

AY 2023-2024

ARCHITECTURE AND ORGANIZATION





WEEK 12:

ARITHMETIC INSTRUCTIONS



Learning Outcomes:

At the end of the topic session, the students should be able to:

- 1. Understand the different types of arithmetic instructions.
- 2. Solve for the updated register content after arithmetic operations.



ARITHMETIC INSTRUCTIONS

ADDITION

- 1. ADD /

2. ADC / Chrry -> CF 3. INC /

SUBTRACTION

- 3. DEC





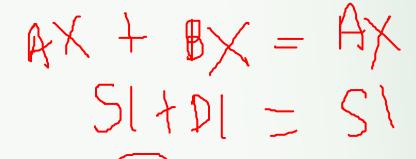
ADD INSTRUCTION

FORMAT: ADD D,S

ACTION: $D \leftarrow [D] + [S]$

Example:

ADD AX, BX ADD [SI], DI





ADD INSTRUCTION- EXAMPLE

Assume the following register content:

AX = 0015H	SS = 2000F

$$BX = 0019H$$
 $SI = 001EH$

$$CX = 0012H$$
 $DI = 0017H$

$$DX = 001BH$$
 $SP = 0035H$

ADD AX, BX ADD [SI], DI



ADD INSTRUCTION- EXAMPLE

ADD AX, BX

PX = GOZEHL

ADD [SI], DI



ADC INSTRUCTION AND WITH







FORMAT: ADC D,S

ACTION: $D \leftarrow [D] + [S] + [CF]$

Example:

CF - \ ADD AX, BX \
- ADC SI, DI + CF



ADD INSTRUCTION- EXAMPLE

Assume the following register content:

$$AX = 0015H$$

$$BX = 0019H$$

$$CX = 0012H$$

$$DX = 001BH$$

$$SS = 2000H$$

$$SI = 001EH$$

$$DI = 0017H$$

$$SP = 0035H$$

MOV AX, FAFA
$$\rightarrow P.A = SS \times 10H + 6035$$
 $20036 - 70$

MOV BX, [SP] $\rightarrow P.A = SS \times 10H + 6035$ $20036 - 70$

ADD AX, BX $= 20035$ $SP = 7000H$



ADC INSTRUCTION- EXAMPLE

MOV AX, FAFA MOV BX, [SP]

ADD AX, BX ADC SI, DI

$$AX = 6AFAH$$

$$CF = 1$$

$$SI = 06IE$$

$$DI = 0017$$

$$C = 1$$



INC INSTRUCTION

FORMAT: INC [D] ACTION: $D \leftarrow [D] + 1$

INC CX INC DX



INC INSTRUCTION- EXAMPLE

Assume the following register content:

AX = 0015H	SS=	2000E

$$BX = 0019H$$
 $SI = 001EH$

$$CX = 0012H$$
 $DI = 0017H$

$$DX = 001BH$$
 $SP = 0035H$

INC AX

INC BX

INC CX

INC DX



SUB INSTRUCTION

FORMAT: SUB D,S ACTION: D ← [D] - [S]

Example:





SUB INSTRUCTION- EXAMPLE

Assume the following register content:

$$BX = 0019H$$
 $SI = 001EH$

$$CX = 0012H$$
 $DI = 0017H$

$$DX = 001BH$$
 $SP = 0035H$

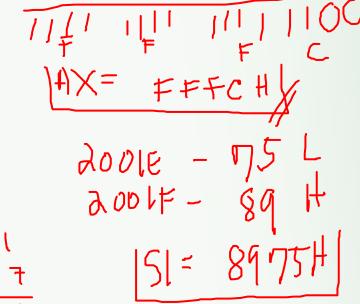
SUB AX, BX SUB [SI], DI



SUB INSTRUCTION- EXAMPLE

SUB AX, BX

151-895EH





SBB INSTRUCTION

FORMAT: SBB D,S

ACTION: D \leftarrow [D] - [S] - [CF]

Example:

MOV AX, 7AFA MOV BX, 913D SUB AX, BX SBB SI, DI



SBB INSTRUCTION- EXAMPLE

Assume the following register content:

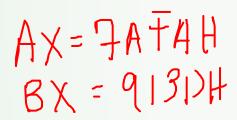
$$AX = 0015H$$
 $SS = 2000H$

$$BX = 0019H$$
 $SI = 001EH$

$$CX = 0012H$$
 $DI = 0017H$

$$DX = 001BH$$
 $SP = 0035H$

MOV AX, 7AFA MOV BX, 913D SUB AX, BX SBB SI, DI





SBB INSTRUCTION- EXAMPLE

MOV AX, 7AFA MOV BX, 913D SUB AX, BX



$$51 = 001E$$
 0017
 0017
 0017
 0006
 0006
 0006



DEC INSTRUCTION

FORMAT: DEC [D]

ACTION: D \leftarrow [D] -1

EXAMPLE:

DEC AX DEC BX

$$AX = 001EH$$
 $BX = 001FH$

$$AX = 001FH$$
, $BX = 0020H$
 $AX = 001FH$ 0020 15
 $BX = 001FH$ $001FH$



DEC INSTRUCTION- EXAMPLE

Assume the following register content:

AX = 0015H	SS=	2000E

$$BX = 0019H$$
 $SI = 001EH$

$$CX = 0012H$$
 $DI = 0017H$

$$DX = 001BH$$
 $SP = 0035H$

DEC AX

DEC BX

DEC CX

DEC DX





REFERENCES:

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 a_encapsulation.htm
- ✓ https://www.programiz.com/java-programming/encapsulation
- ✓ https://www.geeksforgeeks.org/encapsulation-in-java/
- ✓ https://www.w3schools.com/java/java_encapsulation.asp