Lecture 7

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Chapter 3

Instruction Level Parallelism

Data Dependences and Hazards

- Determining how one instruction depends on another is critical to determining how much parallelism exists in a program and how that parallelism can be exploited.

- In particular, to exploit instruction-level parallelism we must determine which instructions can be executed in parallel.

Data Dependences and Hazards

- If two instructions are *parallel*, they can execute simultaneously in a pipeline of arbitrary depth without causing any stalls, assuming the pipeline has sufficient resources (and hence no structural hazards exist).

- If two instructions are dependent, they are not parallel and must be executed in order, although they may often be partially overlapped.

Data Dependences

- There are three different types of dependences: *data dependences* (also called true data dependences), *name dependences*, and *control dependences*.

- An instruction *j* is *data dependent* on instruction *i* if either of the following holds:

- Instruction i produces a result that may be used by instruction j.

- Instruction j is data dependent on instruction k, and instruction k is data dependent on instruction i.

Data Dependences

- The second condition simply states that one instruction is dependent on another if there exists a chain of dependences of the first type between the two instructions.

- This dependence chain can be as long as the entire program. Note that a dependence within a single instruction (such as ADDD R1,R1,R1) is not considered a dependence.

Data Dependencies and Hazards

- Code Example

LOOP: L.D   F0,0(R1)   ;F0=array element

ADD.D   F4,F0,F2   ;add scalar in F2

S.D   F4,0(R1)   ;store result

DADDUI R1,R1,#-8 ;decrement pointer 8

BNE   R1,R2,LOOP;

- The above dependencies are in floating point data for the first two arrows, and integer data in the last two instructions

Data Dependencies and Hazards

- Arrows show where order of instructions must be preserved

- If two instructions are dependent, they cannot be simultaneously executed or be completely overlapped

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