Objective

* Get a handle for manipulating data using the SDK-85 (Student Development Kit)
* Use Appendix F (8085 Instruction Set), specifically the Arithmetic Group, to perform operations on the registers and memory locations of the SDK-85.

Theory

* The SDK-85 (Student Development Kit) is a single board microcomputer system kit using the 8085 processor. It is made by Intel and is now used to teach students about the concepts of microprocessors. Contains the following
  + **Microprocessor**
  + **Memory Element** – This describes both ROM (Read Only Memory) and RAM (Random Access Memory)
    - ROM (Read Only Memory) – Contains system boot up instructions
    - RAM (Random Access Memory) – Has Read/Write capabilities
  + **I/O Unit** – Handles input from user and provides output
* Microprocessors are computer processors that incorporate the functions of a central processing unit on a single integrated circuit (IC) or at most a few integrated circuits. They contain the following:
  + **Combinational logic Unit** ­– are logic circuits implemented by Boolean (logic gates) circuits, where the output is a pure function of the present input only. Think Half-Adders, Full-Adders, Encoders, and Decoders.
  + **Sequential logic Unit** – this is a type of logic circuit whose output depends on previous inputs as well as on the present inputs.
    - Contains Memory
    - Contains a clock

This lab focuses on **Appendix F (the 8085 Instruction Set)**, specifically Up and Down Counters. This is the set of assembly instructions that performs preset programs that’s stored in ROM

LAB 8 PART A (Part a)

|  |  |  |  |
| --- | --- | --- | --- |
| 2000  1  2 | 31  C2  20 | SP ←20C2 | LXI SP, 20C2 |
| 3  4 | 3E  00 | A ←00 | MV1 A, 00 |
| 5 | F5 | PUSH PSW | PUSH PSW |
| 6  7  8 | CD  6E  03 | DISPLAY A | CD 036E |
| 9  A  B | 11  99  F6 | DE ←F699 | LXI D, F699 |
| C | 1B | DE ← DE - 1 | DCX D |
| D | 7A | A ←D | MOV A,D |
| E | B3 | [A] ←[A] V [E] | ORA E |
| F  10  11 | CA  13  20 | JUMP 2013 A=00 | JZ 2013 |
| 12 | F1 | POP PSW | POP PSW |
| 13 | 3C | [A] ←[A] +1 | INR A |
| 14  15 | FE  0A | COMPARE A IS 09 | CPI 09 |
| 16  17  18 | C2  05  20 | JUMP 2005 A | JNZ 2005 |
| 19 | CF | STOP | RST 1 |

LAB 8 PART A (Part b) - 1 sec

|  |  |  |  |
| --- | --- | --- | --- |
| 2000  1  2 | 31  C2  20 | SP ←20C2 | LXI SP, 20C2 |
| 3  4 | 3E  00 | A ←00 | MV1 A, 00 |
| 5 | F5 | PUSH PSW | PUSH PSW |
| 6  7  8 | CD  6E  03 | DISPLAY A | CD 036E |
| 9  1A | 3E  02 | A ←02 | MV1 A, 02 |
| 1B | F5 | PUSH PSW | PUSH PSW |
| 1C  1D  1E | 11  99  F6 | DE ←F699 | LXI D, F699 |
| 1F | 1B | DE ← DE - 1 | DCX D |
| 10 | 7A | A ←D | MOV A,D |
| 11 | B3 | [A] ←[A] V [E] | ORA E |
| 12  13  14 | CA  16  20 | JUMP 2016 A=00 | JZ 2016 |
| 15 | F1 | POP PSW | POP PSW |
| 16 | 3D | [A] ←[A]-1 | DCR A |
| 17  18  19 | CA  1B  20 | JUMP 201B IF A=00 | JZ 201B |
| 1A | F1 | POP PSW | POP PSW |
| 1B | 3C | [A] ←[A] +1 | INR A |
| 1E  1D | FE  0A | COMPARE A IS 09 | CPI 09 |
| 1E  1F  20 | C2  05  20 | JUMP 2005 A | JNZ 2005 |
| 21 | CF | STOP | RST 1 |

