Computer Organization and Architecture

Post-Lab Report

Lab 04

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Class	Computer Organization and Architecture CPE343(**BCE-5B**)
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POST LAB

Question:

Write a program that first inputs total no. of student. It then gets student roll no. and marks secured by all students in 5 subjects, and stores both in memory. After that it gives Maximum, Minimum and Median of all subjects.

Solution:

I am attaching my commented code below,

```
#Title : Lab 4 Postlab.                         Filename: Lab4Postlab.asm
#Author: Muhammad Haris Irfan.                          Date: 11-10-20
#Roll Number: FA18-BCE-090                              Description: Maximum, Minimum and Median
#Registers: $t1, $t2, $t3,$t4, $t5, $v0, $a0
########################## Data Segment  #############################################################
.data
co: .word 0:10
mc: .word 0:10
re: .word 0:10
os: .word 0:10
db: .word 0:10

msg1: .asciiz "Enter the Number of Students: "
msg2: .asciiz "Enter the marks for CO: "
msg3: .asciiz "\nresult: "
msg4: .asciiz "\nMIN is: "
msg5: .asciiz "\nMAX is:"

msg6: .asciiz "\n\nEnter the marks for CO: "
msg7: .asciiz "Enter the marks for DE: "
msg8: .asciiz "Enter the marks for RAES: "
msg9: .asciiz "Enter the marks for OS: "
msg10: .asciiz "Enter the marks for DB: "

msg11: .asciiz "\n\n FOR COMP ORGAN: "
msg12: .asciiz "\n\n FOR MULTI CAL: "
msg13: .asciiz "\n\n FOR RE: "
msg14: .asciiz "\n\n FOR Operating Systems: "
msg15: .asciiz "\n\n FOR Data Bases: "
msg16: .asciiz "\nMEDIAN is: "
################## Code Segment #####################################################
.text
main:

la $a0,msg1                 #Load msg1
li $v0,4
syscall
li $v0,5
syscall
```

