

# 15-213

*“The course that gives CMU its Zip!”*

## **Machine-Level Programming II: Control Flow**

**Jan. 28, 2002**

### **Topics**

- **Condition Codes**
  - **Setting**
  - **Testing**
- **Control Flow**
  - **If-then-else**
  - **Varieties of Loops**
  - **Switch Statements**

# Condition Codes

## Single Bit Registers

CF	Carry Flag	SF	Sign Flag
ZF	Zero Flag	OF	Overflow Flag

## Implicitly Set By Arithmetic Operations

`addl Src, Dest`

C analog: `t = a + b`

- CF set if carry out from most significant bit
  - Used to detect unsigned overflow
- ZF set if `t == 0`
- SF set if `t < 0`
- OF set if two's complement overflow  
`(a > 0 && b > 0 && t < 0) || (a < 0 && b < 0 && t >= 0)`

## Not Set by `leal` instruction

# Setting Condition Codes (cont.)

## Explicit Setting by Compare Instruction

`cmp1 Src2,Src1`

- `cmp1 b, a` like computing `a - b` without setting destination
- CF set if carry out from most significant bit
  - Used for unsigned comparisons
- ZF set if `a == b`
- SF set if `(a - b) < 0`
- OF set if two's complement overflow  
`(a > 0 && b < 0 && (a - b) < 0) || (a < 0 && b > 0 && (a - b) > 0)`