DIGITAL DESIGN AND COMPUTER ORGANIZATION

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Addressing Modes

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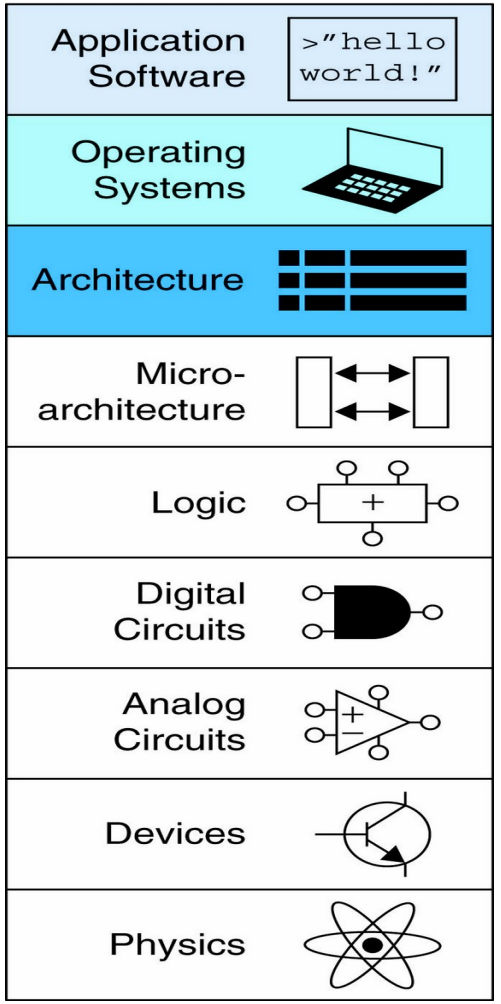
Addressing Modes

- Introduction
- Assembly Language
- Machine Language
- Programming
- Addressing Modes
- Lights, Camera, Action: Compiling, Assembling, & Loading
- Odds and Ends



Addressing Modes

How do we address the operands?

- Register Only
- Immediate
- Base Addressing
- PC-Relative
- Pseudo Direct

Addressing Modes (Register Only)

Register Only

- Operands found in registers
  - **Example:** `add $s0, $t2, $t3`
  - **Example:** `sub $t8, $s1, $0`

Addressing Modes (Immediate)

Immediate

- 16-bit immediate used as an operand
  - **Example:** `addi $s4, $t5, -73`
  - **Example:** `ori  $t3, $t7, 0xFF`

Addressing Modes (Base)

Base Addressing

- Address of operand is:

  `base address + sign-extended immediate`

  - **Example:** `lw  $s4, 72($0)`
    - address = `$0 + 72`
  - **Example:** `sw  $t2, -25($t1)`
    - address = `$t1 - 25`

Addressing Modes (PC Relative)

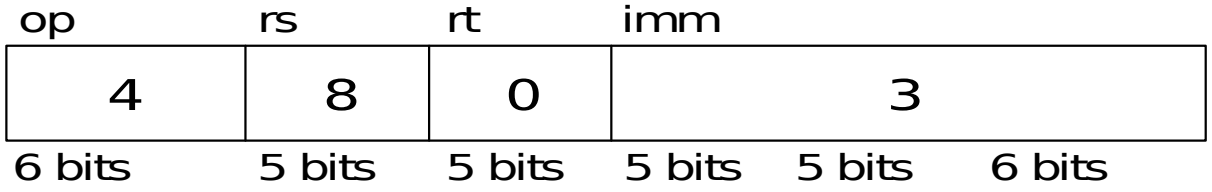
PC-Relative Addressing

```
0x10          beq   $t0, $0, else
0x14          addi  $v0, $0, 1
0x18          addi  $sp, $sp, i
0x1C          jr       $ra
0x20      else:     addi  $a0, $a0, -1
0x24          j     factorial
```

Assembly Code

```
beq $t0, $0, else
(beq $t0, $0, 3)
```

Field Values



Addressing Modes (Pseudo-direct)

Pseudo-direct Addressing

```
0x0040005C          j       sum
...
0x004000A0  sum:    add     $v0, $a0, $a1
```

J TA 0000 0000 0100 0000 0000 0000 1010 0000 (0x004000A0)

26-bit addr 0000 0000 0100 0000 0000 0000 1010 0000 (0x0100028)

0 1 0 0 0 2 8

Field Values

op	imm
3	0x0100028
6 bits	26 bits

Machine Code

op	addr	
000011	00 0001 0000 0000 0000 0010 1000	(0x0C100028)
6 bits	26 bits	