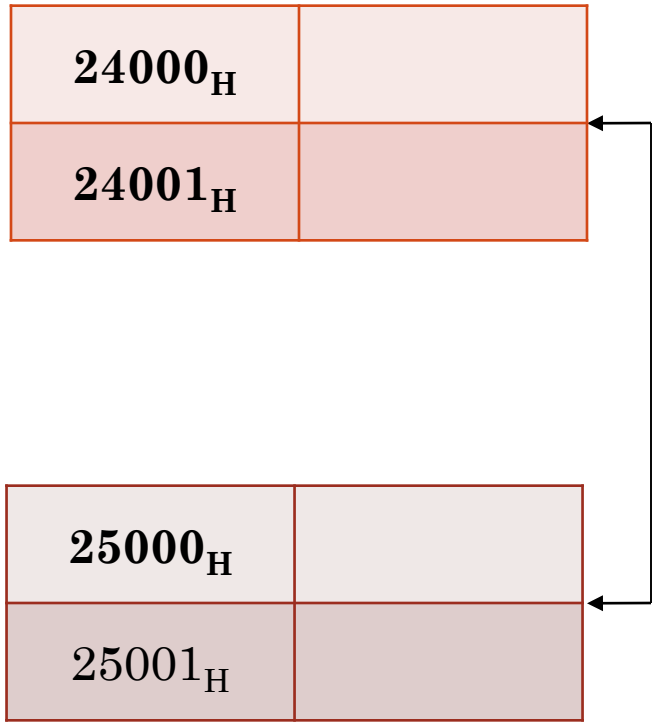
8086-80486 – Inst Set & ALP

MOV Revisted

EX 1. Swap the word at memory location 24000_H with 25000_H



```
MOV AX, 2000H
MOV DS, AX
MOV SI, 4000H
MOV DI, 5000H
MOV BX, [SI]
MOV DX, [DI]
MOV [SI], DX
MOV [DI], BX
```

- Initialise Segment Register
- Initialise Offset Registers
- Transfer data from reg to mem temporarily
- Store back the data in mem

Ex 2

MOV BX, 2000_H

MOV DI, 10_H

MOV AL, [BX+DI]

MOV DI, 20_H

MOV [BX+DI], AL

DS: 2020 ← DS: 2010

Different mov options

R ← M

M ← R

R ← R

M ← I

R ← I

MOV DST,SRC

- Copies the contents of source to destination
- No Flags Affected
- Size of source and destination must be the same
- Source can be register, memory, or immediate data
- Destination can be register or memory location

Types of Instruction

- Data Transfer Instructions
- Arithmetic Instructions
- Logical Instructions
- Branch and Program control Instructions

8086-80486 – Inst Set & ALP

A Simple Program

INC Destination

- Destination – Register or

  memory location (specified in 24 diff ways)

- (AF, OF, PF, SF, ZF affected, CF not affected)

- INC BL
- INC BX

- DEC Destination

Inc / Dec the contents of a Memory location

- Specify the data size in memory
- use directive
- BYTE PTR, WORD PTR, DWORD PTR
- INC WORD PTR [BX]
- INC BYTE PTR[BX]
- BX-1000_H DS- 2000_H

21000	**00**
21001	**00**

Flags

INC WORD PTR [BX]

- OF – 0
- SF – 0
- ZF - 0
- PF – 1(follows only low byte)
- AF - 1

INC BYTE PTR[BX]