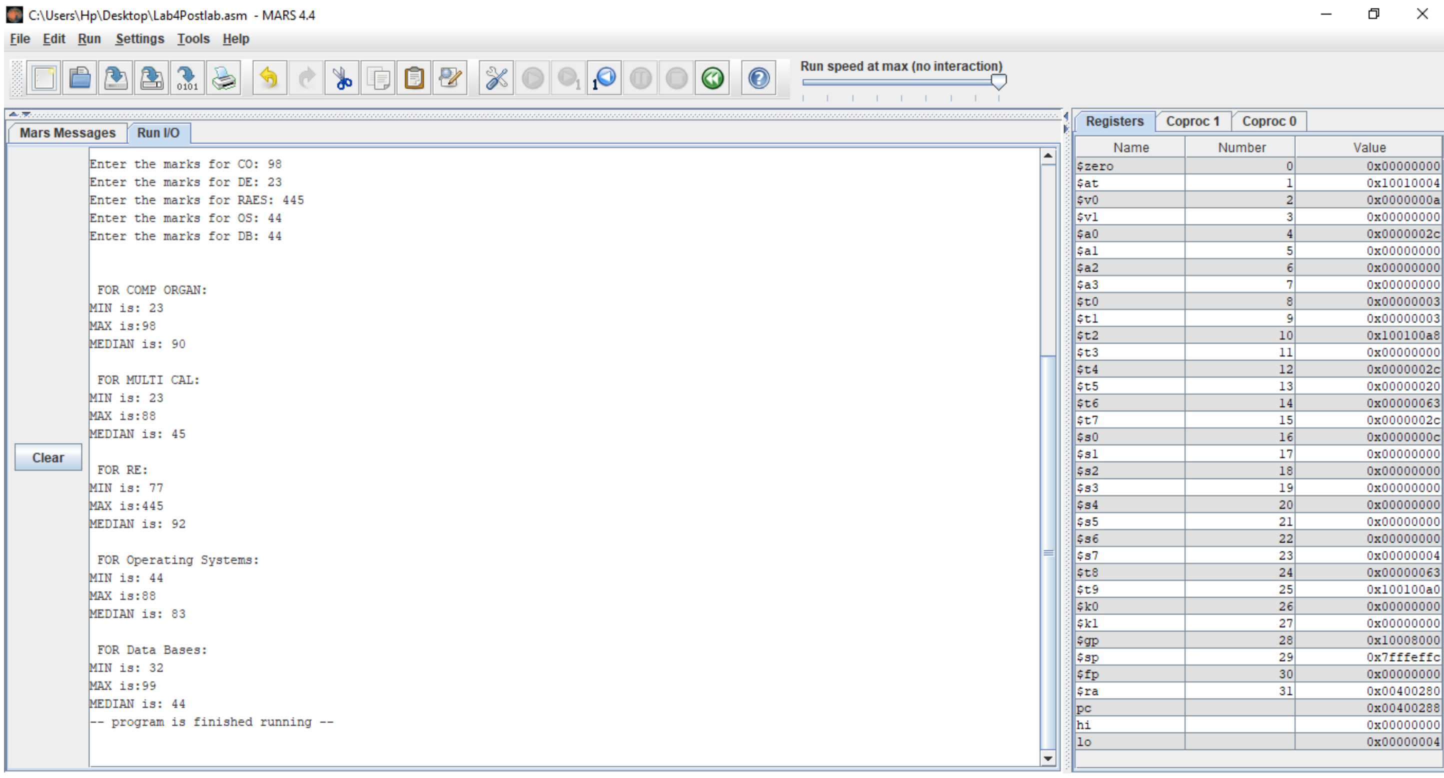
```
move $t0,$v0                    #t0 stores the number of students
move $s7,$v0                    #$s7 will be used in median calculation

div $s7,$s7,2
mul $s7,$s7,4                   #mul and div performed to get to the mid of the sorted array
li $t1, 0                       #for loops


li $s0,0                        #(pointer position)
##############################################
loop:
beq $t1,$t0,here                #loop would run for t0 number of times

            ###################
# THE NEXT FEW STEPS ENTER DATA INTO THE ARRAYS #
            ###################
la $a0,msg6
li $v0,4
syscall
li $v0,5
syscall
sw   $v0, co($s0)

la $a0,msg7
li $v0,4
syscall
li $v0,5
syscall
sw   $v0, mc($s0)

la $a0,msg8
li $v0,4
syscall
li $v0,5
syscall
sw   $v0, re($s0)

la $a0,msg9
li $v0,4
syscall
li $v0,5
syscall
sw   $v0, os($s0)

la $a0,msg10
li $v0,4
syscall
li $v0,5
syscall
sw   $v0, db($s0)



addiu $s0,$s0,4      #array pointer incremented with 4
addiu $t1,$t1,1      #$t1++

j loop
here:

########################################################################

jal initialize        #initializes the values of array pointer, and loop variables hich were changed during the course of last loop
```

```
loop1:
beq $t0,$t1,here1     #loop runs for t0 times
lw $t4,co($s0)

jump1:
bgt $t5,$t4,min1      #bgt branch greater than if t5 < t4 min1 calculates min and stores it in t5
bgt $t4,$t6,max1      #calculates max and stores in t6
addiu $s0,$s0,4
addiu $t1,$t1,1
j loop1

here1:
la $a0,msg11
move $t1,$t0         #for sorting
la  $t9, co          #t9 is the array pointer here
jal sort             #to jump to sort function
jal output           #to jump to output function
jal output1          #to jump to output1 function to pront median


jal initialize
loop2:
beq $t0,$t1,here2
lw $t4,mc($s0)

jump2:
bgt $t5,$t4,min2
bgt $t4,$t6,max2
addiu $s0,$s0,4
addiu $t1,$t1,1
j loop2

here2:
la $a0,msg12
la  $t9, mc
jal sort
jal output
jal output2


jal initialize
loop3:

beq $t0,$t1,here3
lw $t4,re($s0)

jump3:
bgt $t5,$t4,min3
bgt $t4,$t6,max3
addiu $s0,$s0,4
addiu $t1,$t1,1
j loop3

here3:
la $a0,msg13
la  $t9, re
jal sort
jal output
jal output3
jal initialize

loop4:
beq $t0,$t1,here4
lw $t4,os($s0)
jump4:
bgt $t5,$t4,min4
bgt $t4,$t6,max4
addiu $s0,$s0,4
addiu $t1,$t1,1
j loop4
here4:
la $a0,msg14
la  $t9, os
jal sort
jal output
jal output4



jal initialize
loop5:
beq $t0,$t1,here5
lw $t4,db($s0)
jump5:
bgt $t5,$t4,min5
bgt $t4,$t6,max5
addiu $s0,$s0,4
addiu $t1,$t1,1
j loop5
