

Shift Instructions

Shift and rotate instructions shift the bits in the destination operand by one or more positions either to the left or right

The instructions have two formats:

opcode destination, 1

opcode destination, cl

The first shifts by one position, the second shifts by N positions, where cl contains N (cl is the only register which can be used)

Left Shift Instructions

The SHL (shift left) instruction shifts the bits in the destination to the left.

Zeros are shifted into the rightmost bit positions and the last bit shifted out goes into CF

Effect on flags:

SF, PF, ZF reflect the result

AF is undefined

CF = last bit shifted out

OF = 1 if result changes sign on last shift

SHL example

dh contains 8Ah and cl contains 03h

dh = 10001010, cl = 00000011

after shl dh,cl

dh = 01010000, cf = 0

The SAL instruction

The shl instruction can be used to multiply an operand by powers of 2

To emphasize the arithmetic nature of the operation, the opcode sal (*shift arithmetic left*) is used in instances where multiplication is intended

Both instructions generate the same machine code

Right Shift Instructions

The SHR (shift right) instruction shifts the bits in the destination to the right.

Zeros are shifted into the leftmost bit positions and the last bit shifted out goes into CF

Effect on flags:

SF, PF, ZF reflect the result

AF is undefined

CF = last bit shifted out

OF = 1 if result changes on last shift

SHR example

dh contains 8Ah and cl contains 02h

dh = 10001010, cl = 00000010

after shr dh,cl

dh = 001000010, cf = 1

The SAR instruction

The sar (*shift arithmetic right*) instruction can be used to divide an operand by powers of 2

sar operates like shr, except the msb retains its original value

The effect on the flags is the same as for shr

If unsigned division is desired, shr should be used instead of sar

Rotate Instructions

Rotate Left

The instruction rol (*rotate left*) shifts bits to the left

The msb is shifted into the rightmost bit

The cf also gets the the bit shifted out of the msb

Rotate Right

ror (*rotate right*) rotates bits to the right

the rightmost bit is shifted into the msb and also into the cf

Rotate through Carry

Rotate through Carry Left

The instruction rcl shifts bits to the left

The msb is shifted into cf

cf is shifted into the rightmost bit

Rotate through Carry Right

rcr rotates bits to the right

The rightmost bit is shifted into cf

cf is shifted into the msb