

Tutorial: Lab 4

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1

Quick Notes on the Class

- ◆ Lab Grades: You guys are doing well
 - Almost perfect scores on Lab 1, with a few exceptions
- ◆ Common Problems:
 - Not all files are checked in
 - Forgot to check in the written answers
- ◆ Grading Labs
 - Wanted to get test scripts out to you before due date
 - Our fault. Trying to rectify (need your names & emails)
- ◆ If you haven't sent me your email, do so.

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2

Lab 4 – The Processor Lab

◆ Good News!

- Unlike previous labs, we've done this lab many times before
- Hopefully a lot less pain

◆ Lab Goals:

- Explore design refinement
- Hands on experience on tuning scheduling

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3

The Processor:

◆ SMIPSV2 ISA (simplified MIPS)

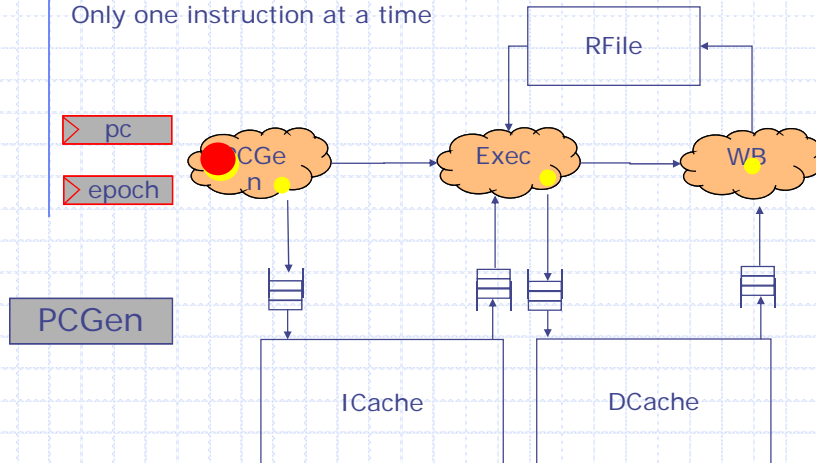
- 35 Instructions
 - ◆ add/sub/xor
 - ◆ bz/blt
 - ◆ lw/sw
 - ◆ Special ops (toHost/fromHost)
 - Helps for testing

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4

What you've been given

Only one instruction at a time



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5

The Multi-stage Design

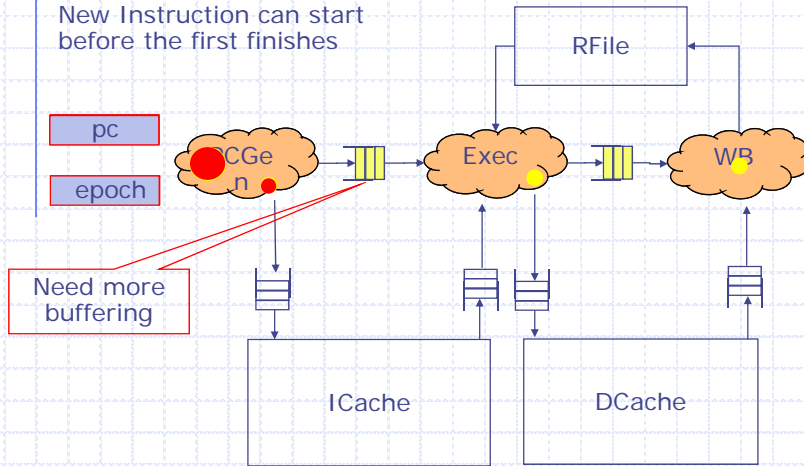
- ◆ 3 Rules (one for each stage)
- ◆ 1 instruction active at a time
- ◆ 2-3 stages / instruction
 - Do WB part in Exec if we aren't doing a memop
- ◆ Little inter-stage buffering
- ◆ Multi-cycle memory interface
 - as discussed in class

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6

First Task: Pipelined CPU

New Instruction can start before the first finishes



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7

High-Level Steps

- ◆ Add inter-stage buffering
- ◆ Isolate data usage to single stages
- ◆ Add program counter speculation
- ◆ Make executing each stage correct
 - Stalling logic (as in lectures)
- ◆ Get correct schedule (fully pipelined)
 - Select correct state elements (correct bypassing)

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8

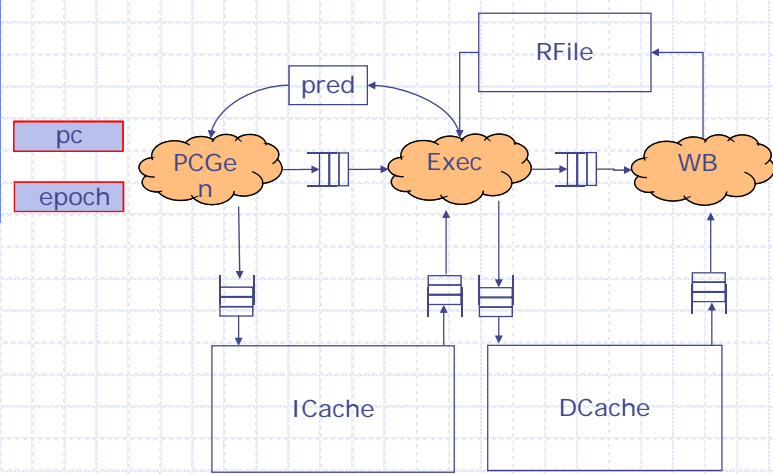
Branch Prediction

- ◆ Pipeline has simple speculation

```
rule pcGen (True);  
  pc <= pc + 4;  
  otherActions;  
endrule
```

Simplest prediction:
Always not-taken

First Task: Pipelined CPU



Branch Prediction

```
interface BranchPredictor;  
    method Addr getNextPC(Addr pc);  
    method Action update (Addr pc,  
                          Addr correct_next_pc);  
endinterface  
rule pcGen (True);  
    pc <= pred.getNextPC(pc);  
    otherActions;  
endrule  
rule execute ...  
    if (nextPC != correctPC) pred.update(curPc, nextPC);  
  
    case (instr) matches ...  
        BzTaken: if (mispredicted) ...  
endrule
```

Make prediction

Update predictions

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11

End Notes

- ◆ This Lab is "easy"
- ◆ Do it early anyways

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12