Quiz 1 Review

Guowei Zhang
Quiz 1 logistics

- Time: 1pm-2:30pm on Friday, March 6
- Location: 32-141

- Covered materials: L01-07

- Handouts will be provided
  - Handout 1 – EDSACjr
  - Handout 3 – RISC MIPS
  - Handout – SRRIP
  - Handout – Interleaved Memory

- No calculators
Pipelining

• Overlaps execution of multiple instructions

• Visualization
  – Instruction flow diagram
  – Resource usage diagram

• Hazard: an instruction cannot execute because
  – Resource is not ready: structural hazard
  – Data value is not ready: data hazard
  – PC is not ready: control hazard
Strategies to resolve hazards

• Stall

• Bypass

• Speculate

• More to cover in the coming lectures
Caches

• A small but fast storage that exploits locality
  – Temporal locality
  – Spatial locality

• Performance metrics
  – AMAT = hit time + miss rate * miss penalty

• Design options
  – # of sets, # of ways
  – Block size
  – Replacement policy
  – Inclusivity and exclusivity
  – More to cover in the future lectures
## Interpreting a byte address

<table>
<thead>
<tr>
<th>Tag</th>
<th>Index</th>
<th>Block/Line Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used to distinguish lines mapped to the same set</td>
<td>Used to locate a set</td>
<td>Used to locate a word/byte within the line</td>
</tr>
</tbody>
</table>
Memory management strategies

• Segmentation

• Paging
Address translation in paging

Virtual Address

TLB Lookup

- hit
- miss

Page Table Walk

Page Fault (OS loads page)

Update TLB

Protection Check

- permitted
- denied

Protection Fault

Physical Address (to cache)

Where?

hardware

hardware or software

software

Virtual Address

PAGE_FAULT
Self-modifying code

• Simplifies data path design but complicates programming
// Candidates and their RRPVs are indexed by w in [0, W - 1]
if access is a hit on way w:
    RRPVs[w] = 0
else: // access is a miss
    while (maximum value of RRPVs != 2^M - 1): // 3 if M == 2
        Increment all RRPVs by 1
    // Now there must be at least an RRPV with value 2^M - 1
Select w as the minimum index s.t. RRPVs[w] == 2^M - 1
// w-th candidate is selected as the victim
Replace the old data of candidate w with the new data
RRPVs[w] = 2^M - 2 // 2 if M == 2

State-transition diagram of an RRPV in 2-bit SRRIP
Handout – Interleaved Memory

2-port, 2-bank Interleaved Memory

EnableA
AddressA
WDataA
WEnableA

EnableB
AddressB
WDataB
WEnableB

src0
clk
bankA

 ADDR rdata
Bank 0
wdata
we

0
1
RDataA

src1
clk
bankB

 ADDR rdata
Bank 1
wdata
we

0
1
RDataB

Conflict

3/3/20
6.823 Spring 2020
Wish you all the best!