**ΕΡΓΑΣΤΗΡΙΑΚΗ ΑΣΚΗΣΗ 8 (ΜΙΚΡΟΠΡΟΓΡΑΜΜΑΤΙΣΜΟΣ 3)**

**20.04.2024**

Μέλη ομάδας :

Τσάλα Ζαφειρία 1084963 ([up1084963@ac.upatras.gr](mailto:up1084963@ac.upatras.gr))

Φουσκαρής Αλέξιος-Ιωσήφ 1100747 ([up1100747@ac.upatras.gr](mailto:up1100747@ac.upatras.gr))

Ομάδα Α4

|  |  |
| --- | --- |
| Accumulator | 0001 |
| Program Counter | **1000** |
| Βοηθητικός Καταχωρητής Χ | **0000** |

**Υλοποίηση της GOTO μέσα στο εργαστήριο**

Φορτώσαμε την dummy εντολή LDA #K που είχε υλοποιηθεί στο Εργαστήριο Μικροπρογραμματισμού 2 και ύστερα υλοποιήσαμε την GOTO, ώστε κάθε φορά που την καλούμε να φορτώνεται η LDA #K.

////////////////// LDA #K /////////////////////////

PC+1->PC,MAR

MDR+0->ACC

PC+1->PC,MAR

NEXT(PC)

////////////////// GOTO ///////////////////////

PC+1->PC,MAR

MDR+0-> PC

NEXT(PC)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BOOTSTRAP** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| SW+0->PC,MAR | xxxxx | 000 | xxx | 111 | 000 | 011 | xxxx | 1000 | xx | x | 1 | 1 | 1 | x | 1 | 0 | 1 | 1 | 1 | m00 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m01 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **LDA #K** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m02 |
| MDR+0->ACC | xxxxx | 000 | xxx | 111 | 000 | 011 | xxxx | 0001 | xx | x | 1 | 1 | 0 | x | 1 | 1 | 1 | 0 | 1 | m03 |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m04 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m05 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **GOTO** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m06 |
| MDR+0->PC | xxxxx | 000 | xxx | 111 | 000 | 011 | xxxx | 1000 | xx | x | 1 | 1 | 0 | x | 1 | 1 | 1 | 0 | 1 | m07 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m08 |

**Ερώτημα 1.**

**Να γραφούν μικροπρογράμματα για την υλοποίηση των ακόλουθων εντολών**

**LDA K(X) :** Φόρτωσε στο συσσωρευτή το περιεχόμενο της θέσης μνήμης με διεύθυνση ίση με το άθροισμα του διψήφιου δεκαεξαδικού αριθμού Κ και του περιεχομένου του βοηθητικού καταχωρητή Χ.

PC+1->PC,MAR

MDR+X->MAR

PC+1->PC,MAR

NEXT(PC)

**LDX #K :** Φόρτωσε στον βοηθητικό καταχωρητή Χ το διψήφιο δεκαεξαδικό αριθμό Κ

PC+1->PC,MAR

MDR+0->X

PC+1->PC,MAR

NEXT(PC)

**INX :** Αύξηση κατά ένα (1) του περιεχομένου του βοηθητικού καταχωρητή Χ

X+1->X

PC+1->PC,MAR

NEXT(PC)

**CMPX #K :** Σύγκριση του περιεχομένου του βοηθητικού καταχωρητή Χ με το διψήφιο δεκαεξαδικό αριθμό Κ.

PC+1->PC,MAR

X-#K->NOP,MSTATUSCLK

PC+1-> PC,MAR

NEXT(PC)

**STA K(X)** : Αποθήκευσε το περιεχόμενο του συσσωρευτή στη θέση μνήμης με διεύθυνση το άθροισμα του διψήφιου δεκαεξαδικού αριθμού Κ και του περιεχομένου του βοηθητικού καταχωρητή Χ.

PC+1->PC,MAR

MDR+X->NOP, MAR

ACC+ 0->MDR

PC+1->PC, MAR

NEXT(PC)

**ADC K(C) :** Πρόσθεσε το περιεχόμενο του συσσωρευτή με το περιεχόμενο της θέσης μνήμης με διεύθυνση ίση με το άθροισμα του διψήφιου δεκαεξαδικού αριθμού Κ και του βοηθητικού καταχωρητή Χ και το κρατούμενο εισόδου και αποθήκευσε το αποτέλεσμα στο συσσωρευτή.

PC + 1 → PC , MAR

MDR + X → MAR

MDR + ACC → ACC, MSTATUSCLK, CARRYE~

PC + 1 → PC, MAR

NEXT(PC)

**CRC :** Καθαρισμός της σημαίας κρατουμένου (C=0).

PC+1->PC,MAR

CARRYE~=1

PC+1->PC,MAR

NEXT(PC)

**JNZ $K :** Εάν η σημαία μηδενικού αποτελέσματος (zero flag) είναι μηδέν (Ζ=0) πήγαινε να εκτελέσεις την εντολή που είναι στη διεύθυνση Κ (δηλαδή φόρτωσε στον Μετρητή Προγράμματος την τιμή Κ).

