

Shift and Rotate Instructions

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Book Chapter

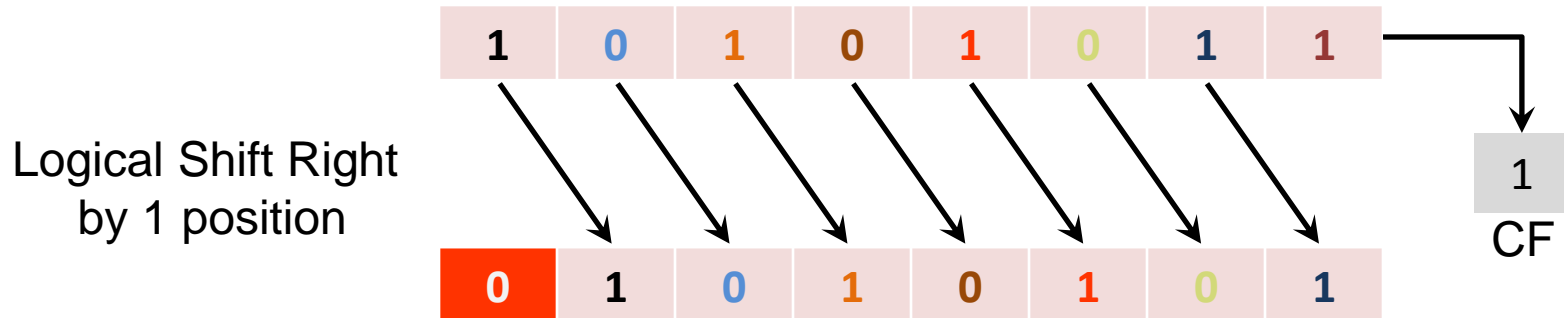
- “Assembly Language for x86 Processors”
- Author “Kip R. Irvine”
- 6th Edition
- Chapter 7
 - Section 7.2

Shift and Rotate Instructions (1/2)

- Shifting an operand means moving bits right or left from their original positions inside the operand
- Rotating an operand fills the bit positions of empty end with the bits gone out on the other end of operand
- Shift and Rotate instructions affect the Carry and Overflow flags
- Two ways to shift an operand's bits
 - Logical Shift
 - Arithmetic Shift

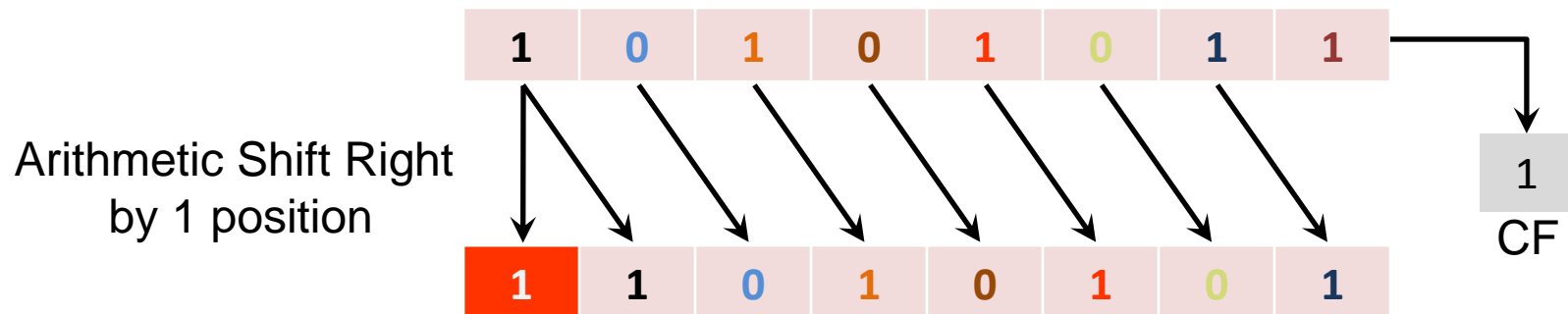
Logical Shift

- Fills the newly created bit positions with zero
- Each bit value is shifted to left or right bit position



Arithmetic Shift

- Newly created bit is filled with a copy of sign-bit
- Preserves the number's sign-bit

