

EECS 388: Computer Systems and Assembly Language

Lab 5

Assembly Language: Shifting and Data Test Instructions

Objectives:

- A) To understand the use of data test instructions, and their relation to the CCR.
- B) To become familiar with branches and loops.

Program Template:

For this lab, use the following program template for your program.

```
ORG $4000

;Start problem 1:
TAB1 EQU $4110 ; table 1
TAB2 EQU $4120 ; table 2

;load table 1 address to X
;load table 2 address to Y
;initialize A (loop counter)

AGAIN ;have we looped 4 times?
;if so, leave the loop
;increment loop counter
;load a number from table 1
;check to see if the number's divisible by 8
;if it's not divisible by 8, loop again
;otherwise, copy it to table 2
;loop again

DONE
;-----

;Start problem 2:
;initialize X (loop counter)
;initialize Y (zero bit counter)
;load the number
LOOP ;check loop counter to see if we've looped 16 times
;if so, leave the loop
;increment loop counter
;examine the lowest bit
;if the lowest bit was a one, loop again
;otherwise, increment the 'zero' bit counter
;loop again
FINISH ;store result count in $4150

;End problem 2
SWI
```

Note: All problems should be combined into one program. You will therefore demonstrate all three problems to the GTA with one program execution.

Problem 1:

There are four 8-bit numbers stored in consecutive locations in table TAB1, starting at address 4110 (use the monitor to set these numbers). Write program code to copy all numbers divisible by eight into locations in table TAB2, starting at 4120. **Do not use divide instructions for this problem.**

HINT: What happens to the binary numbers when you multiplied them by 8? This should suggest that you can use a logical operation with a certain bit mask to determine if a number is divisible by 8. Branching instructions in Ch. 2.6 are useful here to decide whether or not to copy each number.

Problem 2:

Write program code to count the number of zero bits in the 16-bit number stored in memory locations starting at 4130. Store the final count to memory location 4140.

HINT: You may want to use an operation that can test each individual bits of the number. Here, the BCS instruction is useful. It will branch to repeat a loop if the carry bit is set.

REQUIRED: Demonstrate your program to the GTA using the following procedure:

1. Use block fill to load memory locations 4100 – 416F with zeros.
2. Load your program onto the board using hyperterminal.
3. The GTA will then give you the numbers for all three problems, which you will then enter into memory using the monitor.
4. Execute the program, and display memory locations starting at 4100.

Report Format and Grading:

Following the report format in your syllabus, include the following in your report:

1. Your name, student number, lab project number and title, course number, lab section number, and date.
2. Description of the lab in your own words. What did you learn? If your code did not work in the lab, explain why. (45% of report grade)
3. The source code for your program, containing all three problems. Be sure to include comments in your source code. (45% of report grade)
4. A short evaluation of the lab. What did you like about the lab? What could be improved? (10% of report grade)