

BBM234: Computer Organization

MIPS Project Report

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1 Problem: Arrays Using for Loops

MIPS Assembly code for array.asm:

```
1  .data
2  A: .word 2, 4, 6, 8    # definition of array
3  .text
4  main:
5  la $t1, A              #load the array in $t1
6  addi $s0, $s0, 0       # s0 = 0 (i = 0)
7  addi $s1, $s1, 3       # s1 = 3 length of array
8  for:
9  beq $s0, $s1, done     # loop will continue if s0 != s1 if they are equal
10     jump "done"
11  lw $t2, 0($t1)         # load the element of array in t2 (tw = a[i])
12  lw $t3, 4($t1)         # load the element of array in t3 (tw = a[i+1])
13  sub $s3, $t3, $t2       # s3 will keep the difference of elements (diff = a[i
14     +1] - a[i])
15  slt $s4, $0, $s3
16  beq $s4, 1, multiplication # If difference greater than zero then jump "
17     multiplication"
18  sll $s5, $t2, 2         # If difference greater than zero then s5= 4 *
19     t2
20  add $t3, $t2, $s5       # t3 = t2 + s5 so t3 = 5 * t2
21  sub $t3, $0, $t3       # take negative of t3
22  sw $t3, 4($t1)         # assign in array a[i+1] = -5*a[i]
23  addi $s0, $s0, 1       # i = i + 1
24  addi $t1, $t1, 4       # t1 = t1 + 4 for next element of array.We
25     increase the address
26  j for                  # jump the for loop
27
28  multiplication:
29  sll $s5, $t2, 2         # s5 = 4 * t2
30  add $s5, $t2, $s5       # s5 = s5 + t2 so s5 = 5 * t2
31  sw $s5, 0($t1)         # assign in array a[i] = 5 * a[i]
32  addi $s0, $s0, 1       # i = i + 1
33  addi $t1, $t1, 4       # t1 = t1 + 4 for next element of array.We
34     increase the address
```

```

29      j for                                # jump the for loop
30
31      done :
32      lw $t4 , -12($t1)                    #If you want to see elements of array I
33      put them in registers (t4 - t7)
34      lw $t5 , -8($t1)
35      lw $t6 , -4($t1)
36      lw $t7 , 0($t1)
37      li $v0 , 10 # end of the code
38      syscall
      .end

```

Test 1: A=2,4,6,8

Test 2: A=8,6,4,2

Test 3: A=2,2,6,4

Results for Test 1: A=2,4,6,8

before run: Fig. 1.

after run: Fig. 2.