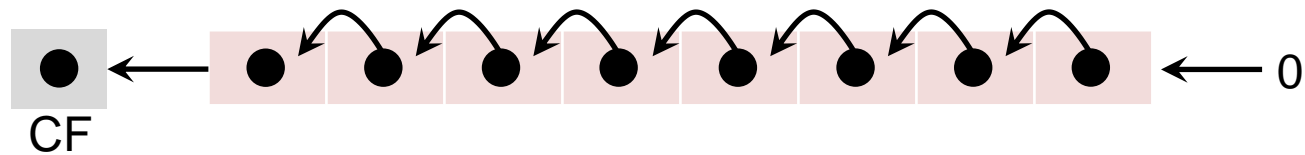


Shift and Rotate Instructions (2/2)

Instruction Mnemonic	Description
SHL	Shift Left
SHR	Shift Right
SAL	Shift Arithmetic Left
SAR	Shift Arithmetic Right
ROL	Rotate Left
ROR	Rotate Right
RCL	Rotate Carry left
RCR	Rotate Carry Right
SHLD	Double-precision Shift Left
SHRD	Double-precision Shift Right

SHL Instructions

- Performs a logical shift left on the destination operand



- Syntax for SHL is
 - SHL dest, count

SHL reg, imm8	}	Same for all shift and rotate instructions
SHL mem, imm8		
SHL reg, CL		
SHL mem, CL		

Fast Multiplication

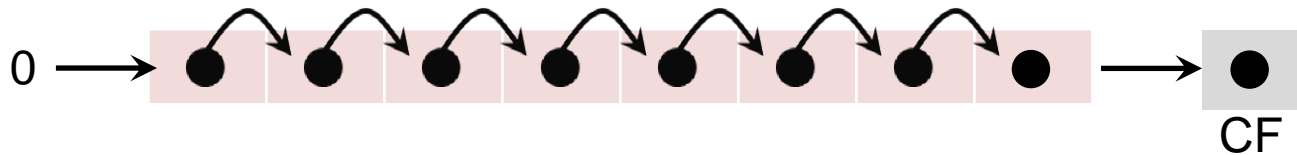
- Shifting left by 1 position generates a number which is 2 times the original operand

Before	0	0	0	0	0	0	1	0
SHL by 1 position	0	0	0	0	0	1	0	0

- Shift left by n position multiplies the operand by 2^n

SHR Instructions

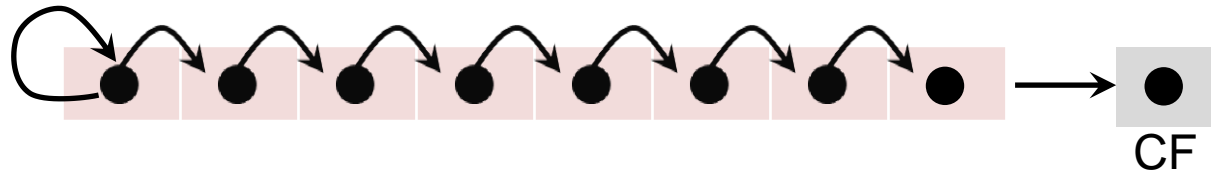
- Performs a logical shift right on the destination operand
- Highest bit position are filled with zero



- Syntax for SHL is
 - `SHR dest, count`

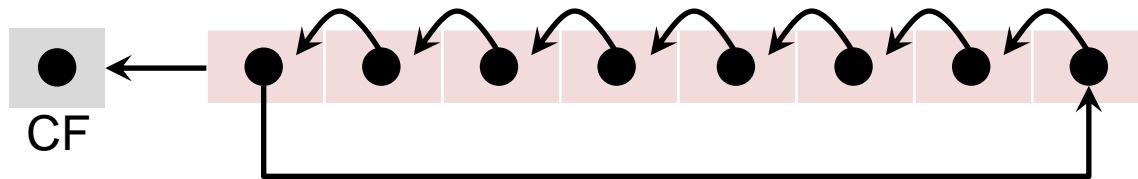
SAL and SAR Instructions

- SAL is identical to SHL
- SAR performs a right arithmetic shift on the destination operand



