CSE 30: Computer Organization and Systems Programming

Lecture 4: Overflow
Memory organization

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Announcements

• Fill out the partner form provided on Piazza by the end of the day
• Quiz is available on TED, complete by 11:30pm tonight
Overflow

- Overflow occurs when an addition or subtraction results in a value which cannot be represented using the number of bits available.
- For signed numbers overflow occurs if
  - On adding two positive numbers, the result is negative, or
  - On adding two negative numbers, the result is positive
Handling Overflow

• Overflow is a problem in modern day programs

• Hardware can detect when overflow occurs

• Software may or may not check for it
  – C and Java don’t!
How To Detect Overflow?

Q: In 2’s complement representation, overflow occurs on addition if there is a carry out of the most significant bit (sign bit).

A. True
B. False
How To Detect Overflow

• Contention: On addition, an overflow occurs if and only if the carry into the sign bit differs from the carry out from the sign bit.
Will $0111_2 + 0101_2$ result in overflow?

A. Yes

B. No

C. It depends
Will $011111111011_2 + 111111101101_2$ result in overflow (assume 2’s comp)?

A. Yes

B. No

C. It depends
Programmer’s model of the computer
Memory Organization

• Sequence of cells in a linear arrangement
• Each cell stores 8 bits (a byte)
• ARM is byte addressable: Each cell has a memory address
A typical memory hierarchy

- Small expensive $/bit fast
- Big cheap $/bit slow

- CPU
- On-chip cache(s)
- Off-chip cache
- Main memory
- Disk

- So then where is my program and data??
Units of Memory

1KB
1MB
1GB
1TB
1PB
1EX
Memory Organization

• If N bits are used to represent memory addresses in a computer, we say it has an N-bit address space.

• ARM is a 32-bit architecture.

  1. 32 bit address space
  2. 32 bit registers
  3. 32 bit instructions
Memory

PL Q: How much memory can be supported on a 32-bit machine?
A. 2GB
B. 4GB
C. 8GB
D. 16GB