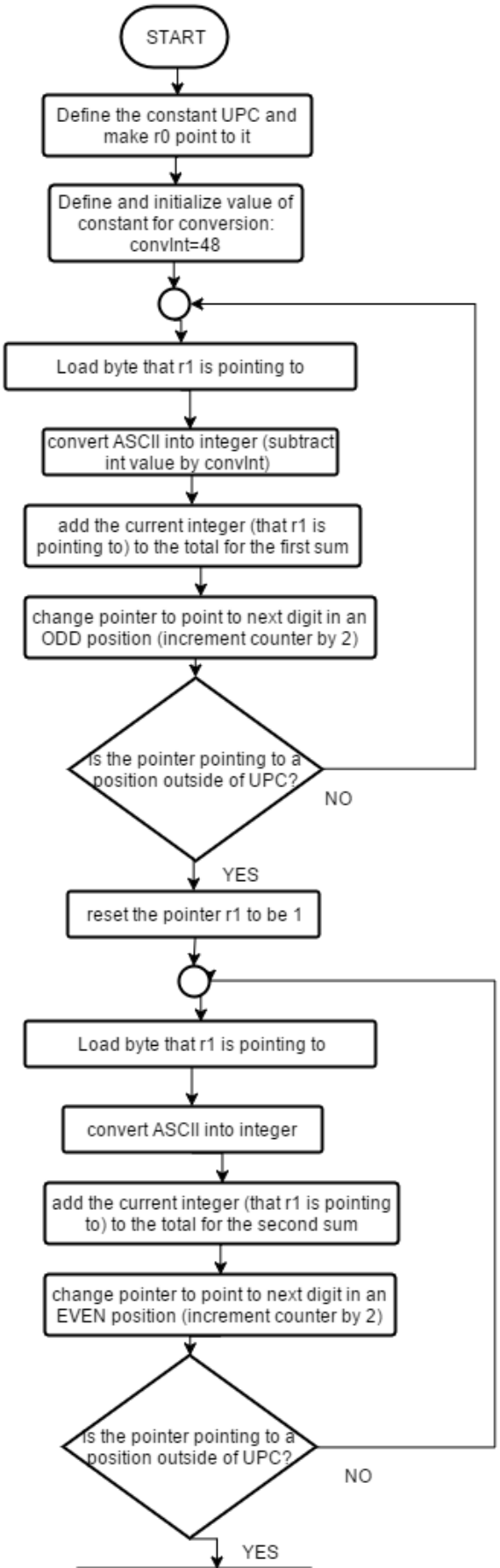
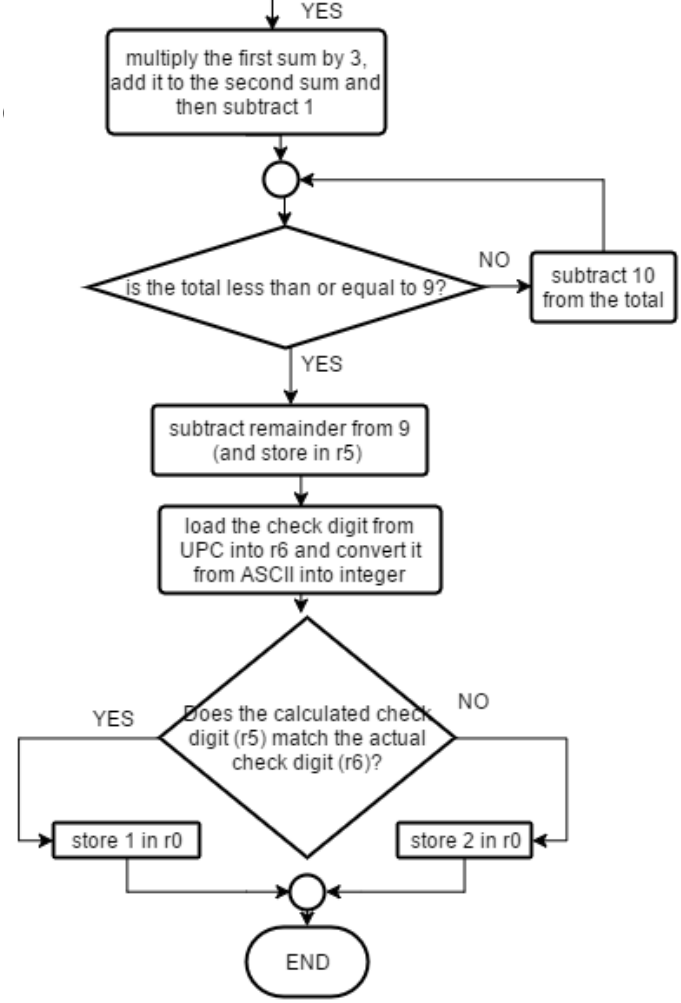
Question 1