here5:
la $a0,msg15
la  $t9, db
jal sort
jal output
jal output5



li $v0,10
syscall
##########################################
 ##       FUNCTIONS AND JUMPS          ##
##########################################


### so many min and max functions were made so the program would jump back to the accurate position.###

min1:
move $t5,$t4
j jump1
max1:
move $t6,$t4
j jump1

min2:
move $t5,$t4
j jump2
max2:
move $t6,$t4
j jump2
```

```
min3:
move $t5,$t4
j jump3
max3:
move $t6,$t4
j jump3

min4:
move $t5,$t4
j jump4
max4:
move $t6,$t4
j jump4

min5:
move $t5,$t4
j jump5
max5:
move $t6,$t4
j jump5

####################################################
        ###########  OUTPUTS ##############
####################################################
initialize: #intializes all variables to be used in a loop
li $t1,0
li $s0,0    #(pointer position)
li $t5,101
li $t6,0

jr $ra

output:
li $v0,4
syscall
la $a0,msg4
li $v0,4
syscall
li $v0,1
move $a0,$t5
syscall

la $a0,msg5
li $v0,4
syscall
li $v0,1
move $a0,$t6
syscall

la $a0,msg16
li $v0,4
syscall
jr $ra


output1:
lw  $t7, co($s7)
li $v0,1
move $a0,$t7
syscall
jr $ra
```

```
output2:
lw  $t7, mc($s7)
li $v0,1
move $a0,$t7
syscall
jr $ra

output3:
lw  $t7, re($s7)
li $v0,1
move $a0,$t7
syscall
jr $ra

output4:
lw  $t7, os($s7)
li $v0,1
move $a0,$t7
syscall
jr $ra

output5:
lw  $t7, db($s7)
li $v0,1
move $a0,$t7
syscall
jr $ra

#########################################
##   TRANSLATED FROM A C++ PROGRAM   ##
#########################################
sort:
    addiu   $sp, $sp, -4
    sw      $ra, 0($sp)         # store $ra into the stack
    sll     $t1, $t1, 2         # shifing to left or mul by 2
    li      $v0, 0              # int i = 0
looop:
    slt     $t3, $v0, $t1       # if (i < n) => $t3 = 1
    beq     $t3, $zero, end     # while (i < n) {
    bne     $v0, $zero, compare  # if (i == 0)
    addiu   $v0, $v0, 4         # i = i + 1
  compare:
    addu    $t2, $t9, $v0       # $s2 = &arr[i]
    lw      $t7, -4($t2)        # $t4 = arr[i-1]
    lw      $t8, 0($t2)         # $t5 = arr[i]
    blt     $t8, $t7, swap      # swap if (arr[i] < arr[i-1])
    addiu   $v0, $v0, 4         # i = i+ 1
    j       looop
  swap:
    sw      $t7, 0($t2)         # swap (arr[i], arr[i-1])
    sw      $t8, -4($t2)
    addiu   $v0, $v0, -4        # i = i - 1
    j       looop
  end:
   srl     $t1, $t1, 2
   lw      $ra, ($sp)           # copy from stack to $ra
   addi    $sp, $sp, 4          # increment stack pointer by 4
   jr      $ra                  # return to main
```

