



# CS305: Computer Architecture

World of Instructions-V (The MIPS language)

<https://www.cse.iitb.ac.in/~biswa/courses/CS305/main.html>

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# Quick recap

Usage of j, jr, jal, and \$ra

We stopped at: Protocol between caller and callee

# MIPS provides

Upto **four** arguments can be passed from the caller to the callee while using **jal**. It uses registers \$a0 to \$a3

A callee can return upto two values to the caller. It uses registers \$v0 and \$v1

# What if?

```
main(){  
a = a + f1(a);  
}
```

```
f1(a) {  
    a = a - f2(a); return a;}  
f2(a) {  
    a = a + f3(a); return a;}  
f3(a) {  
    a = a + 1;    return a;}  
}
```

f1:

f2's argument in \$a0 to \$a3  
jal f2

# What if?

f1:

f2's argument in \$a0 to \$a3

jal f2

...

f2:

f3's argument in \$a0 to \$a3

jal f3

...

# What is the big deal?

f1:

f2's argument in \$a0 to \$a3

jal f2

...

f2:

f3's argument in \$a0 to \$a3

jal f3

...

# What is the big deal? Oh no!

f1:

PC: f2's argument in \$a0 to \$a3

PC+4: jal f2 // \$ra = PC+8

...

f2:

PC+100: f3's argument in \$a0 to \$a3

PC+104: jal f3 // \$ra = PC+108

...

f3: ...

jr \$ra

# What is the big deal? Oh no!

f1:

PC: f2's argument in \$a0 to \$a3

PC+4: jal f2 // \$ra = PC+8

...

f2:

PC+100: f3's argument in \$a0 to \$a3

PC+104: jal f3 // \$ra = PC+108

jr \$ra 😞 Oh no!!

...

f3: ...

jr \$ra



# Saving and Restoring Registers (limited)

**caller** registers

**callee** registers

Why?

**Callee** does not know, registers used by callers, can be many callers too

**Caller** does not know the callee's plan 😊

# MIPS 32 registers

- Registers

- \$Zero
- (Return) Value registers (\$v0,\$v1)
- Argument registers (\$a0-\$a3)
- Return Address (\$ra)
- Saved registers (\$s0-\$s7)
- Temporary registers (\$t0-\$t9)
- Global Pointer (\$gp)
- Stack Pointer (\$sp)
- Frame Pointer (\$fp), or \$t10

## Total Regs

1  
3  
7  
8  
16  
26  
27  
28  
29

- 2 for OS (\$k0, \$k1), 1 for assembler (\$at)



Do not forget 32  
MIPS registers only  
Register spilling 😞

Gracias