START
Define the constant UPC and make r0 point to it
Define and initialize value of constant for conversion: convInt=48
Load byte that r1 is pointing to
convert ASCII into integer (subtract int value by convInt)
add the current integer (that r1 is pointing to) to the total for the first sum
change pointer to point to next digit in an ODD position (increment counter by 2)
Is the pointer pointing to a position outside of UPC?
NO
YES
reset the pointer r1 to be 1
Load byte that r1 is pointing to
convert ASCII into integer
add the current integer (that r1 is pointing to) to the total for the second sum
change pointer to point to next digit in an EVEN position (increment counter by 2)
Is the pointer pointing to a position outside of UPC?
NO
YES


YES
multiply the first sum by 3, add it to the second sum and then subtract 1
is the total less than or equal to 9?
NO
subtract 10 from the total
YES
subtract remainder from 9 (and store in r5)
load the check digit from UPC into r6 and convert it from ASCII into integer
Does the calculated check digit (r5) match the actual check digit (r6)?
YES
NO
store 1 in r0
store 2 in r0
END

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;Vivian Lam
;program to determine whether a string of 12 ASCII encoded digits
;stored in memory
;is a valid UPC or not. If valid, store 1 in r0. if not, store 2 in
;r0.

      AREA prog1, CODE, READONLY
      ENTRY

      ;HINT 1: You can implement the division operation using repeated
      ;subtractio
      ;HINT 2: To calculate 3 × Z, you can do so using only one ADD
      ;instruction with LSL#1 shift.
      ;HINT 3: To load a byte to a register, use LDRB not LDR.

      ;r0 points to UPC
      ;r1 points to the position in UPC
      ;r2 for getting the current byte at that position
      ;r3 is the total for the first sum
      ;r4 is the total for the second sum
      ;convInt is a constant used for converting ASCII into integer

      ADR r0, UPC           ;r0 to point to UPC
convInt EQU 48              ;Constant for converting ASCII into integer
                            ;(subtract 48)

;compute first sum
AddOdd                            ;Loop to add numbers in odd positions
      LDRB r2,[r0,r1]  ;load byte into register. the loaded byte is the
                       ;byte r1 points to in UPC
      SUB r2,#convInt  ;convert that byte ASCII into int (subtract the
                       ;constant)
      ADD r3, r2                  ;add integer value to total (first
                                  ;sum)
      ADD r1, #2                  ;point to next odd digit (increase
                                  ;counter by 2)
      CMP r1, #12           ;loop condition: check if r1 pointer is
                            ;outside of UPC (12 because 12 digits)
      BNE AddOdd                  ;loop UNTIL we have iterated enough to
                                  ;add all the digits at odd positions


      MOV r1, #1                  ;Reset value of r1 to be 1 (this is so
                                  ;we can deal with even digits)


