ΕΘΝΙΚΌ ΜΕΤΣΌΒΙΟ ΠΟΛΥΤΕΧΝΕΊΟ

ΣΧΟΛΉ ΗΛΕΚΤΡΟΛΌΓΩΝ ΜΗΧΑΝΙΚΏΝ ΚΑΙ ΜΗΧΑΝΙΚΏΝ ΥΠΟΛΟΓΙΣΤΏΝ

ΕΡΓΑΣΤΗΡΙΟ ΜΙΚΡΟΫΠΟΛΟΓΙΣΤΩΝ

(2020-2021)

1η ΟΜΆΔΑ ΑΣΚΉΣΕΩΝ

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Εξέταση – Επίδειξη:

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1η Άσκηση

Ο πηγαίος κώδικας, μαζί με τα απαραίτητα σχόλια:

```
START:

LDA 2000H           ;INPUT FROM 4 LSBs
ANI 0FH
CPI 00H             ;IF INPUT=0 READ AGAIN
JZ START
MOV E,A             ;SAVE IN REG E
MVI A,00H           ;INITIALISE A
                    ;A WILL BE USED AS A TIMER

GO_UP:
CALL PRINT          ;PRINT A
INR A
CMP E               ;IF A REACHED LIMIT E
JNC GO_DOWN         ;THEN START GO_DOWN
JMP GO_UP           ;ELSE CONTINUE GO_UP

GO_DOWN:
CALL PRINT          ;DISPLAY A
DCR A
CPI 01H             ;IF >=1
JNC GO_DOWN         ;THEN CONTINUE GO_DOWN
JMP START           ;ELSE START AGAIN

PRINT:
MOV D,A             ;SAVE A
STALL:              ;INFINITE LOOP UNTIL MSB IS ON
LDA 2000H
RAL
JNC STALL
MOV A,D             ;RESTORE A

CMA                 ;PRINT A
STA 3000H
LXI B,03E8H
CALL DELB
CMA

RET
END
```

2η Άσκηση

Ο πηγαίος κώδικας, μαζί με τα απαραίτητα σχόλια:

```
IN 10H
START:

CALL KIND          ;READ X
RLC                ;ROTATE & CREATE X*16
RLC
RLC
RLC
MOV D,A            ;SAVE X*16
CALL KIND          ;READ Y
ADD D              ;CALCULATE ANS=16*X+Y IN HEX

MVI D,00H          ;D COUNTS THE NUMBER OF HUNDREDS
HUNDREDS:
CPI 64H            ;IF ANS<100
JC SKIP_A          ;THEN GO TO SKIP_A
INR D              ;ELSE INCREASE NUMBER OF HUNDREDS
SUI 64H            ;REDUCE ANS BY 100
JMP HUNDREDS       ;AND CONTINUE COUNTING HUNDREDS

SKIP_A:            ;STORE NUMBER OF HUNDREDS
MOV E,A
MOV A,D            ;STORE NUMBER OF HUNDREDS IN THE MEMORY
STA 0912H
MOV A,E

MVI D,00H          ;D COUNTS THE NUMBER OF TENS
TENS:
CPI 0AH            ;IF ANS<10
JC SKIP_B          ;THEN GO TO SKIP_B
INR D              ;ELSE INCREASE NUMBER OF TENS
SUI 0AH            ;REDUCE ANS BY 10
JMP TENS           ;AND CONTINUE COUNTING TENS

SKIP_B:            ;STORE NUMBER OF TENS AND ONES
STA 0910H          ;STORE NUMBER OF ONES IN THE MEMORY
MOV A,D
STA 0911H          ;STORE NUMBER OF TENS IN THE MEMORY
MOV A,E

MVI A,10H          ;CLEAR THE REST OF THE 7-SEGMENT DISPLAY
STA 0913H
STA 0914H
STA 0915H

LXI D,0910H        ;PRINT THE ANSWER
CALL STDM
CALL DCD

JMP START          ;RESTART
END
```

3η Άσκηση

Ο πηγαίος κώδικας, μαζί με τα απαραίτητα σχόλια:

```
START:
LDA 2000H         ;INFINITE LOOP UNTIL LSB IS ON
RAR
JNC START

MVI A,01H         ;A REPRESENTS THE LED THAT IS ON
MVI H,01H         ;H HOLDS THE LAST STATE OF THE LSB

CHANGE_UP:
CALL PRINT        ;TURNS LED ON (ONLY USED WHEN LSB LED IS ON)

UP:
MVI E,00H         ;HOLDS THE DIRECTION OF THE LED (WHEN 0
DIRECTION IS LSB TO MSB)
CALL PRINT        ;TURNS LED ON
CALL CHECK_LSB    ;CALL FUNCTION THAT CHECKS THE LSB
RLC               ;ROTATE

CPI 80H           ;WHEN MSB LED IS ON CHANGE DIRECTION
JZ CHANGE_DOWN
JMP UP            ;ELSE CONTINUE IN THIS DIRECTION


CHANGE_DOWN:
CALL PRINT        ;TURNS LED ON (ONLY USED WHEN MSB LED IS ON)

DOWN:
MVI E,01H         ;DIRECTION IS SET FROM MSB TO LSB
CALL PRINT        ;TURNS LED ON
CALL CHECK_LSB    ;CALL FUNCTION THAT CHECKS THE LSB
RRC               ;ROTATE

CPI 01H           ;WHEN LSB LED IS ON CHANGE DIRECTION
JZ CHANGE_UP
JMP DOWN          ;ELSE CONTINUE IN THIS DIRECTION


PRINT:
MOV D,A           ;STALL UNTIL MSB IS ON

STALL:
LDA 2000H
RAL
JNC STALL
MOV A,D
CMA               ;TURN ON THE LED
STA 3000H
LXI B,01F4H       ;DELAY 0.5 sec

CALL DELB
CMA
RET
```

```
CHECK_LSB:
MOV D,A            ;SAVE A
LDA 2000H
RAR               ;ROTATE
JC LSB_OFF        ;IF LSB SWITCH IS OFF GO TO LSB_OFF
MOV A,H           ;CHECK LSB SWITCHES LAST STATE
CPI 00H
JNZ SKIP_A        ;IF IT WAS ON THEN SKIP EVERYTHING

MVI H,01H         ;ELSE CHECK THE DIRECTION AND CHANGE IT
MOV A,D           ;IF LSB/MSB LED ON DON'T CHANGE THE DIRECTION
CPI 80H
JZ SKIP_A
CPI 01H
JZ SKIP_A
MOV A,E
CPI 00H           ;IF DIRECTION WAS UP
MOV A,D
JZ DOWN           ;THEN GO DOWN
JMP UP            ;ELSE GO UP

LSB_OFF:
MVI H,00H         ;SET PREVIOUS STATE TO OFF

SKIP_A:
MOV A,D
RET


END
```