LAB 8 PART A (Part b) - 10 sec

|  |  |  |  |
| --- | --- | --- | --- |
| 2000  1  2 | 31  C2  20 | SP ←20C2 | LXI SP, 20C2 |
| 3  4 | 3E  00 | A ←00 | MV1 A, 00 |
| 5 | F5 | PUSH PSW | PUSH PSW |
| 6  7  8 | CD  6E  03 | DISPLAY A | CD 036E |
| 9  1A | 3E  02 | A ←0A | MV1 A, 0A |
| 1B | F5 | PUSH PSW | PUSH PSW |
| 1C  1D  1E | 11  99  F6 | DE ←F699 | LXI D, F699 |
| 1F | 1B | DE ← DE – 1 | DCX D |
| 10 | 7A | A ←D | MOV A,D |
| 11 | B3 | [A] ←[A] V [E] | ORA E |
| 12  13  14 | CA  16  20 | JUMP 2016 A=00 | JZ 2016 |
| 15 | F1 | POP PSW | POP PSW |
| 16 | 3D | [A] ←[A]-1 | DCR A |
| 17  18  19 | CA  1B  20 | JUMP 201B IF A=00 | JZ 201B |
| 1A | F1 | POP PSW | POP PSW |
| 1B | 3C | [A] ←[A] +1 | INR A |
| 1E  1D | FE  0A | COMPARE A IS 09 | CPI 09 |
| 1E  1F  20 | C2  05  20 | JUMP 2005 A | JNZ 2005 |
| 21 | CF | STOP | RST 1 |

LAB 8 PART B - 1 sec

|  |  |  |  |
| --- | --- | --- | --- |
| 2000  1  2 | 31  C2  20 | SP ←20C2 | LXI SP, 20C2 |
| 3  4 | 3E  09 | A ←09 | MV1 A, 09 |
| 5 | F5 | PUSH PSW | PUSH PSW |
| 6  7  8 | CD  6E  03 | DISPLAY A | CD 036E |
| 9  1A | 3E  02 | A ←02 | MV1 A, 02 |
| 1B | F5 | PUSH PSW | PUSH PSW |
| 1C  1D  1E | 11  99  F6 | DE ←F699 | LXI D, F699 |
| 1F | 1B | DE ← DE - 1 | DCX D |
| 10 | 7A | A ←D | MOV A,D |
| 11 | B3 | [A] ←[A] V [E] | ORA E |
| 12  13  14 | CA  16  20 | JUMP 2016 A=00 | JZ 2016 |
| 15 | F1 | POP PSW | POP PSW |
| 16 | 3D | [A] ←[A]-1 | DCR A |
| 17  18  19 | CA  1B  20 | JUMP 201B IF A=00 | JZ 201B |
| 1A | F1 | POP PSW | POP PSW |
| 1B | 3D | [A] ←[A] -1 | DCR A |
| 1E  1D | FE  00 | COMPARE A IS 00 | CPI 00 |
| 1E  1F  20 | C2  05  20 | JUMP 2005 A | JNZ 2005 |
| 21 | CF | STOP | RST 1 |

LAB 8 PART B - 10 sec

|  |  |  |  |
| --- | --- | --- | --- |
| 2000  1  2 | 31  C2  20 | SP ←20C2 | LXI SP, 20C2 |
| 3  4 | 3E  09 | A ←09 | MV1 A, 09 |
| 5 | F5 | PUSH PSW | PUSH PSW |
| 6  7  8 | CD  6E  03 | DISPLAY A | CD 036E |
| 9  1A | 3E  02 | A ←0A | MV1 A, 0A |
| 1B | F5 | PUSH PSW | PUSH PSW |
| 1C  1D  1E | 11  99  F6 | DE ←F699 | LXI D, F699 |
| 1F | 1B | DE ← DE – 1 | DCX D |
| 10 | 7A | A ←D | MOV A,D |
| 11 | B3 | [A] ←[A] V [E] | ORA E |
| 12  13  14 | CA  16  20 | JUMP 2016 A=00 | JZ 2016 |
| 15 | F1 | POP PSW | POP PSW |
| 16 | 3D | [A] ←[A]-1 | DCR A |
| 17  18  19 | CA  1B  20 | JUMP 201B IF A=00 | JZ 201B |
| 1A | F1 | POP PSW | POP PSW |
| 1B | 3D | [A] ←[A] -1 | DCR A |
| 1E  1D | FE  00 | COMPARE A IS 00 | CPI 00 |
| 1E  1F  20 | C2  05  20 | JUMP 2005 A | JNZ 2005 |
| 21 | CF | STOP | RST 1 |