;compute second sum    (add numbers in even positions)
AddEven                     ;Looop
      LDRB r2,[r0,r1]  ;load byte into register. the loaded byte is the
                       ;byte r1 points to in UPC
      SUB r2,#convInt  ;convert that byte ASCII into int(subtract the
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                    ;constant)
     ADD r4, r2                 ;add integer value to total (second
                                ;sum)
     ADD r1, #2                 ;point to next even digit (increase
                                ;counter by 2)
     CMP r1, #11           ;loop condition: check if r1 pointer is
                           ;outside of UPC (11 because 12-1 digits)
     BNE AddEven                ;loop UNTIL we have iterated enough to
                                ;add all the digits at even positions

;multiply first sum by 3
     ADD r3, r3, r3, LSL #1     ;left shift to double the first sum
                                ;and add first sum to it

;and add it to second sum (store in r4)
     ADD r4, r3

;subtract 1 (store in r4)
     SUB r4, #1;

;compute remainder when adjusted total is divided by 10
RptSub                          ;LOOP until the remaining total is less
                                ;than or equal to 9
     CMP r4,#9             ;check if total is less than or equal to 9
     SUBGT r4,#10          ;subtract 10 from total if greater than 9
     BHI RptSub                 ;end loop

;subtract remainder form 9
     RSB r5,r4,#9          ;Subtract the remainder from 9, store in r5
                           ;(calculated check digit)
     LDRB r6,[r0,r1] ;Load UPC check digit into r6 (r1 is already
                           ;pointing at check digit position)
     SUB r6,#convInt ;Subtract 48 from check digit's ASCII value to
                           ;obtain its integer value
     MOV r0,#2             ;Set r0 to 2 - if check digits match this will
                           ;change to 1 else, stays 2

;check result
     CMP r5,r6             ;Compare UPC check digit with calculated check
                ;digit valid, store 1 in r0 invalid, store 2 in r0
     MOVEQ r0,#1           ;store 1 in r0 if check digits match and UPC is
                           ;valid
     MOVNE r0,#2                ;store 2 in r0 if check digits match and
                                ;UPC is invalid

Loop B Loop ;Infinite loop to prevent error

;test values
;UPC DCB "013800150738" ;UPC String
;UPC DCB "060383755577" ;UPC String
UPC DCB "065633454712" ;UPC String
     END
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Test 1:

UPC = 013800150738
r0= 0x00000001
r5= 0x00000008
r6= 0x00000008
r5 (supposed check digit) and r6(actual check digit on UPC) are the SAME values and thus is VALID and 1 is stored in r0.

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Test 2:

UPC = 060383755577
r0= 0x00000001
r5= 0x00000007
r6= 0x00000007
r5 (supposed check digit) and r6(actual check digit on UPC) are the SAME values and thus is VALID and 1 is stored in r0.

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Test 3:

UPC = 065633454712
r0= 0x00000001
r5= 0x00000002
r6= 0x00000002
r5 (supposed check digit) and r6(actual check digit on UPC) are the SAME values and thus is VALID and 1 is stored in r0.

