EE312: Assignment III

Embedded Systems

October 3, 2020

Report the contents of the Flag Registers and Calculate T-States for the execution of each code.

1. Write a program to convert two BCD numbers in memory to the equivalent HEX number.

2. Write a program to multiply two 4-bit numbers that are stored in memory, one input is 10 (decimal representation). Save the result in memory.

3. Write a program to multiply a 8-bit number with 0.625. Store the result in memory.

4. Subtract the 16-bit number in memory locations 4002H and 4003H from the 16-bit number in memory locations 4000H and 4001H. The most significant eight bits of the two numbers are in memory locations 4001H and 4003H.Store the result in memory locations 4004H and 4005H, with the most significant byte in memory location 4005H.

5. Find the 2's complement of the number stored at memory location 4400H and store the result at memory location 4300H.

6. Load a 16-bit number from 5001H and 5002H, reverse its nibbles and store it in 5003H and 5004H (For e.g., $A_3A_2A_1A_0 \rightarrow A_0A_1A_2A_3$).

7. Store a 16-bit numbers in memory locations $4044H$ and $4045H$ (most significant byte is stored in $4045H$) as

   $[b_7, b_6, b_5, b_4, b_3, b_2, b_1, b_0, a_7, a_6, a_5, a_4, a_3, a_2, a_1, a_0]$.

Swap the bit values as:

$[a_3, a_2, a_1, a_0, b_7, b_6, b_5, b_4, b_3, b_2, b_1, b_0, a_7, a_6, a_5, a_4]$

After the operation, store the result in memory location 5001H and 5002H, where most significant byte should be stored in 5002H.

8. Write a program to evaluate the following expressions using 8085 instructions:

   (a) $((A + B).(C + D))/4$

   (b) $(A.B + (B + C).D + C) * 8$

   NOTE: Take $A = 06H$, $B = 0AH$, $C = 02H$, $D = 02H$

9. Write a program to find the sum and difference of lower and upper nibble of an 8-bit number stored in memory location 4005H. Store the result in 4006H.

10. Find the value of $2P$ and $P/2$ where P is

    (a) 8-bit number stored in memory location 4000H

    (b) 16-bit number stored in memory location 4000H and 4001H.

    Store the result in 4006H for (i) and 4006H, 4007H for (ii).

11. The Genetic Algorithm (GA) and its variants have revolutionized the field of Nature Inspired Optimization by mimicing the Genetic operations of Crossover and Mutation on Bit-strings. The Operation of Crossover **XOVER** between two 8-bit numbers $A = a_7 \ldots a_0$ and $B = b_7 \ldots b_0$ at bit position $p = 3$ (from LSB) is defined as follows.

$$(a_7a_6a_5a_4a_3a_2a_1a_0)\,\mathbf{XOVER}\,(b_7b_6b_5b_4b_3b_2b_1b_0) = (a_7a_6a_5a_4a_3b_2b_1b_0)\,\mathbf{AND}\,(b_7b_6b_5b_4b_3a_2a_1a_0) \quad (1)$$

The Mutation Operation **MUTN** at a certain bit position ($p = 3$,say) flips the said bit. This is defined as follows.

$$\mathbf{MUTN}[(a_7a_6a_5a_3a_2a_1a_0)\,, p = 3] = (a_7a_6a_5a_4a_3\bar{a_2}a_1a_0) \quad (2)$$

(a) Consider two 8-bit numbers A and B stored at memory locations M_1 and M_2. Write a program to compute $(C, D) = A\mathbf{XOVER}B$ and $E = \mathbf{MUTN}[A, p]$. Assume $p = 3$ for both cases and store the values of C, D and E at respective memory locations M_3, M_4 and M_5.

(b) Implement the problem mentioned in **(a)** with the location $p \in \{2, 3, 4, 5\}$ provided by user input (stored in memory).