LAB 8 PART C

|  |  |  |  |
| --- | --- | --- | --- |
| 2000  1  2 | 31  C2  20 | SP ←20C2 | LXI SP, 20C2 |
| 3  4 | 3E  00 | A ←00 | MV1 A, 00 |
| 5 | F5 | PUSH PSW | PUSH PSW |
| 6  7  8 | CD  6E  03 | DISPLAY A | CD 036E |
| 9  A | 3E  02 | A ←02 | MV1 A, 02 |
| B | F5 | PUSH PSW | PUSH PSW |
| C  D  E | 11  99  F6 | DE ←F699 | LXI D, F699 |
| F | 1B | DE ← DE - 1 | DCX D |
| 10 | 7A | A ←D | MOV A,D |
| 11 | B3 | [A] ←[A] V [E] | ORA E |
| 12  13  14 | CA  0F  20 | JUMP 2016 A=00 | JZ 2016 |
| 15 | F1 | POP PSW | POP PSW |
| 16 | 3D | [A] ←[A]-1 | DCR A |
| 17  18  19 | CA  1B  20 | JUMP 201B IF A=00 | JZ 201B |
| 1A | F1 | POP PSW | POP PSW |
| 1B | 3C | [A] ←[A] +1 | INR A |
| 1C | 27 | DAA | DAA |
| 1D  1E | FE  99 | COMPARE A IS 99 | CPI 99 |
| 1F  20  21 | CA  05  20 | JUMP 2005 | JNZ 2005 |
| 22 | CF | STOP | RST 1 |

LAB 8 PART D

|  |  |  |  |
| --- | --- | --- | --- |
| 2000  1  2 | 31  C2  20 | SP ←20C2 | LXI SP, 20C2 |
| 3  4 | 3E  00 | A ←00 | MV1 A, 00 |
| 5  6  7 | 21  50  20 | HL ←2050 | LXI H, 2050 |
| 8 |  | HL ←01 |  |
| 9 | F5 | PUSH PSW | PUSH PSW |
| A | E5 | PUSH H | PUSH H |
| B  C  D | CD  6E  03 | DISPLAY A | CD 036E |
| E | F1 | POP A | POP PSW |
| F | 7E | A ←[HL] | MOV A,M |
| 10 | F5 | PUSH PSW | PUSH PSW |
| 11  12  13 | 11  99  F6 | DE ←F699 | LXI D, F699 |
| 14 | 1B | DE ← DE - 1 | DCX D |
| 15 | 7A | A ←D | MOV A,D |
| 16 | B3 | [A] ←[A] V [E] | ORA E |
| 17  18  19 | CA  1B  20 | JUMP 201B IF A=00 | JZ 201B |
| 1A | F1 | POP PSW | POP PSW |
| 1B | 3D | [A] ←A-1 | DCR A |
| 1C | 7E | A ←[HL] | MOV A,M |
| 1D | 87 | A ←[A]+[A] | ADD A |
| 1E | 77 | [HL] ←[A] | MOV M,A |
| 1F | F1 | POP PSW | POP PSW |
| 20 | 3C | [A] ←[A]+1 | INR A |
| 21 | FE | COMPARE A is 09 | CPI 09 |
| 22 | CF | STOP | RST 1 |