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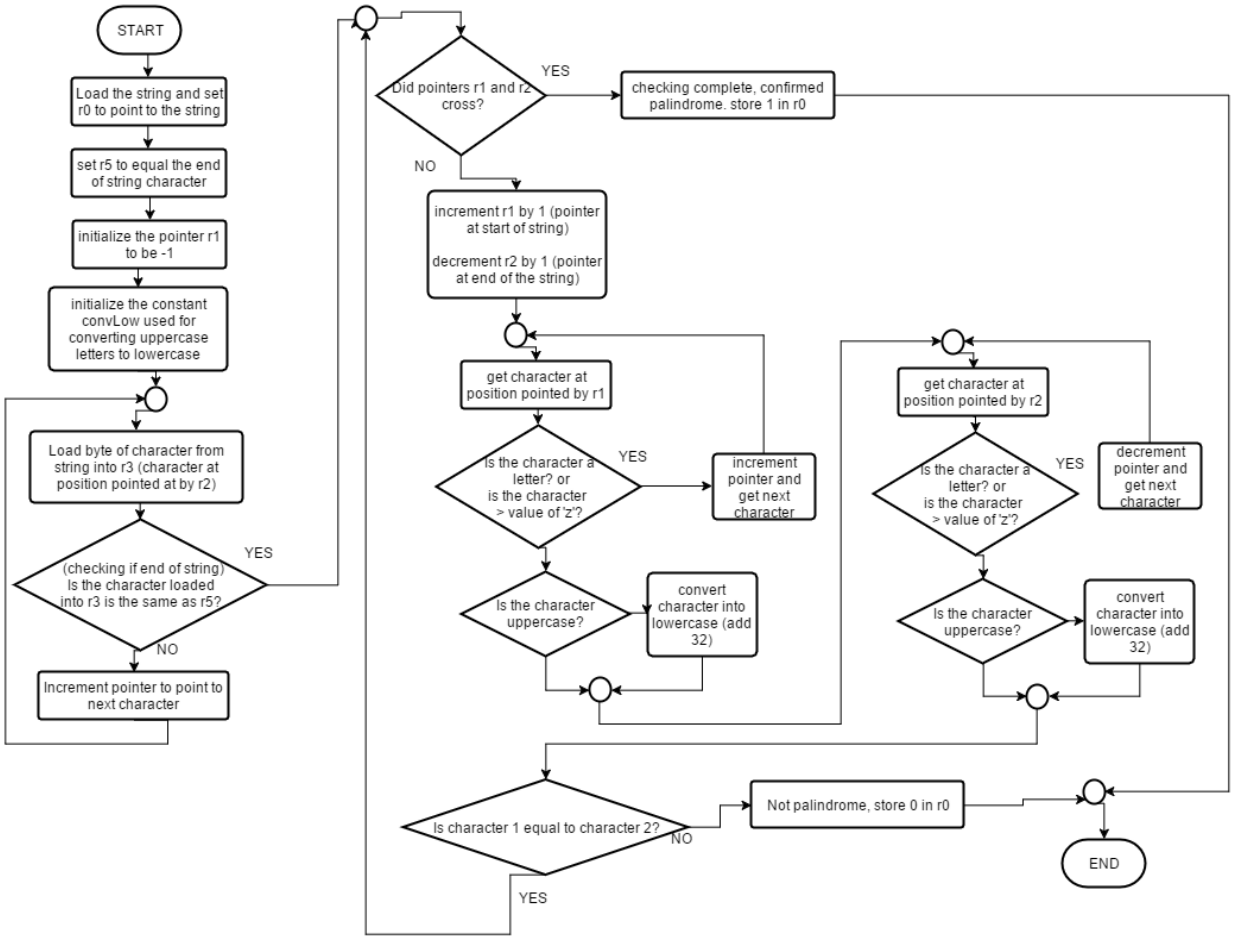
Question 2


START
Load the string and set r0 to point to the string
set r5 to equal the end of string character
initialize the pointer r1 to be -1
initialize the constant convLow used for converting uppercase letters to lowercase
Load byte of character from string into r3 (character at position pointed at by r2)
(checking if end of string) Is the character loaded into r3 is the same as r5?
YES
NO
Increment pointer to point to next character
Did pointers r1 and r2 cross?
YES
checking complete, confirmed palindrome. store 1 in r0
NO
increment r1 by 1 (pointer at start of string)
decrement r2 by 1 (pointer at end of the string)
get character at position pointed by r1
Is the character a letter? or is the character > value of 'z'?
YES
increment pointer and get next character
Is the character uppercase?
convert character into lowercase (add 32)
get character at position pointed by r2
Is the character a letter? or is the character > value of 'z'?
YES
decrement pointer and get next character
Is the character uppercase?
convert character into lowercase (add 32)
Is character 1 equal to character 2?
NO
Not palindrome, store 0 in r0
END
YES

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;Vivian Lam
;program to check if string is a palindrome or not
;ignores case and special characters

