

LECTURE - 16

Hardware Support for Speculation

- *Conditional* or *predicated* instructions
- Execute on condition, annul otherwise
- Example: conditional move

if (A == 0) { S = T; }

BNEZ R1, L
MOV R2, R3 **→** **CMOVZ R2, R3, R1**

L:

- Control dependence has been eliminated
 - Dependence resolution now moves to WB stage

Scheduling Using Conditional Instructions

LW R1, 40(R2) ADD R3, R4, R5

ADD R6, R3, R7

BEQZ R10, L

LW R8, 20(R12)

LW R9, 0(R8)



LW R1, 40(R2) ADD R3, R4, R5

LWC R8, 20(R12), R10 ADD R6, R3, R7

BEQZ R10, L

LW R9, 0(R8), R12

Empty slot filled, stall for last load eliminated

Limitations of Conditional Instructions

- Usefulness limitations:
 - Condition must not be delayed due to data dependence
 - Useful only for simple alternative sequences
- Performance limitations:
 - Annulled conditional instruction is equivalent to noop/stall
 - Except when filling an anyway empty slot
 - Speed penalty in terms of higher clock cycle time