- OF – 0
- SF – 0
- ZF -1
- PF -1
- AF -1

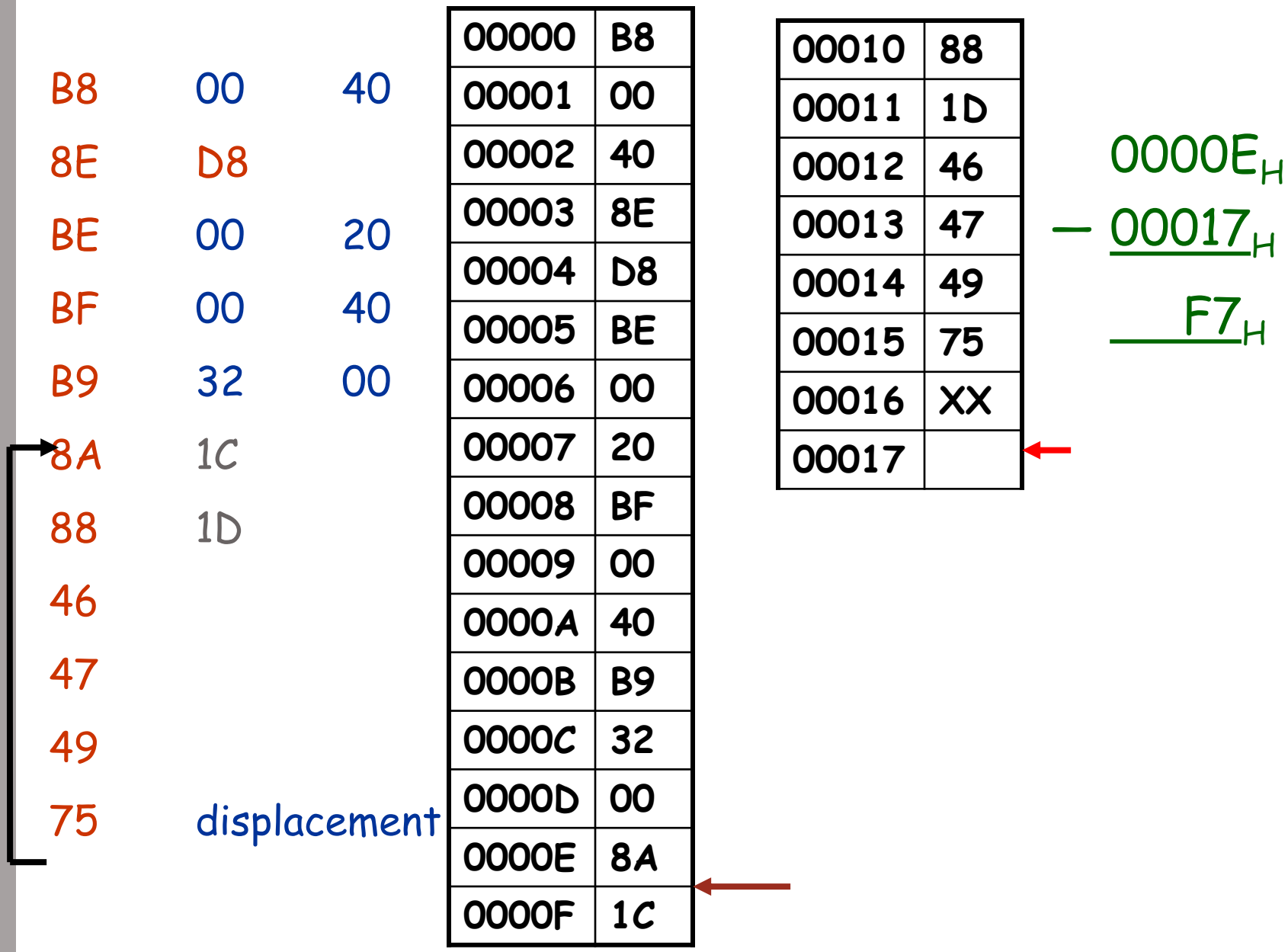
Branch Instructions

JE/JZ	Displacement (-128 to +127)
JNE/ JNZ	Displacement (-128 to +127)

Copy a block of data from one memory area to another memory area- from 42000_H 50 data to 44000_H

MOV	AX, 4000_H	10111000	00	40
MOV	DS,AX	10001110	11011000	
MOV	SI,2000_H	10111110	00	20
MOV	DI,4000_H	10111111	00	40
MOV	CX,0032_H	10111001	32	00

X1:	MOV	BL,[SI]	10001010	00011100
	MOV	[DI],BL	10001000	00011101
	INC	SI	01000110	
	INC	DI	01000111	
	DEC	CX	01001001	
	JNZ	X1	01110101	displacement


B8 00 40
8E D8
BE 00 20
BF 00 40
B9 32 00
8A 1C
88 1D
46
47
49
75 displacement
00000 B8
00001 00
00002 40
00003 8E
00004 D8
00005 BE
00006 00
00007 20
00008 BF
00009 00
0000A 40
0000B B9
0000C 32
0000D 00
0000E 8A
0000F 1C
00010 88
00011 1D
00012 46
00013 47
00014 49
00015 75
00016 XX
00017
0000E$_H$
— 00017$_H$
F7$_H$

8086-80486 – Inst Set & ALP

A Simple Program

INC Destination

- Destination – Register or

  memory location (specified in 24 diff ways)

- (AF, OF, PF, SF, ZF affected, CF not affected)