FP Reqs	Int Regs [10]	Data	Text
Int Regs [10]		Data	
PC = 0		User data segment [10000000]..[10040000]	
EPC = 0		[10000000] [1000ffff] 00000000	
Cause = 0		[10010000] 00000002 00000004 00000006 00000008	
BadVAddr = 0		[10010010]..[1003ffff] 00000000	
Status = 805371664			
HI = 0		User Stack [7ffff850]..[80000000]	
L0 = 0		[7ffff850] 00000002 7ffff920 7ffff907 00000000	
R0 [r0] = 0		[7ffff860] 7fffffe1 7fffffb9 7fffff82 7fffff46	
R1 [at] = 0		[7ffff870] 7fffff15 7ffffef8 7ffffed4 7ffffec7	
R2 [v0] = 0		[7ffff880] 7ffffeb0 7ffffe83 7ffffe57 7ffffe2c	
R3 [v1] = 0		[7ffff890] 7ffffe0e 7ffffdf7 7ffffdd5 7ffffdc7	
R4 [a0] = 2		[7ffff8a0] 7ffffc75 7ffffc37 7ffffc1c 7ffffbff	
R5 [a1] = 2147481684		[7ffff8b0] 7ffffb7 7ffffba5 7ffffb8d 7ffffb72	
R6 [a2] = 2147481696		[7ffff8c0] 7ffffb4e 7ffffb25 7ffffb07 7ffffa9c	
R7 [a3] = 0		[7ffff8d0] 7ffffa85 7ffffa71 7ffffa62 7ffffa4c	
R8 [t0] = 0		[7ffff8e0] 7ffffa23 7ffff9fb 7ffff9e0 7ffff9b6	
R9 [t1] = 0		[7ffff8f0] 7ffff9a6 7ffff98a 7ffff950 7ffff93e	
R10 [t2] = 0		[7ffff900] 00000000 32000000 702f3433 656a6f72	
R11 [t3] = 0		[7ffff910] 662f7463 74636e75 2e6e6f69 006d7361	
R12 [t4] = 0		[7ffff920] 552f3a43 73726573 6e61432f 2ffe6164	
R13 [t5] = 0		[7ffff930] 75636f44 746e656d 62622f73 6977006d	
R14 [t6] = 0		[7ffff940] 7269646e 5c3a433d 444e4957 0053574f	
R15 [t7] = 0		[7ffff950] 584f4256 49534d5f 534e495f 4c4c4154	
R16 [s0] = 0		[7ffff960] 5441505f 3a433d48 6f72505c 6d617267	
R17 [s1] = 0		[7ffff970] 6c694620 4f5c7365 6c636172 69565c65	
R18 [s2] = 0		[7ffff980] 61757472 786f426c 5355005c 52505245	
R19 [s3] = 0		[7ffff990] 4c49464f 3a433d45 6573555c 435c7372	
R20 [s4] = 0		[7ffff9a0] 61646e61 535500fe 414e5245 433d454d	
R21 [s5] = 0		[7ffff9b0] 61646e61 535500fe 4f445245 4e49414d	
R22 [s6] = 0		[7ffff9c0] 414f525f 474e494d 464f5250 3d454c49	
R23 [s7] = 0		[7ffff9d0] 4b534544 2d504f54 51334844 00464a56	
R24 [t8] = 0		[7ffff9e0] 52455355 414d4f44 443d4e49 544b5345	
R25 [t9] = 0		[7ffff9f0] 442d504f 56513348 5400464a 433d504d	
R26 [k0] = 0		[7ffffa00] 7355535a 5c737265 444e4143 5c317e41	
R27 [k1] = 0		[7ffffa10] 44707041 5c617461 61636f4c 65545c6c	
R28 [gp] = 268468224		[7ffffa20] 5400706d 3d504d45 555c3a43 73726573	
R29 [sp] = 2147481680		[7ffffa30] 4e41435c 317e4144 7070415c 61746144	
R30 [s8] = 0		[7ffffa40] 636f4c5c 545c6c61 00706d65 74737953	
R31 [ra] = 0		[7ffffa50] 6f526d65 433d746f 49575c3a 574f444e	
		[7ffffa60] 79530053 6d657473 76697244 3a433d65	
		[7ffffa70] 53455300 4e4f4953 454d414e 6e6f433d	