      AREA prog2, CODE, READONLY
      ENTRY

      ;r0 is a pointer that points to the string
      ;r1 is a pointer to point the the current character in the string
      ;r2 is another character to point to the current character in the
string from the other end
      ;r3 is the current character that r1 points to
      ;r4 is the current character that r2 points to
      ;r5 points to end of string
      ;toLower is a constant



      LDR r0,=STRING             ;make r0 to point to the string
      LDR r5,=EoS                ;make r5 to point to EoS (end of
string, so we can check if we reach the end)
      MOV r1,#-1                       ;make pointer in r1 to -1
(incremented later to 0)

convLow EQU 32 ;Add 32 to convert uppercase to lowercase letters in
ASCII


LEN ;LOOP to find out the length of the string
      LDRB r3,[r0,r2] ;Load a byte of the string (character at position
pointed at by r2)
      CMP r3,r5       ;Check if the character is the null character
(end of string)
      BEQ Check       ;If so, stop length count and exit loop
      ADD r2,#1       ;Else, increment pointer to point to next
character
      B LEN                ;UNTIL end of string is reached & r2 points
at EoS


Check ;Pointers of r1 and r2 are located at opposite ends of the
string
      CMP r1,r2       ;Check if pointers have crossed paths yet
      BGT CheckPal    ;If so, string is a palindrome as letter pairs
have all matched
      ADD r1,#1       ;Increment pointer at the start of the string
      SUB r2,#1       ;Decrement pointer at the end of the string


Char1 ;LOOP
      LDRB r3,[r0,r1] ;Get character 1 at position pointed at by r1
      CMP r3,#'A'     ;Check if character 1 is possibly not a letter
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     ADDLT r1,#1          ;If possibly not a letter,  increment this
pointer
     BLT Char1       ;Get next character

     CMP r3,#'z'     ;Check if character is greater than 'z'
     ADDGT r1,#1     ;If so, character is not a letter so increment
pointer and get next character
     BGT Char1       ;UNTIL character is a letter

     CMP r3,#'a'          ;Check if character 1 is uppercase
     ADDLT r3,#convLow    ;If so, add 32 to convert character to
lowercase equivalent


Char2 ;LOOP
     LDRB r4,[r0,r2] ;Get character 2 at position pointed at by r2
     CMP r4,#'A'     ;Check if character 2 is possibly not a letter
     SUBLT r2,#1     ;If possibly not a letter, decrement this pointer
     BLT Char2       ;Get next character

     CMP r4, #'z'    ;Check if character 2 is greater than 'z'
     SUBGT r2,#1     ;If so, character is not a letter so decrement
pointer and get next character
     BGT Char2       ;UNTIL character is a letter

     CMP r4,#'a'               ;Check if character 2 is uppercase
     ADDLT r4,#convLow    ;If so, add 32 to convert character to
lowercase equivalent Now r3 and r4 contain two lowercase letters


     ;checking
     CMP r3,r4  ;Compare character 1 and character 2
     BEQ Check  ;If equal, the string is possibly a palindrome.
Continue comparing character pairs. If they are not equal, the string
is not a palindrome
     MOV r0,#0  ;Set r0 to 0 to indicating that the string is not a
palindrome


     B Loop ;Skip to end


CheckPal MOV r0,#1    ;Set r0 to 1 indicating that the string is a
palindrome


Loop B Loop          ;End program with infinite loop to prevent error

STRING DCB "He lived as a devil, eh?" ;string test value
;STRING DCB "asdfg";string test value
EoS DCB 0x00 ;End of string ASCII value
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END
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Test 1:

String = "He lived as a devil, eh?"
r0 = 0x00000001
Since r0 stores 1, the string IS a palindrome.

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Test 2:

String = "asdfg"
r0 = 0x00000000
Since r0 stores 0, the string IS NOT a palindrome.

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Test 3:

String = "sauidhi"
r0 = 0x00000000
Since r0 stores 0, the string IS NOT a palindrome.

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Test 4:

String = "a"
r0 = 0x00000001
Since r0 stores 1, the string IS a palindrome.

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