- INC BL
- INC BX

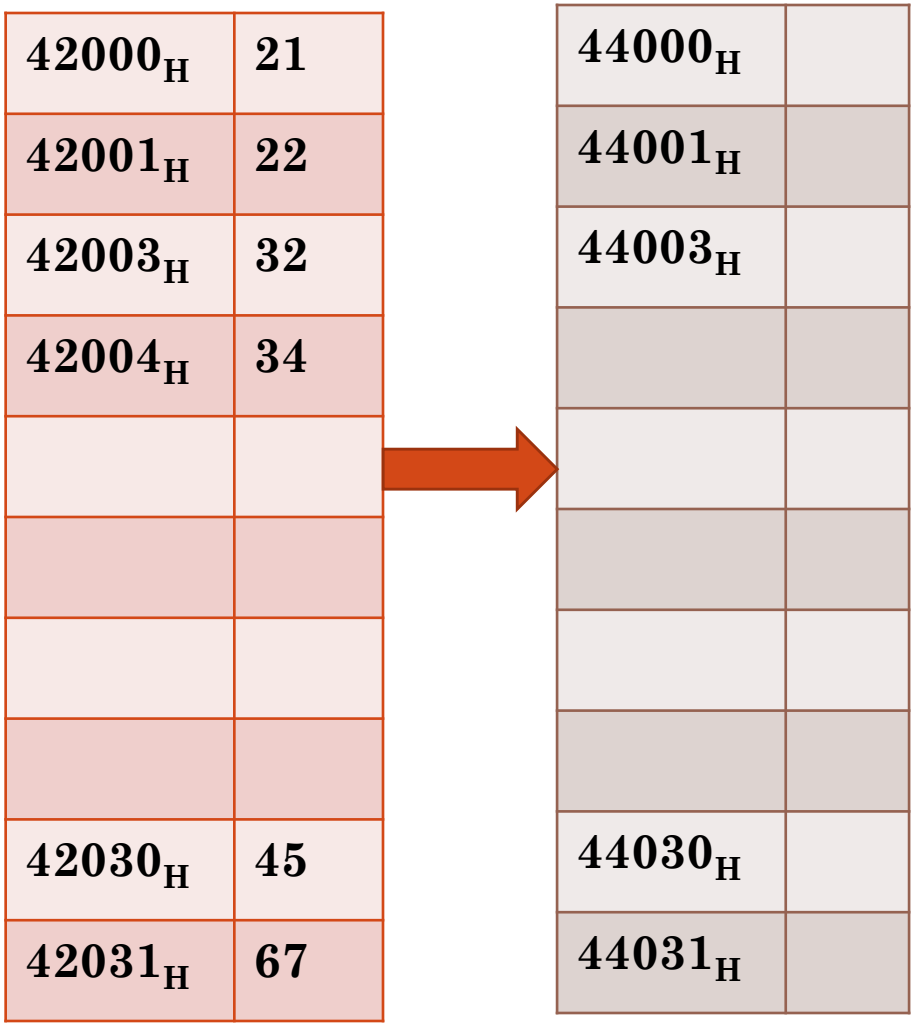
- DEC Destination

Branch Instructions

JE/JZ	Displacement (-128 to +127)
JNE/ JNZ	Displacement (-128 to +127)

Copy a block of data from one memory area to another memory area- from 42000_H 50 data to 44000_H

