ECE/CS 472/572 Computer Architecture: Concluding Remarks

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Some Notes on Grading

- There are two grading schemes:
  - Based on absolute score:

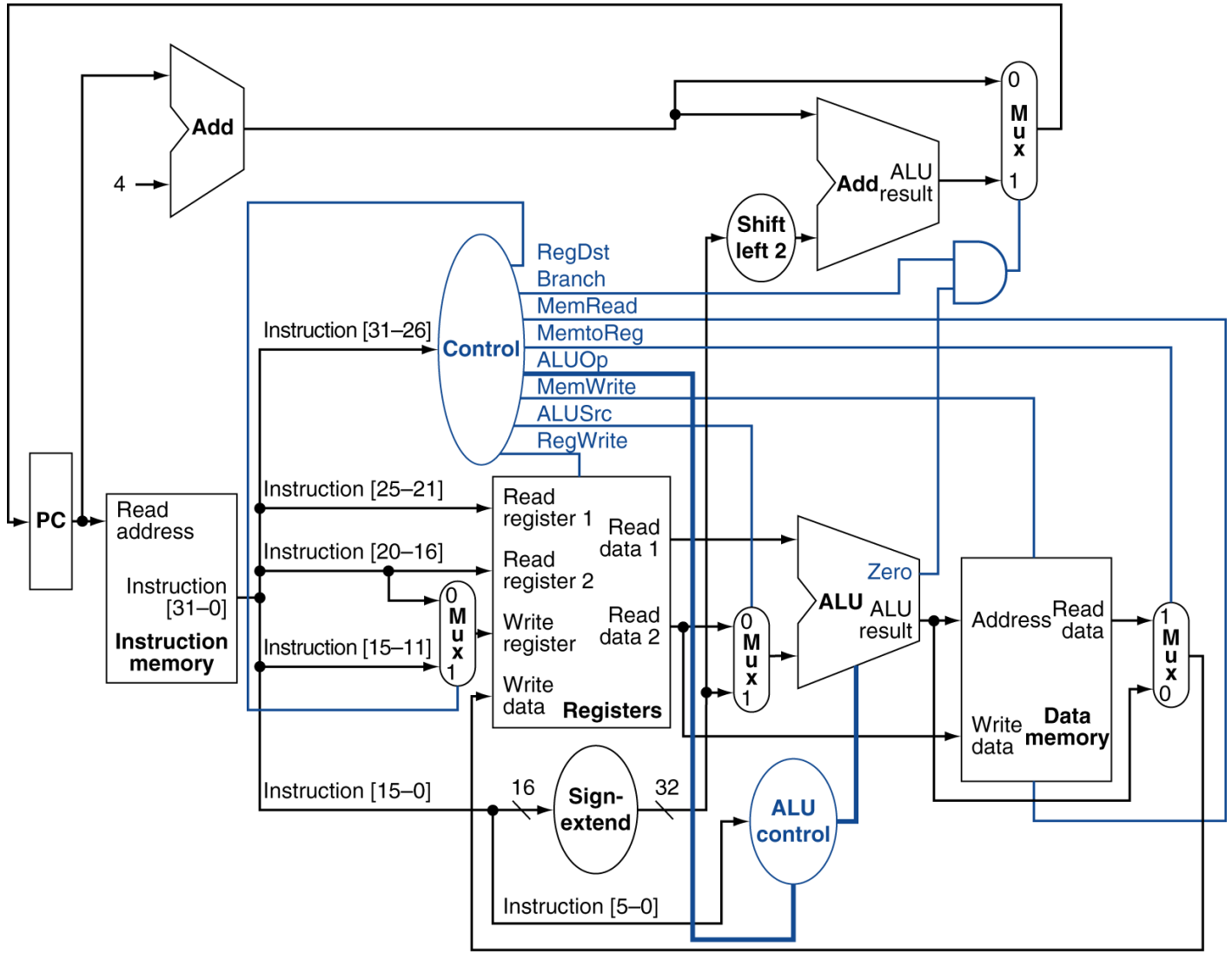
    If > 93, guarantee A; if >83, guarantee B
  - Based on relative ranking:

    A/A-: 35%, B/B+: 40%, B-: 15%: C+ or below: 10%
- Which ever works better for you!

Key Concepts: Part I

- Instruction Set Architecture (ISA)
  - Performance, speedup
    - CPU time = Instruction Count x CPI x Clock cycle time
  - MIPS: R-format, I-format, J-format, addressing mode
  - RISC vs. CISC
- Single-Cycle Processor
  - Components, Combinational & Sequential, Clocking
  - Datapath: Add/Sub, load/store, branch/jump
  - Control: Main control unit, ALU control
  - Put together

