5
```



Part	Instruction	Meaning
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Prologue addi sp, sp, -16 Reserve 16 bytes on the stack for this function.

sw ra, 12(sp) Save the return address (ra) into stack (offset +12 from sp).

Function ... Actual body of your function (e.g., printing via UART).

Epilogue lw ra, 12(sp) Restore return address from stack.

addi sp, sp, 16 Free the 16 bytes of stack space that were reserved.

ret Return to the caller (uses restored ra).

🔍 Why These Instructions Are Used

- **Stack pointer (sp):** Points to the current top of the stack.
- **addi sp, sp, -16:** Moves the stack down to make space for local data or saved registers.
- **sw ra, 12(sp):** Saves the return address so it can be restored later.
- **ret:** Equivalent to jalr x0, ra, 0 — returns from the function.



```

GNU nano 7.2      hello.s
.yo  "hello.c"
.option nopic
.attribute arch, "rv32i2p1_m2p0_c2p0"
.attribute unaligned_access, 0
.attribute stack_align, 16
.text
.section .rodata
.align 2
.LC0:
.string "Hello, RISC-V\n"
.text
.align 1
.globl main
.type main, @function
main:
    addi    sp,sp,-32
    sw     ra,28(sp)
    sw     s0,24(sp)
    addi   s0,sp,32
    li     a5,268435456
    sw     a5,-24(s0)
    lui    a5,%hi(.LC0)
    addi   a5,a5,%lo(.LC0)
    sw     a5,-20(s0)
    j      .L2
.L3:
    lw     a5,-20(s0)
    addi   a4,a5,1
    sw     a4,-20(s0)
[ Read 45 lines ]
^G Help          ^O Write Out    ^W Where Is    ^K Cut        ^T Execute    ^C Location    M-U Undo    M-A Set Mark
^X Exit          ^R Read File    ^V Replace    ^U Paste      ^J Justify    ^Y Go To Line  M-E Redo    M-G Copy

```