Data Transfer of 32 bytes



Src Addr 42000_H
Dst Addr 44000_H

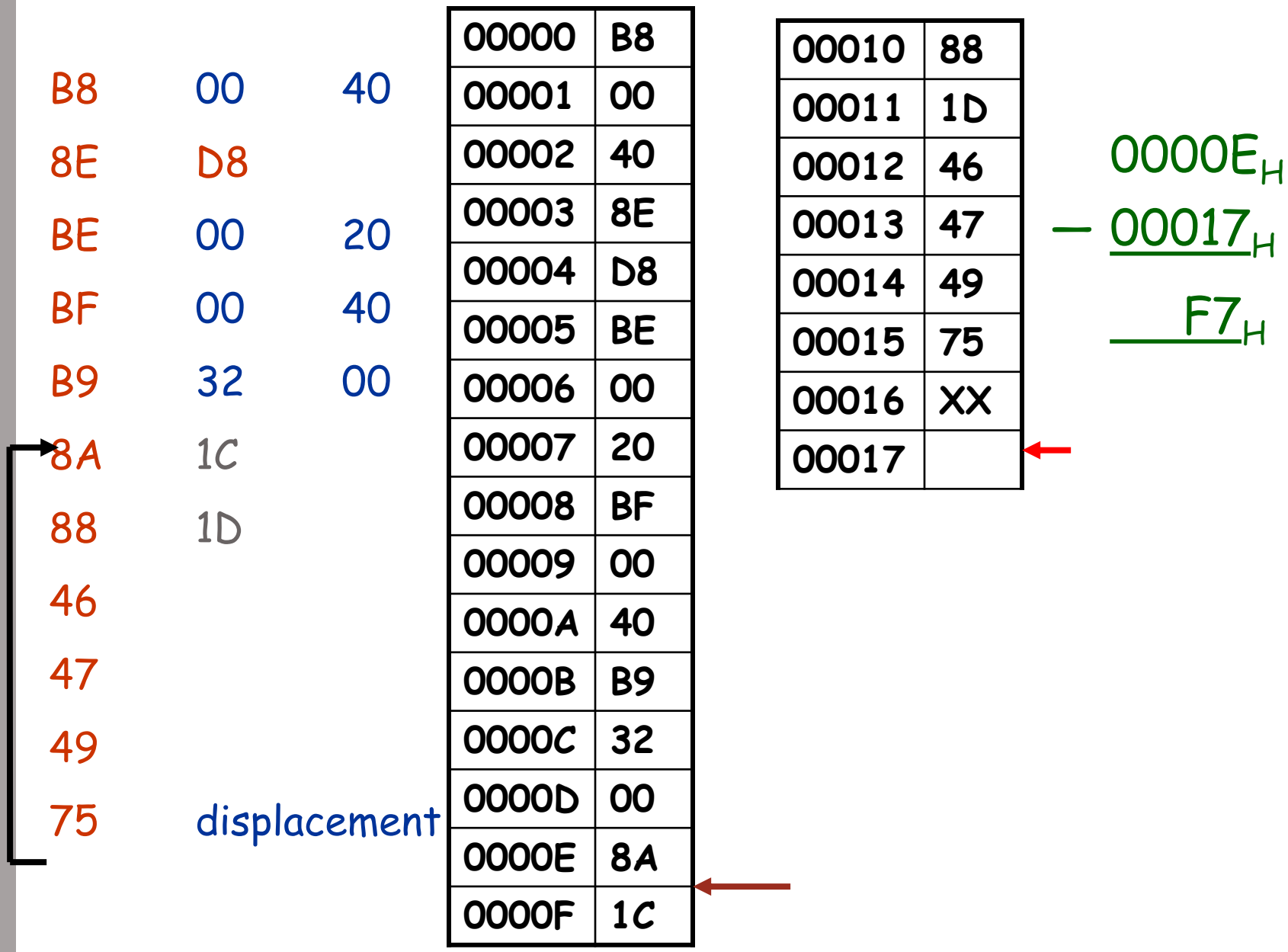
42000 = 4000:2000
44000 = 4000:4000

MOV	AX, 4000_H
MOV	DS,AX
MOV	SI,2000_H
MOV	DI,4000_H
MOV	CX,0032_H

10111000	00	40
10001110	11011000	
10111110	00	20
10111111	00	40
10111001	32	00

```
X1:     MOV     BL,[SI]
        MOV     [DI],BL
        INC     SI
        INC     DI
        DEC     CX
        JNZ     X1
NXT:
```

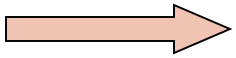
```
10001010    00011100
10001000    00011101
01000110
01000111
01001001
01110101    displacement
```


B8 00 40
8E D8
BE 00 20
BF 00 40
B9 32 00
8A 1C
88 1D
46
47
49
75 displacement
00000 B8
00001 00
00002 40
00003 8E
00004 D8
00005 BE
00006 00
00007 20
00008 BF
00009 00
0000A 40
0000B B9
0000C 32
0000D 00
0000E 8A
0000F 1C
00010 88
00011 1D
00012 46
00013 47
00014 49
00015 75
00016 XX
00017
0000E$_H$
— 00017$_H$
F7$_H$

8086-80486 – Inst Set & ALP

Arithmetic Instructions – ADD& SUB

ADD Destination, Source

(Source) + (Destination)  (Destination)

- Source may be an immediate no. /register/ a memory location specified by any one of the 24 addressing modes
- Destination may be a register / memory location specified by any one of the 24 addressing methods
- Both source and destination in an instruction cannot be memory locations
- Source and Destination must be of same size
- **All Flags Affected**

Example

MOV CL, 73_H 0111 0011

MOV BL, $4F_H$ 0100 1111

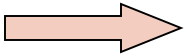
ADD CL, BL

Result in CL = $C2_H$ 11000010_b

(194_d if unsigned -62_d if signed)

CF = 0, PF = 0, AF = 1, ZF = 0, SF = 1, OF = 1

ADC DESTINATION, SOURCE

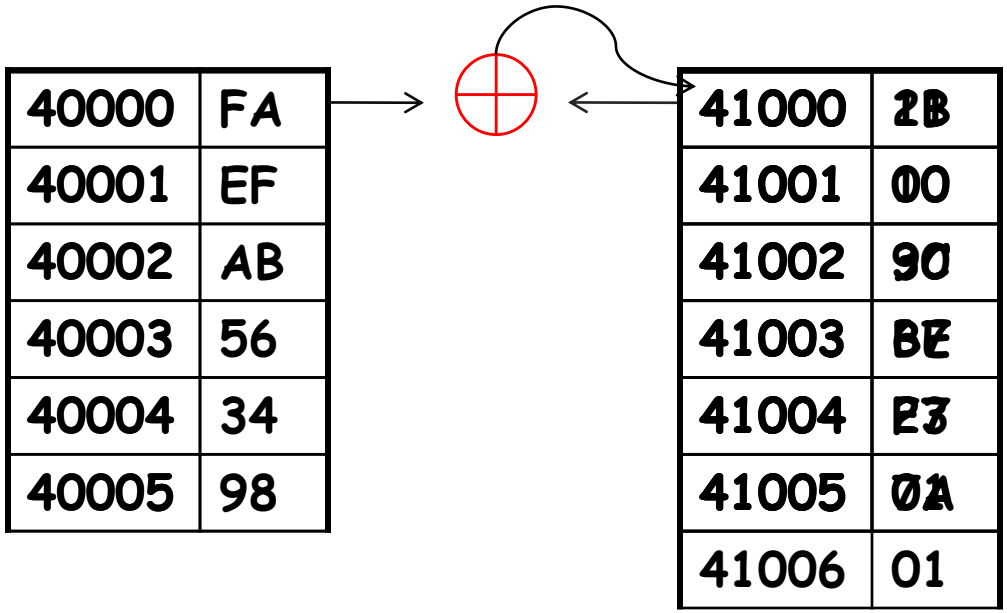
(Source) + (Destination) + (CF)  (Destination)

Useful for muti-byte addition of data

ADD two data of size each 6 bytes

ADC – How it works ???