Figure 1: Test 1: before

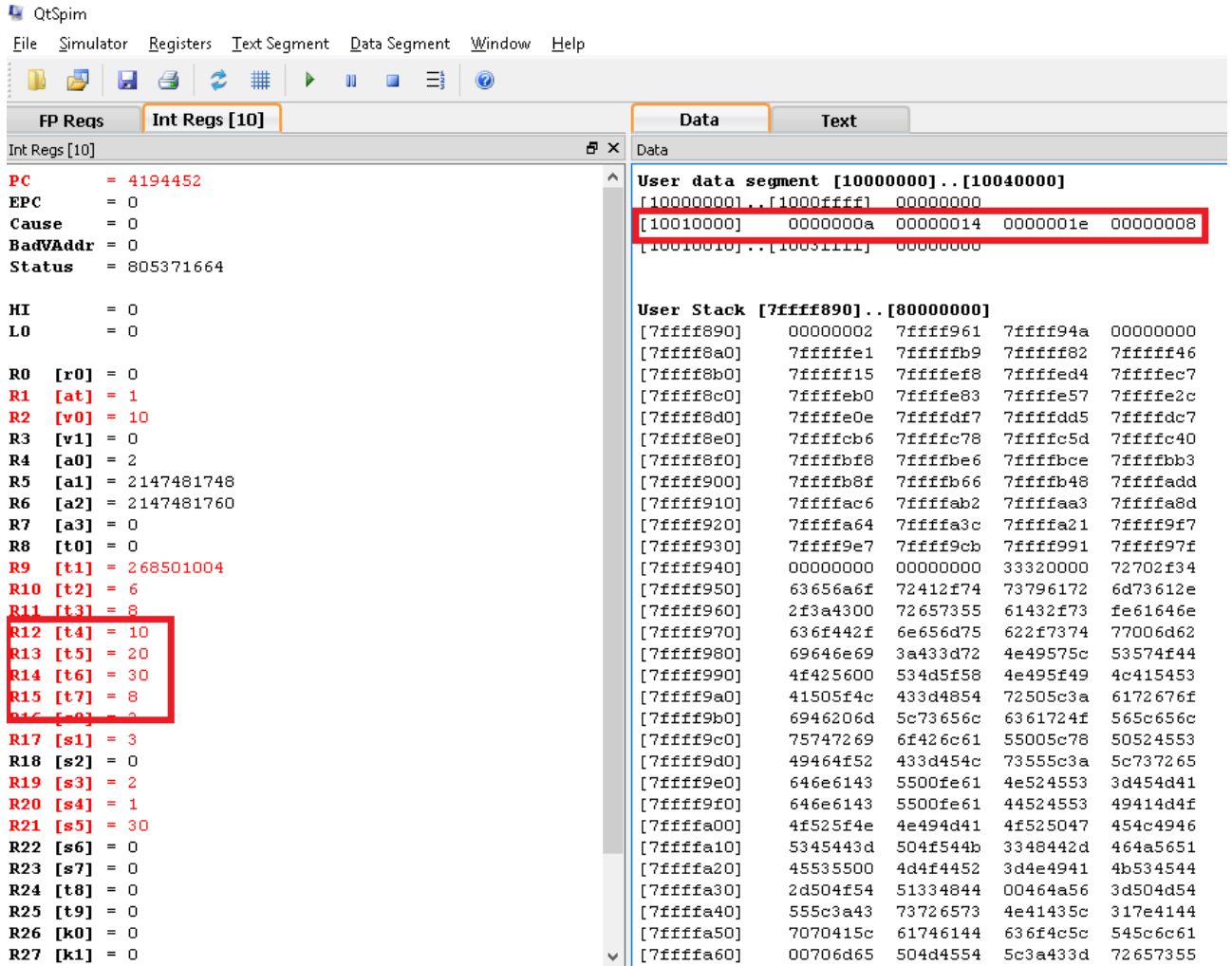


Figure 2: Test 1: after

Final state of array A is 10, 20, 30, 8 for Test1. I show results in registers too.

t4 = a[0]

t5 = a[1]

t6 = a[2]

t7 = a[3]

Results for Test 2: A=8,6,4,2

before run: Fig. 3.

after run: Fig. 4.

FP Regs	Int Regs [10]	Data	Text
Int Regs [10]		Data	
PC	= 0	User data segment [10000000]..[10040000]	
EPC	= 0	[10000000] [1000ffff] 00000000	
Cause	= 0	[10010000] 00000008 00000006 00000004 00000002	
BadVAddr	= 0	[10010010]..[1003ffff] 00000000	
Status	= 805371664		
HI	= 0	User Stack [7ffff850]..[80000000]	
LO	= 0	[7ffff850] 00000002 7ffff920 7ffff90a 00000000	
R0 [r0]	= 0	[7ffff860] 7fffffe1 7fffffb9 7fffff82 7fffff46	
R1 [a1]	= 0	[7ffff870] 7fffff15 7ffffef8 7ffffed4 7ffffec7	
R2 [v0]	= 0	[7ffff880] 7ffffeb0 7ffffe83 7ffffe57 7ffffe2c	
R3 [v1]	= 0	[7ffff890] 7ffffe0e 7ffffdf7 7ffffdd5 7ffffdc7	
R4 [a0]	= 2	[7ffff8a0] 7ffffc75 7ffffc37 7ffffc1c 7ffffb1f	
R5 [a1]	= 2147481684	[7ffff8b0] 7ffffb07 7ffffba5 7ffffb8d 7ffffb72	
R6 [a2]	= 2147481696	[7ffff8c0] 7ffffb4e 7ffffb25 7ffffb07 7ffffa9c	
R7 [a3]	= 0	[7ffff8d0] 7ffffa85 7ffffa71 7ffffa62 7ffffa4c	
R8 [t0]	= 0	[7ffff8e0] 7ffffa23 7ffff9fb 7ffff9e0 7ffff9b6	
R9 [t1]	= 0	[7ffff8f0] 7ffff9a6 7ffff98a 7ffff950 7ffff93e	
R10 [t2]	= 0	[7ffff900] 00000000 00000000 33320000 72702f34	