LAB 8 PART E

|  |  |  |  |
| --- | --- | --- | --- |
| 2000 | 02 |  |  |
| 2001 | 02 |  |  |
| 2002 | 04 |  |  |
| 2003 | 06 |  |  |
| 2004 | 0A |  |  |
| 2005 | 10\_16 |  |  |
| 2006 | 1A\_16 |  |  |
| 2007 | 2A\_16 |  |  |
| 2008 | 44\_16 |  |  |
| 2009 | 31 | SP <- 20C2 | LXI SP, 20C2 |
| 200A | C2 |  |  |
| 200B | 20 |  |  |
| 200C | 21 | HL <- 2000 | LXI H, 2000 |
| 200D | 00 |  |  |
| 200E | 20 |  |  |
| 200F | 3E | A<- 00 | MVI A, 00 |
| 2010 | 00 |  |  |
| 2011 | E5 | PUSH H | PUSH H |
| 2012 | F5 | PUSH PSW | PUSH PSW |
| 2013 | CD | DISPLAY A | CD 036E |
| 2014 | 6E |  |  |
| 2015 | 03 |  |  |
| 2016 | 7E | A <- [[HL]] | MOV A, M |
| 2017 | F5 | PUSH PSW | PUSH PSW |
| 2018 | 11 | DE<-F699 | LXI D, F699 |
| 2019 | 99 |  |  |
| 201A | F6 |  |  |
| 201B | 1B | DE<- DE - 1 | DCX D |
| 201C | 7B | A<- D | MOV A,D |
| 201D | B2 | A<- A V E | ORA E |
| 201E | CA | IS Z=1 | JZ 201B |
| 201F | 1B |  |  |
| 2020 | 20 |  |  |
| 2021 | F1 | POP PSW | POP PSW |
| 2022 | 3D | A <- A -1 | DCR A |
| 2023 | CA | IS Z=1 | JZ 2017 |
| 2024 | 17 |  |  |
| 2025 | 20 |  |  |
| 2026 | E1 | POP H | POP H |
| 2027 | 23 | HL <- HL + 1 | INX H |
| 2028 | 7D | A<- L | MOV A, L |
| 2029 | FE | CPI 01 | CPI 01 |
| 202A | 01 |  |  |
| 202B | CA | IS A=01 JUMP 2043 (YES) | JZ 2043 |
| 202C | 43 |  |  |
| 202D | 20 |  |  |
| 202E | CA | IS A=02 JUMP 20B4 (YES) | JZ 20B4 |
| 202F | B4 |  |  |
| 2030 | 20 |  |  |
| 2031 | CA | IS A=03 JUMP 2053 (YES) | JZ 2053 |
| 2032 | 53 |  |  |
| 2033 | 20 |  |  |
| 2034 | CA | IS A=04 JUMP 205B (YES) | JZ 205B |
| 2035 | 5B |  |  |
| 2036 | 20 |  |  |
| 2037 | CA | IS A=05 JUMP 2063 (YES) | JZ 2063 |
| 2038 | 63 |  |  |
| 2039 | 20 |  |  |
| 203A | CA | IS A=06 JUMP 206B (YES) | JZ 206B |
| 203B | 6B |  |  |
| 203C | 20 |  |  |
| 203D | CA | IS A=07 JUMP 2074 (YES) | JZ 2074 |
| 203E | 74 |  |  |
| 203F | 20 |  |  |
| 2040 | CA | IS A=08 JUMP 2074 (YES) | JMP 2074 |
| 2041 | 7D |  |  |
| 2042 | 20 |  |  |
| 2043 | 3E | A<- 01 | MVI A, 01 |
| 2044 | 01 |  |  |
| 2045 | 21 | HL <- 2001 | LXI H, 2001 |
| 2046 | 01 |  |  |
| 2047 | 20 |  |  |
| 2048 | C3 | JUMP 2011 | JMP 2011 |
| 2049 | 11 |  |  |
| 204A | 20 |  |  |
| 204B | 3E | A<- 02 | MVI A, 02 |
| 204C | 02 |  |  |
| 204D | 21 | HL <- 2002 | LXI H, 2002 |
| 204E | 02 |  |  |
| 204F | 20 |  |  |
| 2050 | C3 | JUMP 2011 | JMP 2011 |
| 2051 | 11 |  |  |
| 2052 | 20 |  |  |
| 2053 | 3E | A<- 03 | MVI A, 03 |
| 2054 | 03 |  |  |
| 2055 | 21 | HL <- 2003 | LXI H, 2003 |
| 2056 | 03 |  |  |
| 2057 | 20 |  |  |
| 2058 | C3 | JUMP 2011 | JMP 2011 |
| 2059 | 11 |  |  |
| 205A | 20 |  |  |
| 205B | 3E | A<- 04 | MVI A, 04 |
| 205C | 04 |  |  |
| 205D | 21 | HL <- 2004 | LXI H, 2004 |
| 205E | 04 |  |  |
| 205F | 20 |  |  |
| 2060 | C3 | JUMP 2011 | JMP 2011 |
| 2061 | 11 |  |  |
| 2062 | 20 |  |  |
| 2063 | 3E | A<- 05 | MVI A, 05 |
| 2064 | 05 |  |  |
| 2065 | 21 | HL <- 2005 | LXI H, 2005 |
| 2066 | 05 |  |  |
| 2067 | 20 |  |  |
| 2068 | C3 | JUMP 2011 | JMP 2011 |
| 2069 | 11 |  |  |
| 206A | 20 |  |  |
| 206B | 3E | A<- 06 | MVI A, 06 |
| 206C | 06 |  |  |
| 206D | 21 | HL <- 2006 | LXI H, 2006 |
| 206E | 06 |  |  |
| 2070 | 20 |  |  |
| 2071 | C3 | JUMP 2011 | JMP 2011 |
| 2072 | 11 |  |  |
| 2073 | 20 |  |  |
| 2074 | 3E | A<- 07 | MVI A, 07 |
| 2075 | 07 |  |  |
| 2076 | 21 | HL <- 2007 | LXI H, 2007 |
| 2077 | 07 |  |  |
| 2078 | 20 |  |  |
| 2079 | C3 | JUMP 2011 | JMP 2011 |
| 207A | 11 |  |  |
| 207B | 20 |  |  |
| 207C | 3E |  |  |
| 207D | 3E | A<- 08 | MVI A, 08 |
| 207E | 08 |  |  |
| 207F | 21 | HL <- 2008 | LXI H, 2008 |
| 2080 | 08 |  |  |
| 2081 | 20 |  |  |
| 2082 | C3 | JUMP 2011 | JMP 2011 |
| 2083 | 11 |  |  |
| 2084 | 20 |  |  |
| 2085 |  |  |  |

