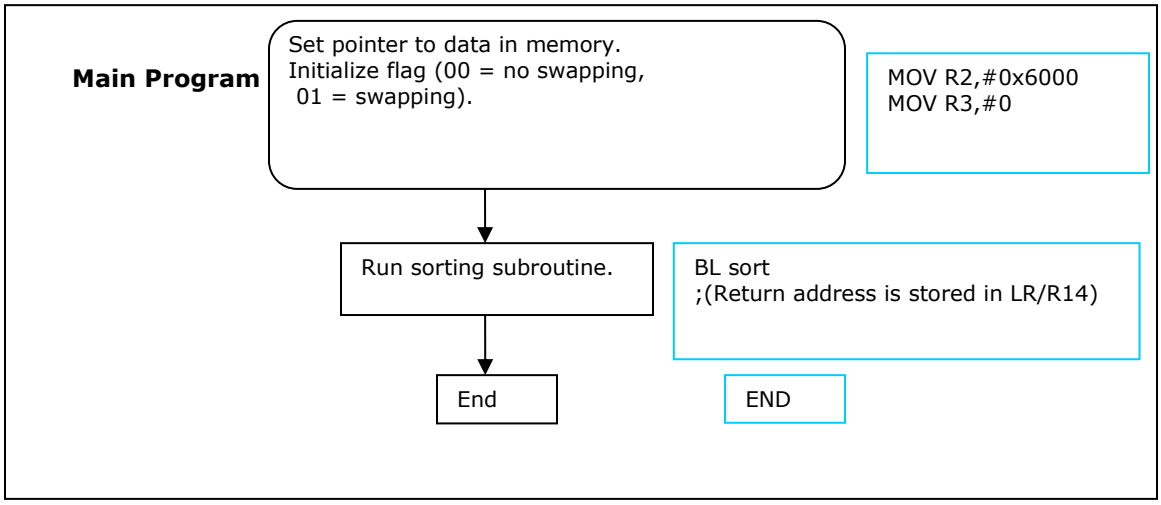
Lab B-06: Programming Exercise 4

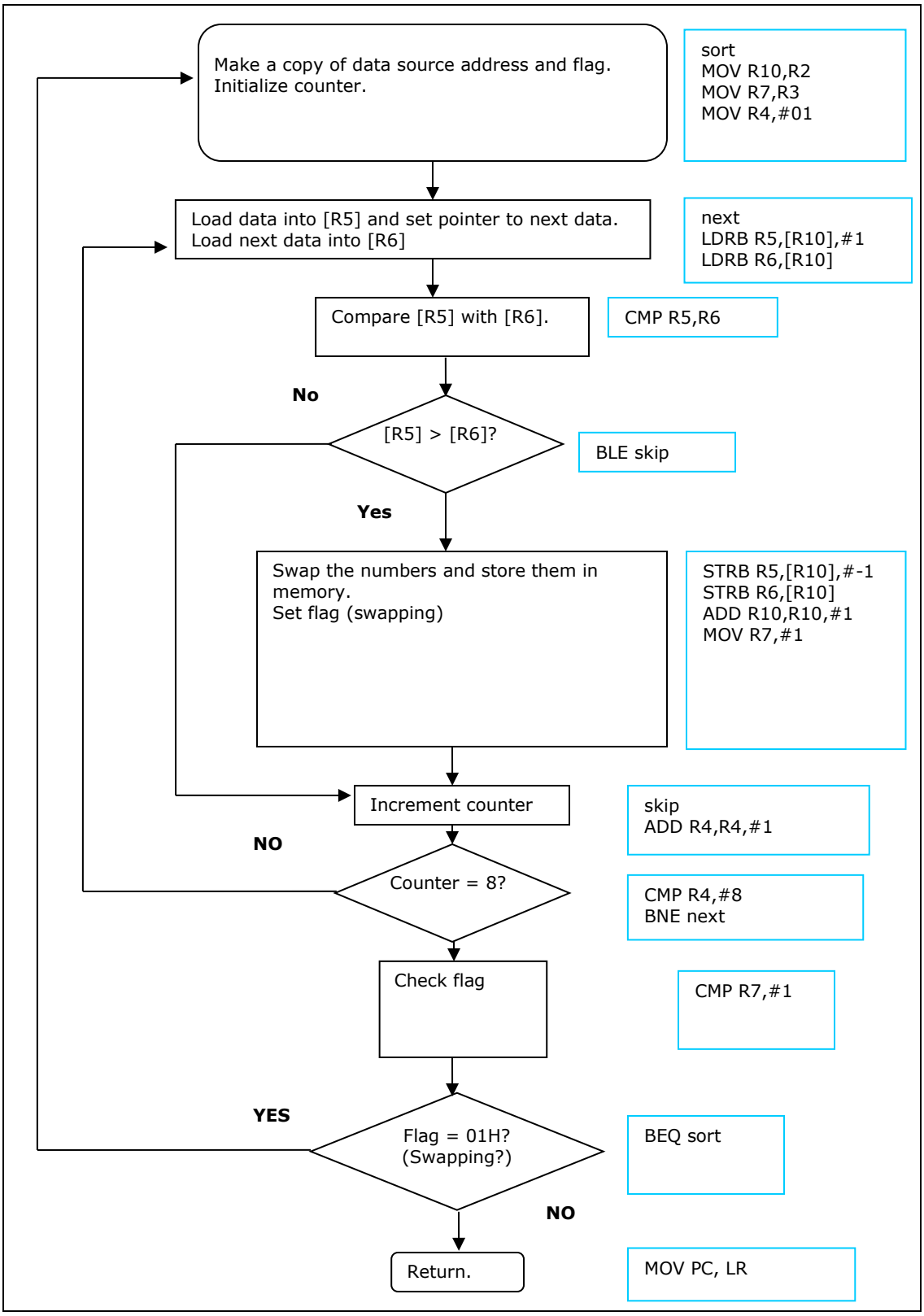
1. Perform the following operations by writing programs using ARM instructions.