R11 [t3]	= 0	[7ffff910] 63656a6f 72612f74 2e796172 006d7361	
R12 [t4]	= 0	[7ffff920] 552f3a43 73726573 6e61432f 2ffe6164	
R13 [t5]	= 0	[7ffff930] 75636f44 746e656d 62622f73 6977006d	
R14 [t6]	= 0	[7ffff940] 7269646e 5c3a433d 444e4957 0053574f	
R15 [t7]	= 0	[7ffff950] 584f4256 49534d5f 534e495f 4c4c4154	
R16 [s0]	= 0	[7ffff960] 5441505f 3a433d48 6f72505c 6d617267	
R17 [s1]	= 0	[7ffff970] 6c694620 4f5c7365 6c636172 69565c65	
R18 [s2]	= 0	[7ffff980] 61757472 786f426c 5355005c 52505245	
R19 [s3]	= 0	[7ffff990] 4c49464f 3a433d45 6573555c 435c7372	
R20 [s4]	= 0	[7ffff9a0] 61646e61 535500fe 414e5245 433d454d	
R21 [s5]	= 0	[7ffff9b0] 61646e61 535500fe 4f445245 4e49414d	
R22 [s6]	= 0	[7ffff9c0] 414f525f 474e494d 464f5250 3d454c49	
R23 [s7]	= 0	[7ffff9d0] 4b534544 2d504f54 51334844 00464a56	
R24 [t8]	= 0	[7ffff9e0] 52455355 414d4f44 443d4e49 544b5345	
R25 [t9]	= 0	[7ffff9f0] 442d504f 56513348 5400464a 433d504d	
R26 [k0]	= 0	[7ffffa00] 73555c3a 5c737265 444e4143 5c317e41	
R27 [k1]	= 0	[7ffffa10] 44707041 5c617461 61636f4c 65545c6c	
R28 [gp]	= 268468224	[7ffffa20] 5400706d 3d504d45 555c3a43 73726573	
R29 [sp]	= 2147481680	[7ffffa30] 4e41435c 317e4144 7070415c 61746144	
R30 [s8]	= 0	[7ffffa40] 636f4c5c 545c6c61 00706d65 74737953	
R31 [ra]	= 0	[7ffffa50] 6f526d65 433d746f 49575c3a 574f444e	
		[7ffffa60] 79530053 6d657473 76697244 3a433d65	

