Addressing Modes

General Considerations

- Addressing mode: notation used to tell the CPU where is the datum to operate with
- A datum can only be
  - Explicitly given
  - In a Register
  - In a memory or I/O location
- A result can only be stored at
  - A register
  - A memory location
- When in memory, we use the address.

Addressing modes

- **Immediate**: Number is data
  - Syntax: #N
  - Not for destination
  - Example: mov #356, R5
- **Register**: Data is register contents
  - Syntax: Register name Rn
  - Examples: add R5, R7

Addressing modes for addresses (1)

- **Direct**: Give the address!
  - MSP430: Absolute: syntax N
  - MSP430: Symbolic: syntax &N
  - Example:

    Before: R15= 143Fh, [234Ah]= 26AFh

    mov R15, 234Ah → [234Ah] = 143Fh

    RTN notation: (234Ah) ←R15

    mov 234Ah, R15 → R15 = 26AFh

    mov &234Ah, R15 → R15 = 26AFh

    mov #234Ah, R15 → R15 = 234Ah

Addressing modes for addresses (2)

- **Register indirect**: Address is contents of register
  - MSP430 @Rn
  - MSP430: not valid as destination
  - Examples:

    R5 = 234Ah, R6=34FCh [234Ah] = 890Fh

    mov R5, R6 → R6 = 234Ah

    mov @R5, R6 → R6 = 890Fh

With byte instructions

- R5 = 234Ah, R6=34FCh [234Ah] = 890Fh
- [234C] = 0124h
- mov.b @R5,R6 → R6 = 000Fh

- R7=234Bh
- mov.b @R7,R8 →R8 = 0089h
- mov @R7,R8 → R8=2489h

Addressing modes for addresses (3)

- **<u>Specific for MSP430:</u>**
- **Register indirect with autoincrement**: Address is contents of register, and register increments contents after execution (by 2 for word, 1 for bytes)
  - MSP430 @Rn+
  - MSP430: not valid as destination
  - Examples:

    R5 = 234Ah, R6=34FCh [234Ah] = 890Fh

    mov R5, R6 → R6 = 234Ah

    mov @R5+, R6 → R6 = 890Fh and R5= 234Ch

Example of byte instruction

– Examples:

R5 = 234Ah, R6=34FCh [234Ah] = 890Fh

mov.b @R5+, R6 → R6 =000Fh, R5= 234Bh

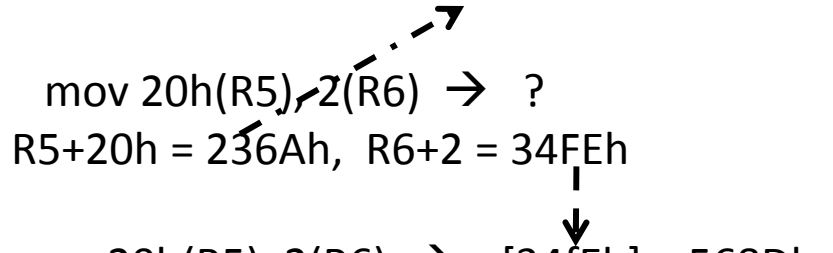
mov.b @R5+, R7 → R7 = 0089h, R5= 234Ch

- (See pages 170-172 of book)

Addressing modes for addresses (4)

- **Indexed mode**: Address is contents of register plus a number (Rn+X)
  - MSP430 syntax X(Rn)
  - @Rn equivalent to 0(Rn)
  - Examples:

R5 = 234Ah, R6=34FCh
[234Ah] = 890Fh [236Ah]= 568Dh



mov 20h(R5), 2(R6) → [34fEh] = 568Dh
mov.b 20h(R5),2(R6) → [34FEh] = xx8Dh
mov.b 20h(R5),3(R6) → [34FEh] = 8Dxxh

Example

- Ten words are stored in memory, and need to be transferred to ouput port PA (put a delay between transfers)

- DATA:

WORDSX **DW** 1234h, 256h, ……

Objective

- Repeat ten times:
  - Get data
  - Send to port A
  - Point to next data
  - Delay
- First method: autoincrement pointer
  - Requires initializing of pointer
- Second method: Use array WORDSX(index)
  - Requires initialization of index

First Method

```
        mov  #WORDSX, R4  ; initialize pointer
        mov #10,R15       ; initialize counter
LOOP:   mov @R4+,&P1OUT ; transfer and
                                ;increment pointer
DelLp:  mov #50000,R7       ; Delay loop
        dec  R7
         jnz  DelLp             ; end delay group
         dec   R15               ; decrement counter
         jnz LOOP               ; repeat if not finished
```

Second Method

```
        mov  #0, R4  ; initialize index
        mov #10,R15      ; initialize counter
LOOP:   mov WORDSX(R4),P1OUT ; transfer an
        incd  R4        ;increment index
DelLp:  mov #50000,R7        ; Delay loop
        dec  R7
         jnz  DelLp
         dec   R15                ; decrement counter
         jnz LOOP                ; repeat if not finished
```