

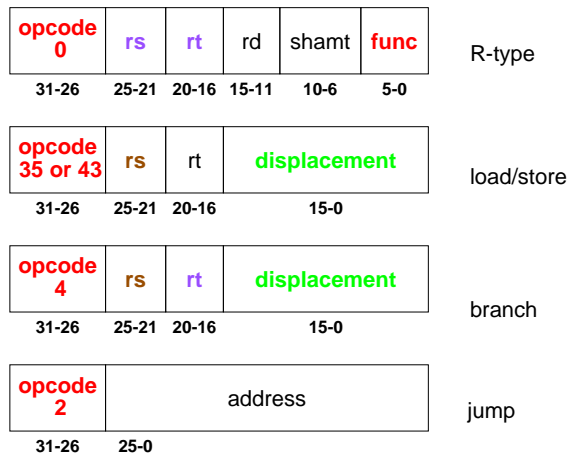
Control Unit

CPU hardware that controls instruction execution

- sends signals to the datapath to operate it
- specifies what operations to perform, what data to move, when to move it, where to move it

Control Signals

Many **control signals** driven by the instruction



Regularity of the MIPS formats

- **opcode** always in bits 31-26 (Op[5-0])
- **source registers** are always rs & rt
- **base register** always rs
- **branch offset** always bits 15-0

Our R2000 Control Signals

Register file

- register write signal: **RegWrite**
asserted for R-type instructions & load
- register destination field: **RegDst**
rt, rd
- results value: **MemToReg**
loaded value, R-type instruction result
- all generated by the opcode

ALU

- type of the second operand: **ALUSrc**
register, immediate
 - generated by the opcode
- ALU operation: **ALUOp**
add, subtract, and, or, set-on-less-than
 - generated by a small control unit
 - inputs: opcode & func field
 - output: ALU operation
 - examples:
lw/sw \Rightarrow add
beq \Rightarrow subtract
R-type instruction \Rightarrow func value

Our R2000 Control Signals

Memory

- read signal: **MemRead**
- write signal: **MemWrite**
 - both generated by the opcode

Branch control

- new PC value: **PCSrc**
incremented PC, target address
 - generated by the opcode AND'd with Zero

Jump control

- new PC value: **Jump**
incremented PC or target address, jump address
 - generated by the opcode

Changing the Implementation

How should you approach a problem in which you had to redesign the implementation to include another instruction?

- What does the instruction do?
- What parts of the datapath does it need?
 - Can it use what is there already?
 - What new logic or registers does it need?
- How is the datapath activated?
 - What control lines does it need
 - Where should the control lines come from?