	1	0	1	1	1	
	98	34	56	AB	EF	FA
	71	F3	67	90	10	21
1	0A	27	BE	3C	00	1B



CLC

Add 2 – 6 byte nos stored in location 20000_H and 21000_H store the result starting from location 21000_H

```
        MOV     AX, 2000H
        MOV     DS,AX
        MOV     SI,0000H
        MOV     DI,1000H
        MOV     CL,06H
        MOV     BL,00
        CLC
X1:     MOV     AL,[SI]
        ADC     [DI],AL
        INC     SI
        INC     DI
        DEC     CL
        JNZ     X1
        JNC     X2
        INC     BL
X2:     MOV     [DI],BL
```

Subtract

SUB DESINATION, SOURCE

(Destination) – (Source)  (Destination)

SBB DESTINATION, SOURCE

(Destination) - (Source) – (CF)  (Destination)

Example

MOV BX,8021_H

SUB BX,8190_H

8	0	2	1
8	1	9	0
F	E	9	1

8	0	2	1
7	E	7	0
F	E	9	1

Z -0 C -1 A-0 P-X S-1 O-0

Write a Program to add an array of bytes stored in Memory starting at 40000_H and store the result in 41000_H

Number of elements in the array 50_d

8086-80486 – Inst Set & ALP

Arithmetic Instructions – ADD& SUB

Write a Program to add an array of bytes stored in Memory starting at 40000_H and store the result in 41000_H

Number of elements in the array 50_d

Example – Add 5 Numbers

40000	FF
40001	FF
40002	FF
40003	FF
40004	01

```
MOV     AX, 4000H
MOV     DS,AX
MOV     SI,0000H
MOV     DI,1000H
MOV     CX,0032H
MOV     BL,00
MOV     BH,BL
```

```
B8      00      40
8E      D8
BE      00      10
BF      00      10
B9      32      00
B3      00
8A      FB
```

```
X1:     ADD     BL,[SI]
        JNC     X2
        INC     BH
X2:     INC     SI
        DEC     CX
        JNZ     X1
        MOV     [DI],BX
```

```
02      1C
73      X2
FE      C7
46
49
75      X1
89      1D
```

B8	00	40
8E	D8	
BE	00	10
BF	00	10
B9	32	00
B3	00	
8A	FB	
02	1C	
73	YY	
FE	C7	
46		
49		
75	XX	
89	1D	

00018_H

$-\ 00016_H$

02_H

00000	B8	00010	8A
00001	00	00011	FB
00002	40	00012	02
00003	8E	00013	1C
00004	D8	00014	73
00005	BE	00015	YY
00006	00	0016	FE
00007	00	0017	C7
00008	BF	0018	46
00009	00	0019	49
0000A	10	001A	75
0000B	B9	001B	XX
0000C	32	001C	89
0000D	00	001D	1D
0000E	B3		
0000F	00		

00012_H

$-\ 0001C_H$

$F6_H$

YY – 02

XX – F6

8086-80486 – Inst Set & ALP

MASM Assembler Directives

Data Declaration

DB, DW, DD

DATA1 DB 45_H, 35_H, 74_H

DATA2 DW 2000_H, 37_H, 2222_H

DATA3 DD $234567AB_H$

ORG 0000_H

```
        ORG     0000H
DATA1   DB      25
DATA2   DB      10001001b
DATA3   DB      12H

        ORG     0010H
DATA4   DB      '2591'
ORG     0018H
DATA5   DB      ?
```

This is how data is initialized in the data segment

0000	19_H	0010	32_H
0001	89_H	0011	35_H
0002	12_H	0012	39_H
		0013	31_H

0018	00_H

0000	31	0010	00
0001	32	0011	45
0002	33	0012	23
0003	34	0013	00
0004	35	0014	03
0005	36	0015	00
0006	67	0016	00
0007	66	0017	FF
0008	01	0018	FF
0009	02	0019	FF
000A	03	001A	FF
000B	61	001B	FF
000C	F0	001C	FF
000D	0C	001D	FF
000E	00	001E	FF
000F	0D	001F	FF

```
                ORG     0000H
MSG2            DB      '123456'
MSG3            DW      6667H
data1           db      1,2,3
                db      'a'
                db      11110000b

data2           dw      12,13
                dw      2345H
                dd      300H
                DB      9 DUP(FFH)
```

