

CIS 350 – INFRASTRUCTURE TECHNOLOGIES

HOMEWORK # 3

NAME(S): _____
(You may do this homework in groups of 2 students maximum.)

Topics: Data formats, representing numerical data, and LMC assembly language (Chapters 4-6)

1. Ex 4.12, p. 133. (Assume that a typical page of text holds, say roughly 2000 characters.)

2. Ex. 4.19, p. 134 (Not more than 150 words).

3. Find the 16-bit 2's complementary binary representation for the decimal number $(-1987)_{10}$.

4. Below is a Little Man program that implements exercise 6.9, p. 194. The program is very similar to the last LMC program in the posted lecture notes on chapter 6. The difference is that the program below is somewhat simpler as it uses only 2 branches (BRZ 09 and BR 01), whereas the program in the lecture notes uses 3 branches (BRP 05, BR 10, and BR 01). Assume that the following items in this order will be placed in the In-basket: 4, 34, 17, 19, and 20, one at a time. (The 4 is the count of numbers that follow.) What will the Out-basket contain after the program is executed? First try to understand each instruction thoroughly and then trace the execution of each instruction. Next write the brief and precise comments that describe what each instruction does. Note that we initialized memory location 81 and 89 with 1 and 0, respectively. Memory location 89 will eventually store the sum (total) of four input values (34, 17, 19, and 20).

Address	Instruction (Mnemonics)	Instruction code	Comments start with // (for you to fill in)
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00	IN	901	//
01	STO 80	380	//
02	BRZ 09	709	//
03	IN	901	//
04	ADD 89	189	//
05	STO 89	389	//
06	LDA 80	580	//
07	SUB 81	281	//
08	BR 01	601	//
09	LDA 89	589	//
10	OUT	902	//
11	HLT	000	//

Address		Contents	Comments
80	DAT	?	//
81	DAT	1	//
...			
89	DAT	0	//

5. Assume now that the program from problem 4 will read only 3 numbers. That is, the following numbers will be placed, one at a time, in the In-basket: 2, 15, and 34, where 2 is the count of numbers that follow, and 15 and 34 are the numbers that are to be added. The first column in the table below shows the order in which the instructions from the program will be executed. Trace the execution of these instructions and determine the contents of the PC **before** and **after** each instruction is executed. Also, write down in the table the contents of the In-basket, Out-basket, Accumulator, and Memory locations 80, 81, and 89 **after** each instruction is executed. Memory locations 81 and 89 are initialized with 1 and 0, respectively. The entry $0 \rightarrow 1$ in the PC column means that the PC is 0 when the instruction IN started and is changed to 1 when the instruction IN is finished.

The sequence in which instructions are executed	PC before → after	In-basket	Out-basket	Accumulator	Memory location 80	Memory location 81	Memory location 89
IN	$0 \rightarrow 1$	2	?	2	?	1	0
STO 80							
BRZ 09							
IN							
ADD 89							
STO 89							
LDA 80							
SUB 81							
BR 01							
STO 80							
BRZ 09							
IN							
ADD 89							
STO 89							
LDA 80							
SUB 81							
BR 01							
STO 80							
BRZ 09							
LDA 89							
OUT							
HLT							