

# LAB #5: WRITING SUBROUTINES AND USING BUFFALO I/O ROUTINES

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## OBJECTIVE

Introduce students to writing subroutines in HC11 assembly language and using the BUFFALO I/O routines to display results.

## ASSIGNMENT

Write a subroutine to swap the first row of a matrix MAT with the last row, the second row with the second-to-last row, etc. The matrix MAT is NxM and is stored in row-major order. The starting address of MAT and its dimensions (N and M) are passed to this subroutine in the stack in this order: matrix base address, N, and M (that is, the matrix base address is pushed onto the stack first, followed by N and M). The matrix elements are 8-bit. Write a main program to test this subroutine, including the following features:

- 1) Call the Buffalo monitor I/O subroutine OUTSTRG to output the message "The original matrix is as follows: " and call the routine OUTCLRF to move the cursor to the next line.
- 2) Call the Buffalo monitor I/O subroutines OUTLHLF and OUTRHLF to output the matrix elements, one row per line. Elements should be separated by one space.
- 3) Call the matrix swap subroutine to swap the rows of the matrix.
- 4) Call the Buffalo monitor I/O subroutine OUTSTRG to output the message "The swapped matrix is as follows: " and call the routine OUTCLRF to move the cursor to the next line.
- 5) Call the Buffalo monitor I/O subroutines OUTLHLF and OUTRHLF to output the elements of the swapped matrix, one row per line.

Test your code with a 4x5 matrix that you enter starting at memory location \$0100 (your code should work with matrices of any size and not just 4x5). Your main program should be stored in EEPROM starting at memory location \$B600. You can check examples 3.4 and 3.5 of your textbook (pages 121-125) for help on writing your code. Also, a skeleton of the code is shown below in the Program Skeleton section.

## PRE-LAB

- 1) Write and debug your code.
- 2) Generate the listing and S-record of your code. Bring a copy of your list file with you to the lab.

## IN-LAB

- 1) Download the S-record of your code to the EVBU board.

- 2) Demonstrate your code to the lab instructor.
- 3) Modify the value of your input matrix (using the MM Buffalo command) and re-run your code.

## PROGRAM SKELETON

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N            EQU 3                ; Number of matrix rows
M            EQU 4                ; Number of matrix columns
OUTA         EQU $FFB8            ; Address of OUTA Buffalo subroutine
OUTSTRG      EQU $FFC7            ; Address of OUTSTRG Buffalo subroutine
OUTLHLF      EQU $FFB2            ; Address of OUTLHLF Buffalo subroutine
OUTRHLF      EQU $FFB5            ; Address of OUTRHLF Buffalo subroutine
OUTCRLF      EQU $FFC4            ; Address of OUTCRLF Buffalo subroutine

Matrix       ORG $100
            FCB . . .            ; Enter matrix elements here.
            FCB . . .            ; "
            FCB . . .            ; "
            FCB . . .            ; "
            . . .                ; Allocate memory for variables if needed

            ORG $B600            ; Save code in EPROM
**** START OF MAIN PROGRAM ****
Main         LDS #$01FF          ; Initialize SP
            . . .
            LDX #MSG1            ; Load X with base address of MSG1
            JSR OUTSTRG          ; Call subroutine to print MSG1
            . . .
            BSR PRINTMAT         ;Call subroutine to print original matrix
            . . .
            BSR SWAPMAT          ; Call subroutine to swap matrix columns
            . . .
            LDX #MSG2            ; Load X with base address of MSG2
            JSR OUTSTRG          ; Call subroutine to print MSG2
            . . .
            BSR PRINTMAT         ;Call subroutine to print modified matrix
            SWI                  ; return to Buffalo monitor

**** CODE FOR SUBROUTINES GOES HERE ****
PRINTMAT     . . .                ; code for printing the matrix
            . . .                ; "
            RTS                  ; Return from subroutine

SWAPMAT       . . .                ; code for swapping the matrix columns
            . . .                ; "
            RTS                  ; Return from subroutine

**** DEFINE MESSAGES ****
MSG1         FCC "The original matrix is as follows:", $04
MSG2         FCC "The modified matrix is as follows:", $04

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