19. Instruction Sets: Characteristics and Functions

Chapter 12: section 12.4

Types of Operations

- Although opcodes vary widely from machine to machine, they all cover the same general operations.

- A typical characterization includes:
  - Data transfer
  - Arithmetic
  - Logical
  - Transfer of control
  - Conversion
  - Input/output
  - System control

1. Data Transfer

- **Data Transfer** - copies data from a source operand into a destination operand

- x86 Examples (Reference: http://zeus.cs.pacificu.edu/ryand/cs320/2005/cs320.html)
  - mov ax,1 ; move 1 into ax
  - movzx ax, 10000000b ; mov 128 zero-extended into ax
  - movsx ax, 10000000b ; mov -128 sign-extended into ax
  - push ebx ; push 32-bit contents of ebx onto the stack
  - pop edx

2. Arithmetic

- **Arithmetic** - perform some arithmetic calculation and in the case where the processor has a flags register, sets the flags accordingly

- x86 Examples
  - add ax,bx ; ax<-ax+bx
  - sub ax,1 ; ax<-ax-1
  - inc cx
  - dec cx

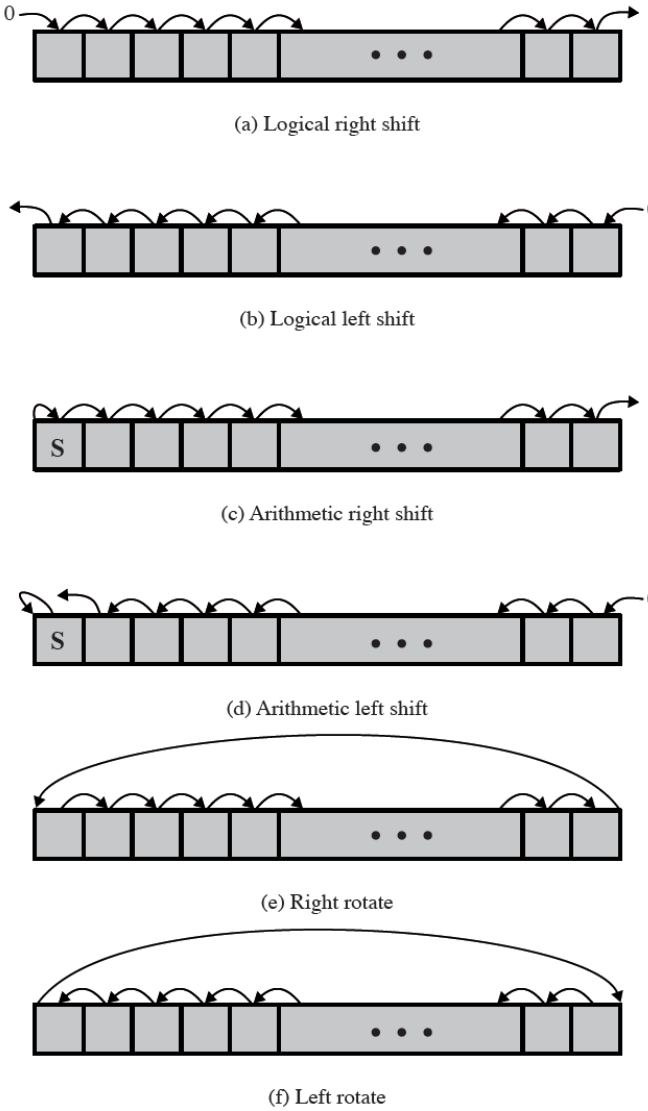
3. Logical

- **Logical** - instructions that are used to perform bit manipulation

- x86 Examples (h indicates hex)
  - and bh,0fh
  - or ax,10h
  - xor ax,bx

3. Logical (cont.)

- More Examples of Logical Operations
  - shr ax,1 ; (a)
  - shl ax,1 ; (b)
  - sar bh,1 ; (c)
  - sal bh,1 ; (d)
  - ror edx,1 ; (e)
  - rol edx,1 ; (f)