The result for this program is shown below,


C:\Users\Hp\Desktop\Lab4Postlab.asm - MARS 4.4
File Edit Run Settings Tools Help
Run speed at max (no interaction)
Mars Messages
Run I/O
Clear

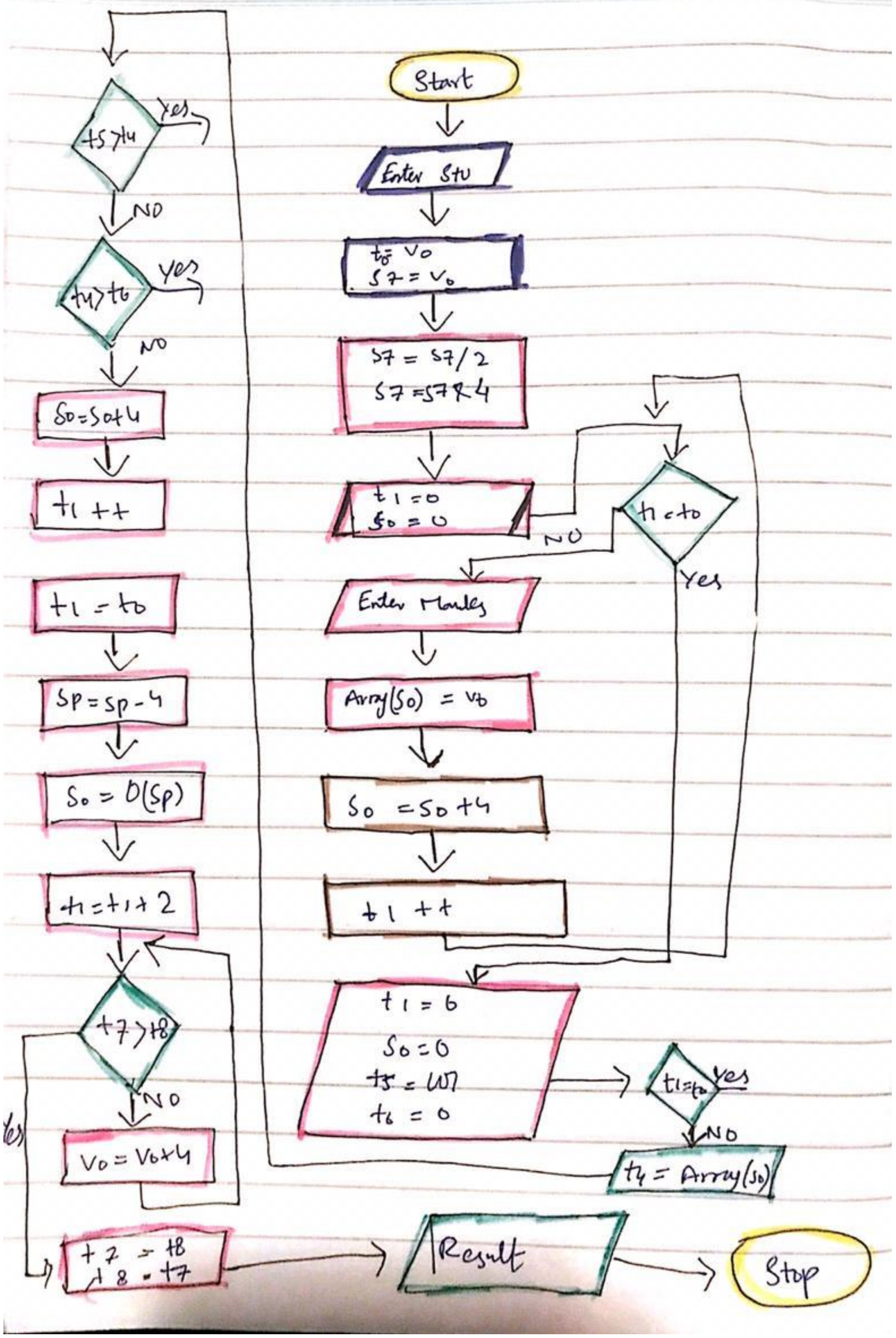
```
Enter the marks for CO: 98
Enter the marks for DE: 23
Enter the marks for RAES: 445
Enter the marks for OS: 44
Enter the marks for DB: 44


 FOR COMP ORGAN:
MIN is: 23
MAX is:98
MEDIAN is: 90

 FOR MULTI CAL:
MIN is: 23
MAX is:88
MEDIAN is: 45

 FOR RE:
MIN is: 77
MAX is:445
MEDIAN is: 92

 FOR Operating Systems:
MIN is: 44
MAX is:88
MEDIAN is: 83

 FOR Data Bases:
MIN is: 32
MAX is:99
MEDIAN is: 44
-- program is finished running --
```

Registers | Coproc 1 | Coproc 0

Name	Number	Value
$zero	0	0x00000000
$at	1	0x10010004
$v0	2	0x0000000a
$v1	3	0x00000000
$a0	4	0x0000002c
$a1	5	0x00000000
$a2	6	0x00000000
$a3	7	0x00000000
$t0	8	0x00000003
$t1	9	0x00000003
$t2	10	0x100100a8
$t3	11	0x00000000
$t4	12	0x0000002c
$t5	13	0x00000020
$t6	14	0x00000063
$t7	15	0x0000002c
$s0	16	0x0000000c
$s1	17	0x00000000
$s2	18	0x00000000
$s3	19	0x00000000
$s4	20	0x00000000
$s5	21	0x00000000
$s6	22	0x00000000
$s7	23	0x00000004
$t8	24	0x00000063
$t9	25	0x100100a0
$k0	26	0x00000000
$k1	27	0x00000000
$gp	28	0x10008000
$sp	29	0x7fffeffc
$fp	30	0x00000000
$ra	31	0x00400280
pc		0x00400288
hi		0x00000000
lo		0x00000004

Flow chart of thtask:

Lab4 Postlab.



Critical Analysis/ Conclusion:

In This lab, we learnt about accessing Arrays, through implementation we learnt how to use lw(Load word) and sw(Store word) commands to put and get data from an Array. We also implemented these commands in Different tasks. Moreover, we made handwritten Flowcharts for each task, depicting the working of our code.

______THE END_______