EQU Directive

Equate directive equates a symbolic name to a value

```
COUNT   EQU  10
CONST   EQU  20H

        MOV  AH, COUNT
        MOV  AL, CONST
        ADD  AH,AL
```

```
        ORG     0010H
COUNT   EQU     32H
VAL1    EQU     0030H
DAT1    DB      45H, 67H ,100,'A'
WRD     DW      10H,3500H,0910H
DAT2    DD      0902H
VAL2    EQU     32H
DAT3    DW      2 DUP(0)
        ORG     VAL1
DAT4    DB      56H
        ORG     VAL2
RES     DB      10DUP(?)
DWRD    DD      01020304H
```

DAT1	0010	45		0020	00	DAT4	0030	56
	0011	67		0021	00		0031	
	0012	64		0022		RES	0032	X
	0013	41		0023			0033	X
WRD	0014	10		0024			0034	X
	0015	00		0025			0035	X
	0016	00		0026			0036	X
	0017	35		0027			0037	X
	0018	10		0028			0038	X
	0019	09		0029			0039	X
DAT2	001A	02		002A			003A	X
	001B	09		002B			003B	X
	001C	00		002C		DWRD	003C	04
	001D	00		002D			003D	03
DAT3	001E	00		002E			003E	02
	001F	00		002F			003F	01

```
MOV     SI,DAT3
MOV     AL, DAT1 + 1
MOV     BX, DAT1+4
ADD     BX,20H
MOV     AL,[BX]
LEA     BX,DAT4
MOV     AL,[BX]
MOV     BX,VAL1
MOV     AL,[BX]
MOV     BX, OFFSET DAT4
MOV     AL,[BX]
MOV     AL,DAT4
```

8086-80486 – Inst Set & ALP

MASM Program Models

Physical Vs. Logical Segmentation

- A block of memory of discrete size-called a “physical segment”
- The number of bytes in a physical memory segment is 64K for 16-bit processors or 4 gigabytes for 32-bit processors
- A variable-sized block of memory- called a “logical segment” occupied by a program’s code or data

Logical Segments

- Logical segments contain the 3 components of a program:
  - code
  - data
  - stack
- Mapping of Logical segments to actual physical segments in memory
- Load Segment Registers with actual physical addresses
- MASM has assembler directives to do the same