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- 4. Conversion
  - Convert from one type to another
  - Decimal to binary
- 5. Input/Output
- 6. System Control
  - Reserved for use by the operating system

7. Transfer of Control

- **Transfer of Control**

  a. Branch Instructions:
     a. Conditional branch (conditional jump)
     b. Unconditional branch

  a. Subroutine call

7. a. Branch Instructions

- **Conditional branch** - branching is conditionally based on some flags register or some status register

- x86 Example
  - jne top ; branch to top if ZF != 0
  - jb top ; unsigned … branch to top if not above or equal
    ; CF = 1
  - jl top ; signed … branch to top if not greater or equal
    ; SF <> OF

7. a. Branch Instructions (cont.)

- Another Conditional Branch x86 Example

  - Conditional branch instructions assume a calculation occurred setting flags in the flags register BEFORE the branch occurs

  - dec ax
    jne top

7. a. Branch Instructions (cont.)

- **Unconditional branch** - the branch occurs regardless

- x86 Example

  - jmp top

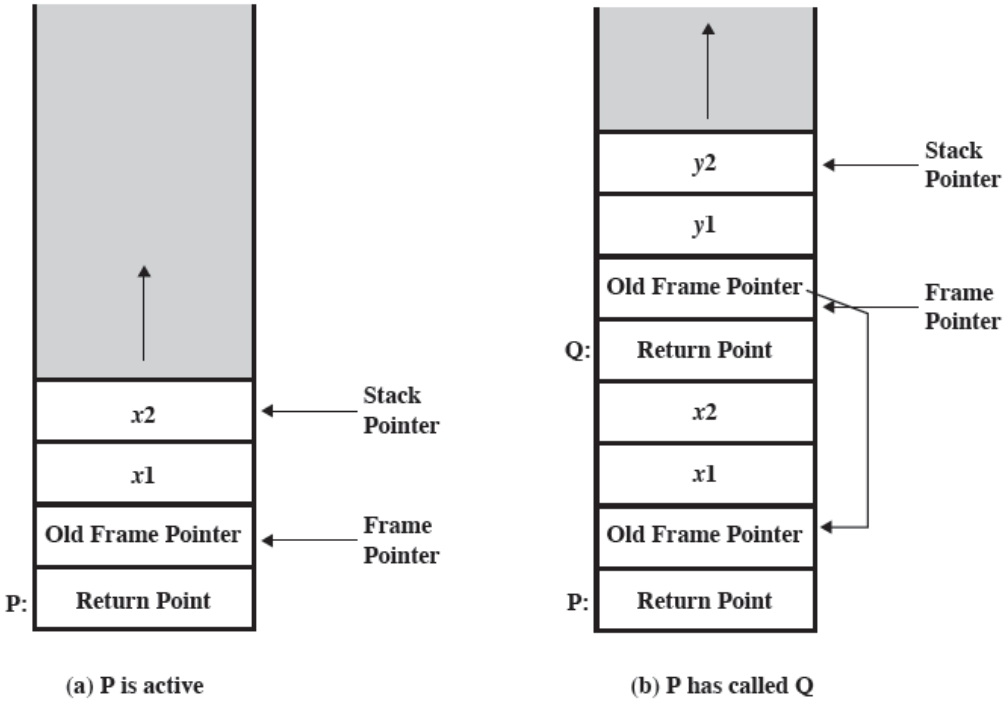
7. b. Subroutine Call

- **Subroutine call**

- x86 Example
  - call Foo ; Foo is an assembly language subroutine

7. b. Subroutine Call

- Subroutine call - what is happening below?



7. b. Subroutine Call

- Subroutine call - a typical x86 procedure might begin with the following code:

- push ebp
- mov ebp, esp
- sub esp, space_for_locals