   34,25,15,23,45,64,56,23

   a. Sort the numbers above in ascending order using bubble sort. (Reference: http://en.wikipedia.org/wiki/Bubble_sort)
   b. Sort the numbers above in descending order. (Hint: Modify the subroutine in part [a] by checking the flag values after the compare operation)

a.




Make a copy of data source address and flag.
Initialize counter.
sort
MOV R10,R2
MOV R7,R3
MOV R4,#01
Load data into [R5] and set pointer to next data.
Load next data into [R6]
next
LDRB R5,[R10],#1
LDRB R6,[R10]
Compare [R5] with [R6].
CMP R5,R6
No
[R5] > [R6]?
BLE skip
Yes
Swap the numbers and store them in memory.
Set flag (swapping)
STRB R5,[R10],#-1
STRB R6,[R10]
ADD R10,R10,#1
MOV R7,#1
Increment counter
skip
ADD R4,R4,#1
NO
Counter = 8?
CMP R4,#8
BNE next
Check flag
CMP R7,#1
YES
Flag = 01H?
(Swapping?)
BEQ sort
NO
Return.
MOV PC, LR

Take Home Exercise

2. Assume there is a **five-stages** instruction pipeline - Fetch (F), Decode (D), Fetch Operand (FO), Execute (E) and Write (W) running in a microprocessor. Assume that each stage requires one-time unit and no branch instruction is involved.

i. By using formula, how many time units are needed to complete these **FOUR** instructions with pipelining?
ii. By using formula, calculate the total time required to execute **FOUR** instructions without pipelining.
iii. Calculate the speedup factor for the same number of instructions.

3) Write a program to evaluate the arithmetic expression A = [(B+C) - D)] / E, using one address instructions, two address instructions and three address instructions. The instructions available for use are as follows:

One address	Two address	Three address
LOAD X	MOVE X ,Y	
STORE X	ADD X, Y	ADD X,Y,Z
ADD X	SUB X, Y	SUB X,Y,Z
SUB X	MUL X ,Y	MUL X,Y, Z
MUL X	DIV X, Y	DIV X, Y, Z
DIV X		

4) Suppose an 8-bit data word stored in memory is 1111 1000. Using the Hamming algorithm, determine what is the value of the four check bits (Check bit 8, Check bit 4, Check bit 2 and Check bit 1) that would be stored in memory with the data word. Show how you got your answer.