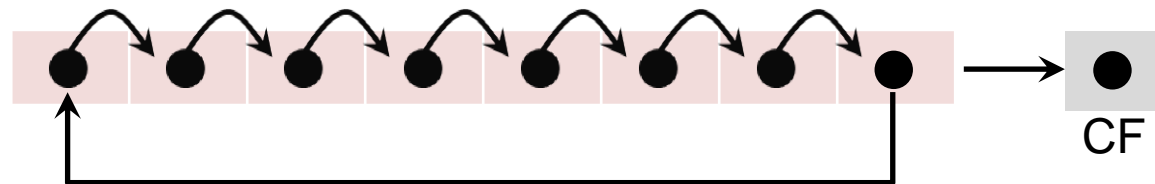
ROL Instructions

- Shifts each bit to the left
- The highest bit is copied into the CF and into the lowest bit
- No bits are lost



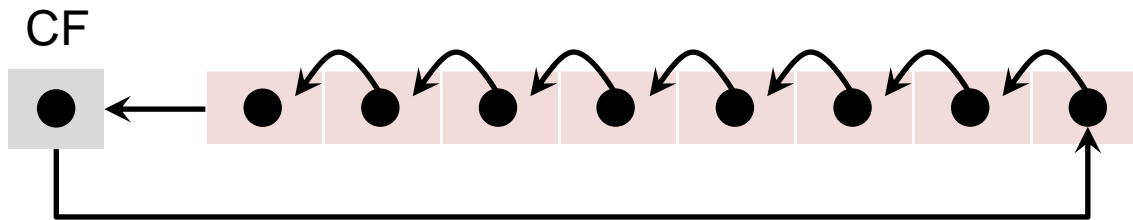
ROR Instructions

- Shifts each bit to the right
- The lowest bit is copied into the CF and into the highest bit
- No bits are lost



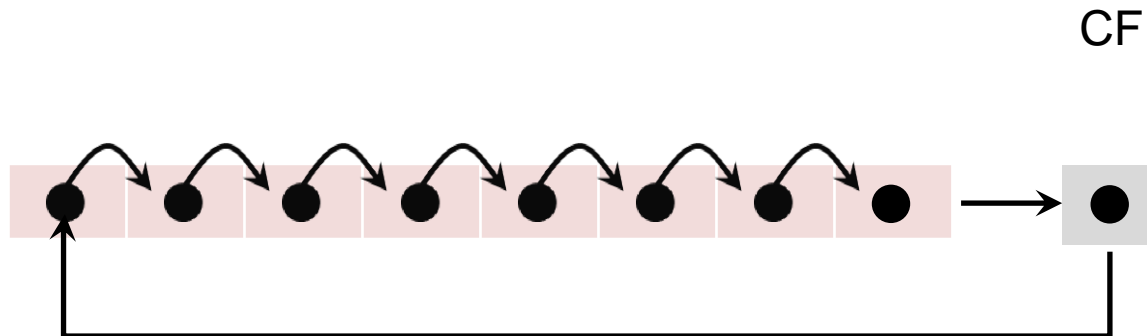
RCL Instruction

- Shifts each bit to the left
- Copies the carry flag to the LSB
- Copies the MSB into carry flag



RCR Instruction

- Shifts each bit to the right
- Copies the carry flag to the MSB
- Copies the LSB to the carry flag



SHLD Instruction

- Shifts destination operand a give number of bits to left
- Bit positions opened up by the shift are filled by the most significant bits of the source operand
- Source operand is not affected
- Syntax is `SHLD dest, src, count`
- Operand Types

`SHLD reg16/32, reg16/32, imm8/CL`

`SHLD mem16/32, reg16/32, imm8/CL`

SHRD Instruction

- Shifts destination operand a given number of bits to the right
- Bit positions opened up by the shift are filled by the least significant bits of the source operand
- Source operand is not affected
- Syntax is `SHRD dest, src, count`
- Operand Types

`SHRD reg16/32, reg16/32, imm8/CL`

`SHRD mem16/32, reg16/32, imm8/CL`