EE 337: Microprocessors Laboratory (Spring 2021)
Section: S2 (Third year UG)
Indian Institute of Technology Bombay

Lab 1: 20 points Date: January 14, 2021

1. [5 points] Write an assembly language program that adds two 8-bit numbers in memory locations `70H` and `71H` and writes the result to memory location `72H`. The carry should be at memory location `73H`, i.e., the byte at this memory location should contain `01H` in case carry occurs during the addition. Otherwise, it should contain `00H`.

2. [15 points] A $(7, 4)$ Hamming code encoder converts a 4-bit message into a 7-bit codeword. The extra 3 bits help in correcting a single error in any of the 7 codeword bits. A error here refers to the flipping of a bit from 1 to 0 or 0 to 1. If the message bits are denoted by b_0, b_1, b_2, b_3, the three parity bits b_4, b_5, b_6 are given by the following equations where $\oplus$ denotes XOR operation.

$$b_4 = b_0 \oplus b_2 \oplus b_3$$
$$b_5 = b_0 \oplus b_1 \oplus b_3$$
$$b_6 = b_1 \oplus b_2 \oplus b_3$$

   The codeword is given by the 7-bit vector $\begin{pmatrix} b_6 & b_5 & b_4 & b_3 & b_2 & b_1 & b_0 \end{pmatrix}$.

   Write an assembly language to generate 4 Hamming codewords by encoding the 16 bits in memory locations `70H` and `71H`. The 16 bits have to encoded 4 bits at a time. The codewords should be stored in memory locations `72H` to `75H`. Each codeword occupies the least significant 7 bits of the byte at each memory location. The bit b_0 occupies the least significant bit in the byte, bit b_1 occupies the next significant bit and so on.

TA Checkpoints

1. Check that the student knows how to create a new project in Keil μVision with the right settings for the Pt-51 board.

2. Check that the student knows how to add an assembly language program to the project.

3. Check that the student knows how to compile the assembly program.

4. Check that the student knows how to step through the program in debug mode.

5. Check that the student knows how to examine the contents of registers.

6. Check that the student knows how to examine the contents of memory at a particular location.

7. For question 1, ask the student to load some bytes into memory locations `70H` and `71H` and show you the result of running the program.

8. For question 2, ask the student to load some bytes into memory locations `70H` and `71H` and show you the result of running the program.