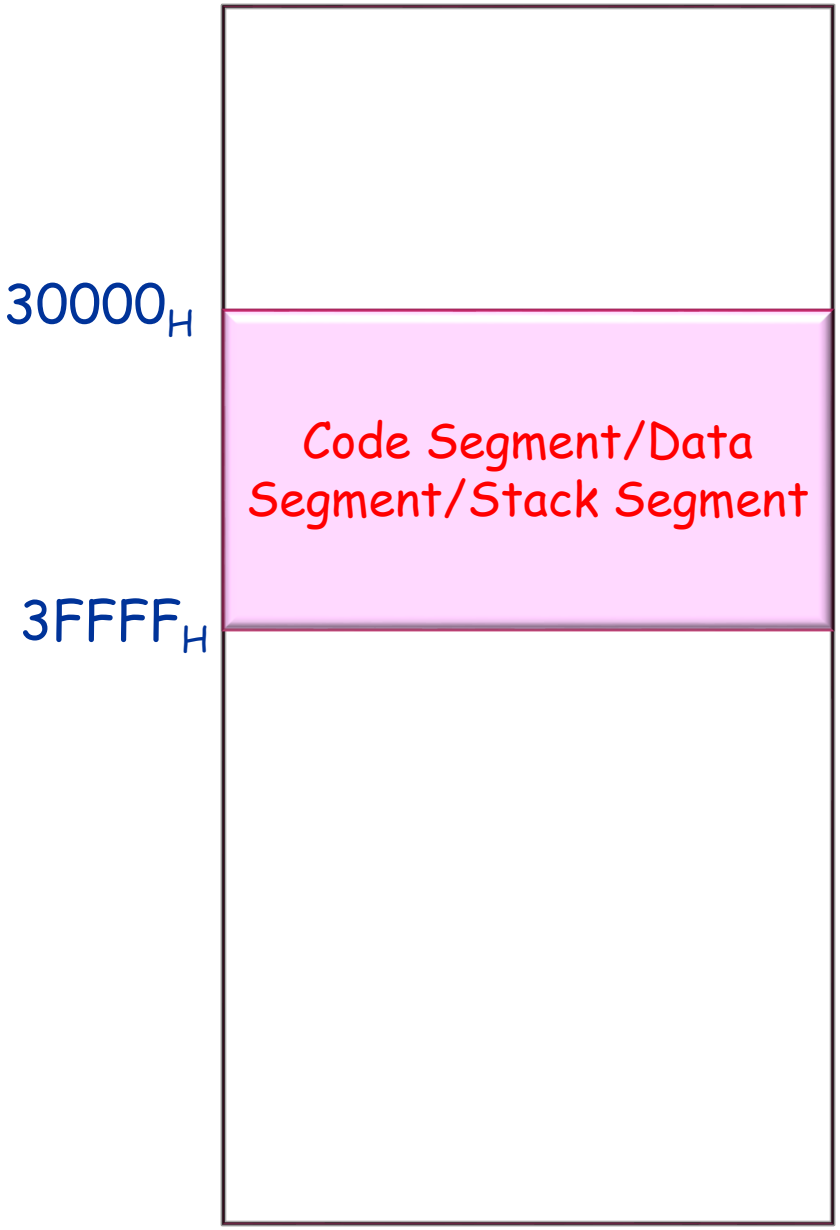
Logical Segments

- Segments defined in two ways
  - Simplified segment directives
  - Full segment definitions

Models

- There are many models available to MASM Assembler ranging from Tiny to Huge
- To designate a model use the .MODEL statement followed by the size of the memory system
- Ex: .MODEL TINY
- TINY Model requires that all program and data fit into one 64K segment

. CODE defines code segment
. DATA defines data segment
. STARTUP
. EXIT


30000H
Code Segment/Data Segment/Stack Segment
3FFFFH

Ex1

```
.model tiny
.data
DATA1  DB      23
DATA2  DW      9999h
DATA3  DW      9999
ARRAY  DW      01,02,03,04,05,06,07,08
.code
.startup
        MOV    BX,DATA2
        MOV    CX,DATA3
        MOV    DATA1,BL
        MOV    DL,DATA1
        MOV    DI,0002H
        MOV    AX, ARRAY [DI]
 .exit
 end
```

Ex 2

```
.DATA
DATA1  DB      23H
ARRAY  DW      01,02,03,04,05,06,07,08

.CODE

       MOV     DX, ARRAY
       MOV     CL, DATA1

       MOV     BX, OFFSET ARRAY
       MOV     AL,[BX]
```

Write an ALP to find the greatest signed no. From a set of 10 bytes stored at array. The greatest no. must be stored at location *RES*

80X86 ISA & PROGRAMMING

COMPARE INSTRUCTIONS

COMPARE INSTRUCTION

- Compare instruction is a subtraction that changes only - the flag bits

- CMP Destination, Source
- CMP CL, [BX]
- CMP AX, 2000_H
- CMP [DI], CH

CMP CX, BX

CX = BX CF-0 ZF-1 SF-0

CX < BX CF-1 ZF-0 SF-1

CX > BX CF-0 ZF-0 SF-0

OF, PF, ACF –depends on data

TO CHECK RESULT OF COMPARE - LOGICAL

JA/JNBE	CF-0 AND ZF-0
JAE/JNB/JNC	CF-0
JB/JC/JNAE	CF-1
JBE/JNA	CF-1 OR ZF-1
JE/JZ	ZF-1
JNE/JNZ	ZF-0

TO CHECK RESULT OF COMPARE -ARITHMETIC

JG/JNLE	SF ⊕ OF-0, AND ZF-0
JGE/JNL	SF ⊕ OF-0
JL/JNGE	SF ⊕ OF-1
JLE/JNG	SF ⊕ OF-1 OR ZF-1
JE/JZ	ZF-1
JNE/JNZ	ZF-0

WRITE AN ALP TO FIND THE GREATEST SIGNED NO. FROM A SET OF 10 BYTES STORED AT **ARRAY**. THE GREATEST NO. MUST BE STORED AT LOCATION ***RES***

```
.model tiny
.data
ARRAY   DB      91H,02H,83H,FFH,75H,06H,07H,47H ,12H ,90H
RES     DB      ?
.code
.startup
        LEA     BX, ARRAY
        MOV     CL,0AH
        MOV     AL,[BX]
        DEC     CL
        INC     BX
X2:     CMP     AL,[BX]
        JGE     X1
        MOV     AL,[BX]
X1:     INC     BX
        DEC     CL
        JNZ     X2
        MOV     RES,AL
 .exit
 end
```