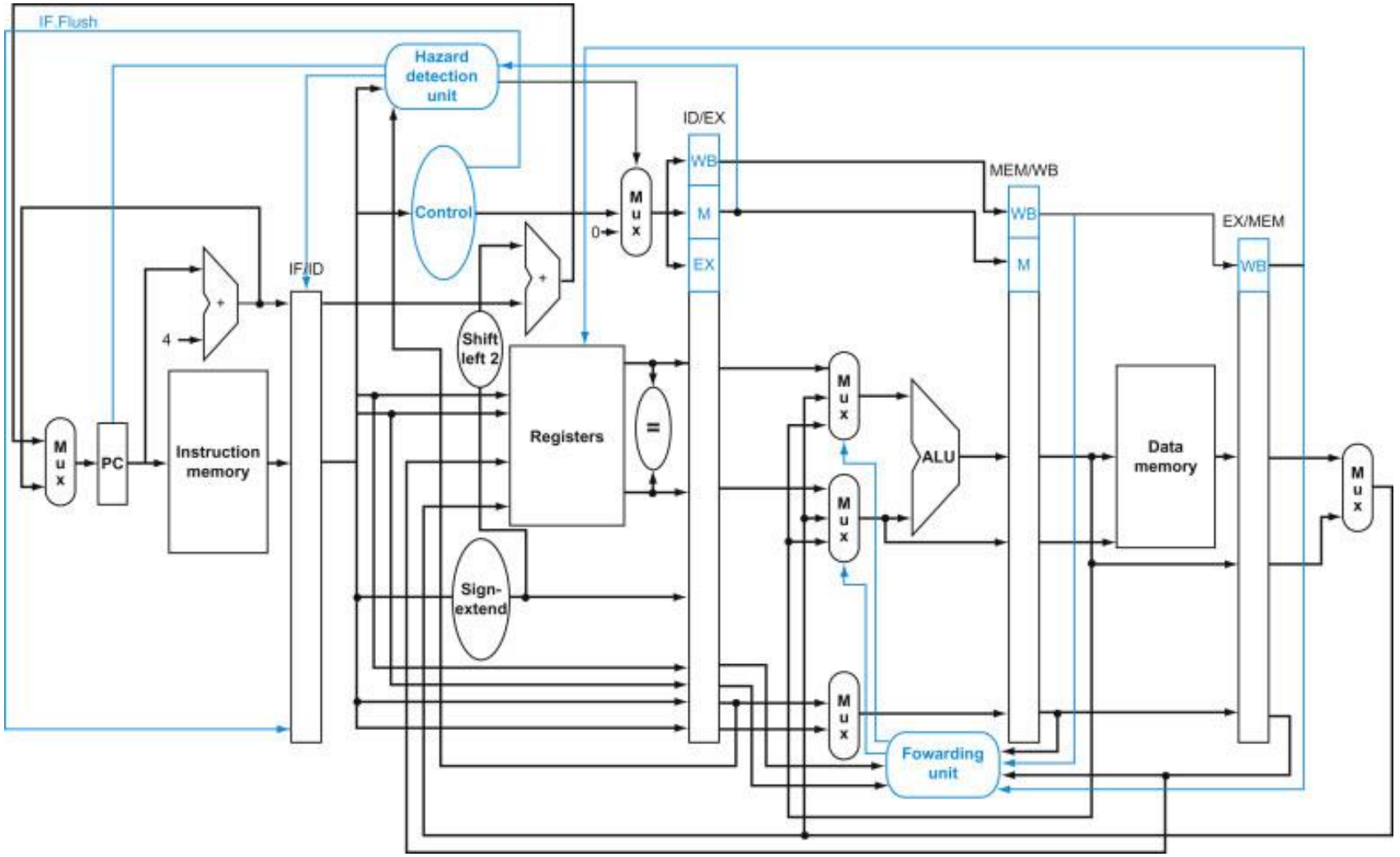
Single-Cycle Processor



Key Concepts: Part II

- Pipelined Processor
  - 5-stage: IF - ID - EX - MEM - WB
  - Datapath & How pipeline increases performance
  - Hazard: Structure, Data, and Control hazards
  - Solution 1: Insert Stall (Bubbles), where & how many
  - Solution 2: Forwarding
    - Within registers, EX->EX, EX->MEM (datapath & detecting)
    - Load-use data hazard
  - Solution 3: Code scheduling
  - Solution 4: Branch prediction, static & dynamic
  - Pipeline Control: carry signals along the stages
  - Put together

Final datapath and control



Key Concepts: Part III

- Memory Hierarchy
  - Principle of Locality: Temporal & Spatial
  - SRAM – DRAM – Flash SSD/Disk
- Cache
  - Basic concepts: hit/miss, AMAT, write-back vs. write through, replacement, multi-level, 3-C model
  - Structure: tag, block, valid bit, index, offset
  - Associativity: direct mapped, set & fully-associative
  - Interaction w/ CPUs and Software (sorting example)
- Virtual Memory
  - Physical vs. virtual address, page table, TLB
  - TLB miss, page fault, replacement, writes

Broader Vision

- Real examples
  - Opening the iPad, A5 processor
  - ARM Cortex-A8 and Intel Core i7
- Terminology
  - ITRS, Superpipeline, Superscalar, Static multiple Issue, Dynamic multiple Issue (Tomasulo), Speculation, VLIW, ILP, MLP, TLP, Hype Cycle, SISD, MIMD, SPMD, SIMD
- Videos
  - How computer is made (link)
  - Thermal issue in CPUs (cooling, cooking)
  - Intel 3D XPoint memory (link)
  - HPC simulations for Science and Industry (link)

Broader Vision

- Special Topics
  - Terminology
  - Many-core processors
  - HPC and supercomputers
  - Quantum computers (video)
  - GPU architecture introduction

Course Evaluation Reminder

- eSET is open from 5/29 to 6/9 (11pm)
- Very important to me; your participation is greatly appreciated ☺