PC+1->PC,MAR

MDR+X->NOP,MAR

MDR+0->PC

PC+1->PC,MAR

NEXT(PC)

**SHLA :** Κάνε αριστερή ολίσθηση κατά μια θέση στο περιεχόμενο του συσσωρευτή

ENABLESH~

PC+1->PC,MAR

NEXT(PC)

**HALT :** Τέλος εκτέλεσης του προγράμματος.

PC+0->PC

NEXT(PC)

**40αδες των μικροεντολών**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BOOTSTRAP** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| SW+0->PC,MAR | xxxxx | 000 | xxx | 111 | 000 | 011 | xxxx | 1000 | xx | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | m00 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m01 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **LDA K(X)** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m02 |
| MDR+X->MAR | xxxxx | 000 | 000 | 100 | 000 | 001 | 0000 | xxxx | xx | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | m03 |
| MDR+0->ACC | xxxxx | 000 | xxx | 111 | 000 | 011 | xxxx | 0001 | xx | x | x | 1 | 0 | x | 1 | 1 | 1 | 1 | 1 | m04 |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m05 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m06 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **LDX #K** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m07 |
| MDR+0->X | xxxxx | 000 | xxx | 111 | 000 | 011 | xxxx | 0000 | xx | x | x | 1 | 0 | x | 1 | 1 | 1 | 1 | 1 | m08 |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m09 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m0A |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **INX** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| X+1->X | xxxxx | 000 | xxx | 101 | 000 | 011 | 0000 | 0000 | 01 | x | x | 1 | 0 | x | 1 | 1 | 1 | 1 | 0 | m0B |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m0C |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m0D |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CMPX #K** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m0E |
| X- #K->NOP,MSTATUSCLK | xxxxx | 000 | 000 | 100 | 000 | 001 | 0001 | xxxx | xx | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | m0F |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m10 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m11 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **STA K(X)** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m12 |
| MDR+X->NOP,MAR | xxxxx | 000 | 000 | 100 | 000 | 001 | 0000 | xxxx | xx | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | m13 |
| ACC+0->MAR | xxxxx | 000 | xxx | 111 | 000 | 011 | 0001 | xxxx | xx | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 1 | m14 |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m15 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m16 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ADC K(X)** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m17 |
| MDR+X->MAR | xxxxx | 000 | 000 | 100 | 000 | 001 | 0000 | xxxx | xx | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | m18 |
| MDR+ACC->ACC,MSTATUSCLK,CARRYE~ | xxxxx | 000 | xxx | 111 | 000 | 011 | 0001 | 0001 | xx | x | x | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | m19 |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m1A |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m1B |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CRC** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m1C |
| CARRYE~=1 | xxxxx | 000 | 000 | 100 | 000 | 001 | xxxx | xxxx | xx | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | m1D |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m1F |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m20 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **JNZ $K** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m21 |
| MDR+X->NOP,MAR | xxxxx | 000 | 000 | 100 | 000 | 001 | 0001 | xxxx | xx | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | m22 |
| MDR+0->PC | xxxxx | 000 | xxx | 111 | 000 | 011 | xxxx | 1000 | xx | x | x | 1 | 0 | x | 1 | 1 | 1 | 1 | 1 | m23 |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m24 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m25 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SHLA** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| ENABLESH~ | xxxxx | 000 | xxx | 100 | 000 | 111 | 0001 | 0001 | 00 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | m26 |
| PC+1->PC,MAR | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 01 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | m27 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | Xxxx | xxxx | xx | x | 1 | 1 | 0 | 0 | 0 | x | 1 | x | x | m28 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **HALT** | BRA | BIN | CON | I | I | I | APORT | BPORT | DDATA | SH~ | SELB | MWE~ | MARCLK | MSTATUS | LDS~ | PCE~ | CARRYE~ | MDE~ | DDATAE~ | **ADDRESS** |
|  | (4:0) | (2:0) | (2:0) | (2:0) | (5:3) | (8:6) | (3:0) | (3:0) | (1:0) |  |  |  |  |  |  |  |  |  |  |  |
| PC+0->PC | xxxxx | 000 | xxx | 101 | 000 | 011 | 1000 | 1000 | 00 | x | x | 1 | 1 | x | 1 | 1 | 1 | 1 | 0 | m29 |
| NEXT(PC) | xxxxx | 000 | xxx | xxx | xxx | 001 | xxxx | xxxx | xx | x | x | 1 | x | x | 0 | x | 1 | x | x | m2A |

**Ερώτημα 2.**

**Να γραφεί πρόγραμμα για την εκτέλεση της παρακάτω επαναληπτικής διαδικασίας: W[i] = Y[i] + 2\* Z[i], όπου i=0 έως 7. Οι προσθέσεις θα πρέπει να χρησιμοποιούν το κρατούμενο που προέκυψε από την πρόσθεση της προηγούμενης επανάληψης. Οι αρχικές τιμές των W, Y και Ζ θα σας δοθούν κατά την διάρκεια του εργαστηρίου.**

CRC

LDX #0

LDA K(X)

SHLA

INX

ADC K(X)

STA K(X)

INX

CMPX #K

JNZ $2

HALT

|  |  |
| --- | --- |
| **Mapper:**  m00 02  m01 06  m02 0a  m03 0f  m04 12  m05 15  m06 1a  m07 1f  m08 22  m09 27  m0a 29 | **MAIN MEMORY**  m00 00 opcode crc  m01 01 opcode ldx  m02 11 entelo ldx  m03 02 opcode lda  m04 12 entelo lda  m05 03 opcode shla  m06 04 opcode inx  m07 05 opcode adc  m08 13 entelo adc  m09 06 opcode sta  m0a 14 entelo sta  m0b 07 opcode inx  m0c 08 opcode cmpx  m0d 15 entelo cmpx  m0e 09 opcode jnz  m0f 16 entelo jnz  m10 0a opcode halt  **Περιοχή δεδομένων**  m11 0  m12 k+x  m13 k+x  m14 k+x  m15 k  m16 2 |