80X86 ISA & PROGRAMMING

PROGRAM MODELS

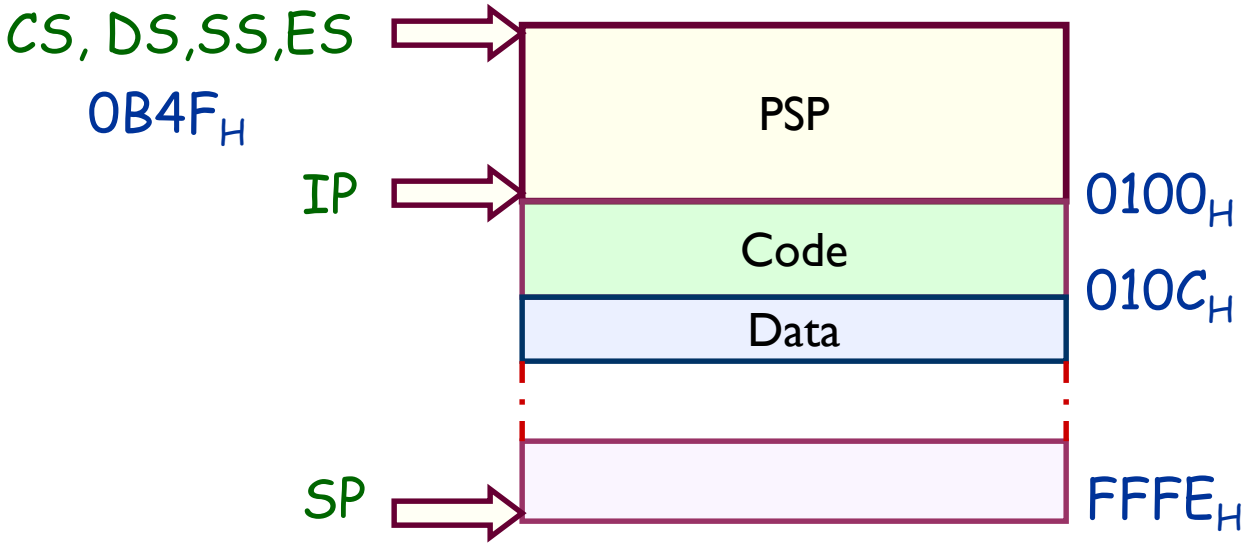
Model Type	Description
Tiny	All the data and code fit in one segment. Tiny programs are written in .COM which means the program must be originated at location 100H
Small	Contains two segments - One DS of 64k bytes and one CS of 64k bytes

* Flat Model –Special type of Tiny Model for 32-bit

Model Type	Description
Medium	Contains one DS of 64kbyte and any number of CS for large programs
Compact	One CS contains the program and any number of DS contains the data
Large	allows any number of CS & DS
Huge	Same as large - but the DSs may contain more than 64k bytes each

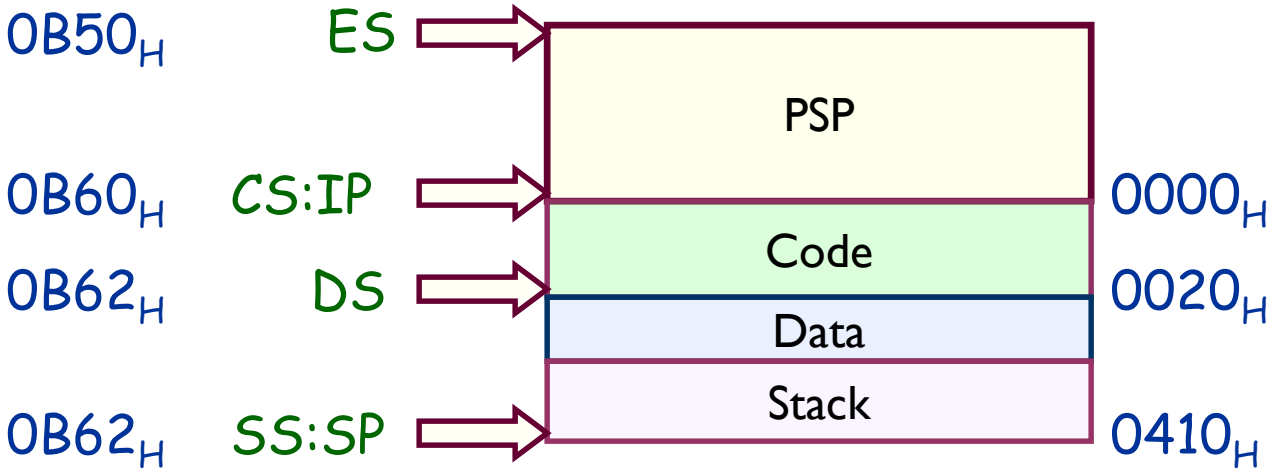
```
.Model Tiny

.data
dat1    db      'a'
        align     2
dat2    db      'b'
.code
.startup
        mov     al,dat1
        add     dat2,al
.exit
end
```

```
.Model Small
.stack
.data
dat1    db      'a'
        align     2
dat2    db      'b'
.code
.startup
        mov     al,dat1
        add     dat2,al
.exit
end
```



Memory Map

Model Tiny



Memory Map

Model Small

```
; This is the structure of a main module
; using simplified segment directives

.MODEL SMALL          ; This statement is reqd before
                      ;  you can use other simplified
                      ;  segment directives

.STACK                ; Use default 1-kilobyte stack
.DATA                 ; Begin data segment
                      ; Place data declarations here

.CODE                 ; Begin code segment
.STARTUP              ; Generate start-up code
.....                 ; Place instructions here
.EXIT                 ; Generate exit code
 END
```