

# Out of Order and Super Scalar

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Section 8

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# Agenda

- Complex Pipelines
  - Hazards
- Out of Order
  - ROB vs Issue Window
  - Speculative store buffer
- Superscalar
  - Renaming
  - Branch Prediction
- Lab 3

# Complex Pipeline Hazards

- What are the types of data hazards?
  - Why do we care?
  - Example code?
  - Solutions?
- What else limits our throughput
  - Respecting program-order
  - Inherent ILP of program (max width of CFG)

# Reorder Buffer

- Why?
  - cheat sheet so we don't get caught
- What?
  - Tracking info on instructions decoded but not committed yet
- How?

# Issue Window

- Why?
  - Can more efficiently use resources
    - Allocation times?
- What?
  - Tracking yet to be issued instructions
- How?

# Rollback

- Why?
  - Branch mispredict
  - Exception
- What?
  - Mechanism to return to previous state
- How?
  - What do we want it to look like after rollback
  - Where is the info?

# Speculative Memory

- Why?
  - Can't rewrite to memory before commit
- What?
  - Speculative store buffer holds tags, and data
- How
  - Bypass to load if tags match

# Superscalar

- Why?
  - ILP in code can be exploited
- What?
  - Fetch, decode, issue, execute, commit multiple instructions per cycle
    - At minimum issue and execute
- How?
  - Many mechanisms



# Superscalar Register Renaming

- Why?
  - RAW hazards between consecutive instructions
- What?
  - Parallel read and write ports in rename table during decode
- How?
  - Compare destination and sources

# Superscalar Fetch

- Why?
  - Need to feed the beast
    - Out of order machines only work well if they have lots of instructions to schedule
- What?
  - Tight next line prediction coupling with I\$
  - Predict multiple branches per fetch packet
- How?
  - Many ways

Questions?

# Lab3

- Experimenting with BOOM
- Directed portion should be straight forward data collection and inference
- Open-ended again split into hw/sw
  - HW+SW: Branch prediction
  - HW: Issue window policy
  - SW: Torture and Parameter introspection
- Chance to finally get chiseling if you want

# Paper Handback