

RISC-V ECE253 ONE-PAGE CHEATSHEET

Subroutine Template (Fully Commented)

```
myfunc:
    addi sp, sp, -16 # allocate stack frame
    sw ra, 12(sp) # save return address
    sw s0, 8(sp) # save s0 (callee-saved)

    # function body here

    lw s0, 8(sp) # restore s0
    lw ra, 12(sp) # restore ra
    addi sp, sp, 16 # deallocate stack
    jr ra # return to caller
```

Recursive Sum $n + (n-1) + \dots + 1$

```
sum:
    addi sp, sp, -16 # make stack frame
    sw ra, 12(sp) # save ra

    beq a0, x0, base # if n == 0, go to base case
    addi a0, a0, -1 # compute n-1
    jal ra, sum # recursive call
    add a0, a0, a1 # add returned value to n
    j done # skip base case

base:
    mv a0, x0 # return 0

done:
    lw ra, 12(sp) # restore ra
    addi sp, sp, 16 # pop frame
    jr ra
```

Recursive Fibonacci

```
fib:
    addi sp, sp, -32 # big frame for storage
    sw ra, 28(sp) # save ra
    sw a0, 24(sp) # save n

    li t0, 1
    ble a0, t0, base # if n <= 1 return n

    addi a0, a0, -1
    jal ra, fib # fib(n-1)
    mv t1, a0 # store fib(n-1)

    lw a0, 24(sp)
    addi a0, a0, -2
    jal ra, fib # fib(n-2)

    add a0, a0, t1 # fib(n) = f(n-1) + f(n-2)
    j done

base:
    lw a0, 24(sp) # return n

done:
    lw ra, 28(sp)
    addi sp, sp, 32
    jr ra
```

Stack Manipulation (Push / Pop)

```
# PUSH (allocate space first)
addi sp, sp, -16
sw ra, 12(sp)
sw s0, 8(sp)

# POP (restore then free)
lw s0, 8(sp)
lw ra, 12(sp)
addi sp, sp, 16
jr ra
```

Rules:

- Stack grows DOWN (towards smaller addresses)
- Adjust sp first on push
- Restore registers before freeing stack
- Callee-saved: s0--s11, ra
- Caller-saved: t0--t6, a0--a7

Interrupt Setup Example

```
.global _start
_start:
    li sp, 0x20000 # initialize stack pointer

    jal CONFIG_DEVICE # setup peripherals

    # register handler address
    la t0, interrupt_handler
    csrw mtvec, t0

    # enable interrupt source 17
    li t0, 0x00020000 # bit 17
    csrw mie, t0

    # enable global interrupts
    li t0, 0x8 # MIE bit
    csrw mstatus, t0

END:
    j END # wait for interrupt
```

Interrupt Handler Template

```
interrupt_handler:
    addi sp, sp, -16
    sw ra, 12(sp)

    # ... handle interrupt ...

    lw ra, 12(sp)
    addi sp, sp, 16
    mret
```

Hex to Binary Bit Mapping

Hex: 0x00020000

Binary:
0000 0000 0000 0010 0000 0000 0000 0000
 ^
 |
 bit 17

Explanation:

- Each hex digit = 4 binary bits
- 0x00020000 means:
 - Only the 17th bit is 1
 - All other bits are 0
- That bit enables interrupt line 17 in mie

FULLY COMMENTED POLLING EXAMPLE

```
.equ TIMER, 0xFF202000 # base addr timer
.equ TEMP, 0xFFFF0010 # temperature sensor
.equ TRANSMIT, 0xFFFF0080 # transmitter base

_start:
    la s0, TIMER # s0 = timer base address

    li t0, 50000000 # 0.5 seconds at 100MHz
    slli t1, t0, 16 # move low half up (prep masking)
    srli t1, t0, 16 # extract low 16 bits
    sw t1, 8(s0) # store low start count

    srli t0, t0, 16 # extract high 16 bits
    sw t0, 12(s0) # store high start count

    li t0, 0x6 # START + CONT bits = 0110
    sw t0, 4(s0) # write control register

polling_loop:
    lw t0, 0(s0) # read status register
    and t0, t0, 0x1 # check timeout bit
    beqz t0, polling_loop # wait until done

    sw zero, 0(s0) # acknowledge timer timeout

    la s1, TEMP
    lw t0, 0(s1) # read temperature

    la s2, TRANSMIT # transmitter base

polling_transmit:
    lw s3, 0(s2) # read status (ready bit)
    and s3, s3, 0x1 # isolate ready bit
    beqz s3, polling_transmit # wait until ready

    sw t0, 4(s2) # write temperature to transmit reg
    j polling_loop # repeat forever
```