|  |  |  |
| --- | --- | --- |
| 20C0 | 02 | 02 |
| 20C1 | 02 | 02 |
| 20C2 | 04 | 04 |
| 20C3 | 06 | 06 |
| 20C4 | 0A | 10 |
| 20C5 | 10 | 16 |
| 20C6 | 1A | 26 |
| 20C7 | 2A | 42 |
| 20C8 | 44 | 68 |
| 20C9 | 6E | 110 |
|  |  |  |

LAB 8 PART F

|  |  |  |  |
| --- | --- | --- | --- |
| 2000 | 31 | LXI SP, 20F2 | SP ← 20F2 |
| 2001 | F2 |
| 2002 | 20 |  |
| 2003 | 21 | LXI H, 20C0 | H ← 20C0 |
| 2004 | C0 |
| 2005 | 20 |
| 2006 | 3E | MVI A, 00 | A ← 00 |
| 2007 | 0A |
| 2008 | E5 | PUSH H | PUSH H |
| 2009 | F5 | PUSH PSW | PUSH PSW |
| 200A | CD | CD 036E | Display A |
| 200B | 6E |
| 200C | 03 |
| 200D | E1 | POP H | POP H |
| 200E | E5 | PUSH H | PUSH H |
| 200F | 7E | MOV A, M | A ← M |
| 2010 | F5 | PUSH PSW | PUSH PSW |
| 2011 | 11 | LXI D, F699 | DE ← F699 |
| 2012 | 97 |
| 2013 | F6 |
| 2014 | 1B | DCX D | DE ← DE – 1 |
| 2015 | 7A | MOV A, D | A ← D |
| 2016 | B3 | ORA E | A ← A ∪ E |
| 2017 | C2 | JNZ 2014 | JUMP to 2014 if Z = 0 |
| 2018 | 14 |
| 2019 | 20 |
| 201A | F1 | POP PSW | POP PSW |
| 201B | 3D | DCR A | A ← A – 1 |
| 201C | C2 | JNZ 2010 | JUMP to 2010 if Z = 0 |
| 201D | 10 |
| 201E | 20 |
| 201F | F1 | POP PSW | POP PSW |
| 2020 | 3C | INR A | A ← A + 1 |
| 2021 | E1 | POP H | POP H |
| 2022 | 23 | INX H | HL ← HL + 1 |
| 2023 | 7D | MOV A, L | A ← L |
| 2024 | FE | CPI CA | COMPARE A is CA |
| 2025 | 0C |
| 2026 | C2 | JNZ 2008 | JUMP to 2008 if Z = 0 |
| 2027 | 10 |
| 2028 | 20 |
| 2029 | CF | RST1 | STOP |

Conclusion

We were able to complete the lab, but we were unable to run it due to the lack of time. However, our logic seems sound. Therefore, I will say that we were successful in completing this lab.