Figure 3: Test 2: before

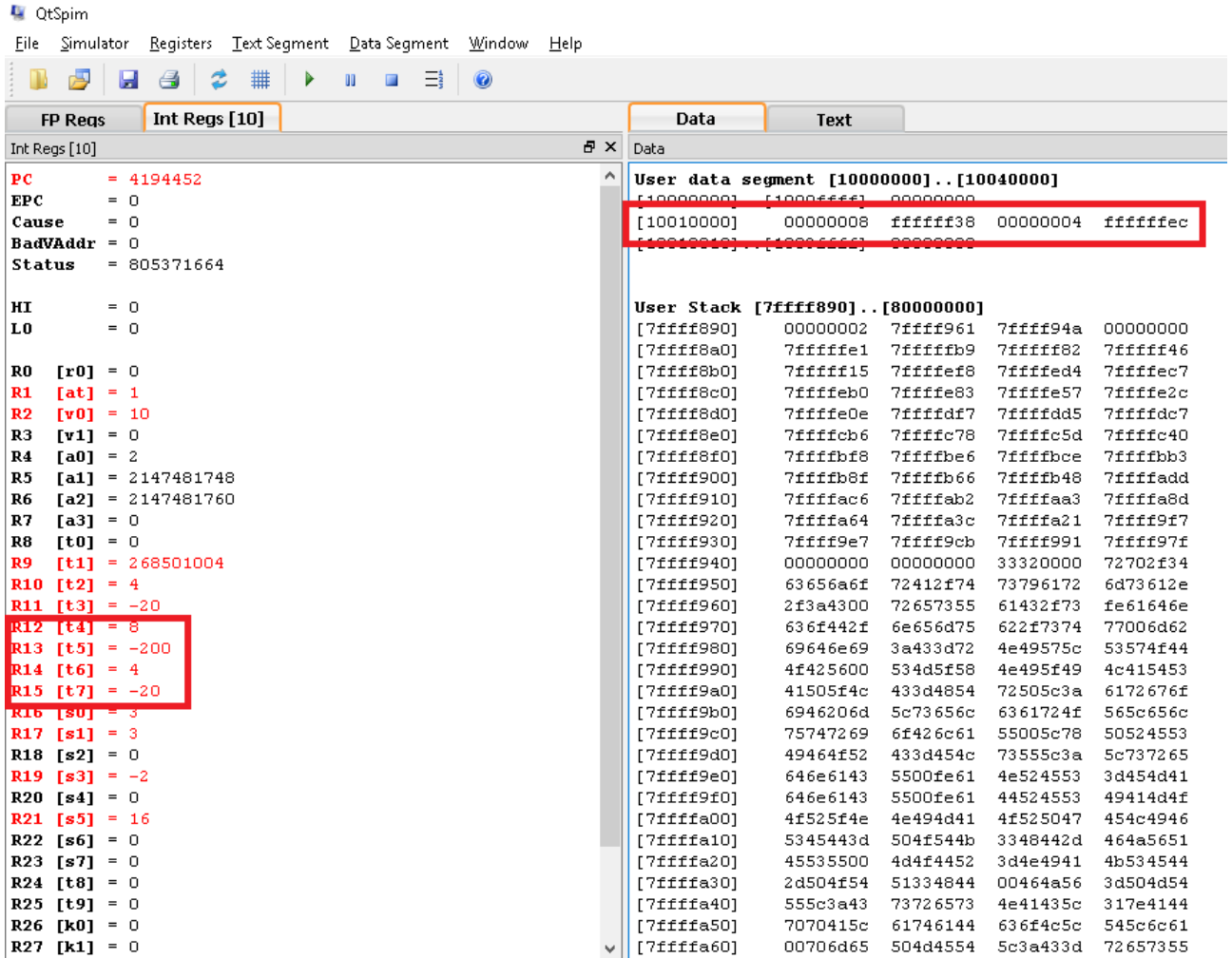


Figure 4: Test 2 : after
Final state of array A is 8, -200, 4, -20 for Test2. I show results in registers too.

t4 = a[0]
t5 = a[1]
t6 = a[2]
t7 = a[3]

Results for Test 3: A=2,2,6,4

before run: Fig. 5.
after run: Fig. 6.

FP Regs	Int Regs [10]	Data	Text
Int Regs [10]		Data	
PC	= 0	User data segment [10000000]..[10040000]	
EPC	= 0	[10000000]..[1000ffff] 00000000	
Cause	= 0	[10010000] 00000002 00000002 00000006 00000004	
BadVAddr	= 0	[10010010]..[1003ffff] 00000000	
Status	= 805371664		
HI	= 0	User Stack [7ffff850]..[80000000]	
L0	= 0	[7ffff850] 00000002 7ffff920 7ffff90a 00000000	
R0 [r0]	= 0	[7ffff860] 7fffffe1 7fffffb9 7fffff82 7fffff46	
R1 [at]	= 0	[7ffff870] 7fffff15 7ffffef8 7ffffed4 7ffffec7	
R2 [v0]	= 0	[7ffff880] 7ffffeb0 7ffff83 7ffff57 7ffff2c	
R3 [v1]	= 0	[7ffff890] 7ffff0e 7ffffdf7 7ffffd5 7ffffdc7	
R4 [a0]	= 2	[7ffff8a0] 7ffffc75 7ffffc37 7ffffc1c 7ffffbff	
R5 [a1]	= 2147481684	[7ffff8b0] 7ffffbb7 7ffffba5 7ffffb8d 7ffffb72	
R6 [a2]	= 2147481696	[7ffff8c0] 7ffffb4e 7ffffb25 7ffffb07 7ffffa9c	
R7 [a3]	= 0	[7ffff8d0] 7ffffa85 7ffffa71 7ffffa62 7ffffa4c	
R8 [t0]	= 0	[7ffff8e0] 7ffffa23 7ffff9fb 7ffff9e0 7ffff9b6	
R9 [t1]	= 0	[7ffff8f0] 7ffff9a6 7ffff98a 7ffff950 7ffff93e	
R10 [t2]	= 0	[7ffff900] 00000000 00000000 33320000 72702f34	
R11 [t3]	= 0	[7ffff910] 63656a6f 72612f74 2e796172 006d7361	
R12 [t4]	= 0	[7ffff920] 552f3a43 73726573 6e61432f 2ffe6164	
R13 [t5]	= 0	[7ffff930] 7563f444 746e656d 62622f73 6977006d	
R14 [t6]	= 0	[7ffff940] 7269646e 5c3a433d 444e4957 0053574f	
R15 [t7]	= 0	[7ffff950] 584f4256 49534d5f 534e495f 4c4c4154	
R16 [s0]	= 0	[7ffff960] 5441505f 3a433d48 6f72505c 6d617267	
R17 [s1]	= 0	[7ffff970] 6c694620 4f5c7365 6c636172 69565c65	
R18 [s2]	= 0	[7ffff980] 61757472 786f426c 5355005c 52505245	
R19 [s3]	= 0	[7ffff990] 4c49464f 3a433d45 6573555c 435c7372	
R20 [s4]	= 0	[7ffff9a0] 61646e61 535500fe 414e5245 433d454d	
R21 [s5]	= 0	[7ffff9b0] 61646e61 535500fe 4f445245 4e49414d	
R22 [s6]	= 0	[7ffff9c0] 414f525f 474e494d 464f5250 3d454c49	
R23 [s7]	= 0	[7ffff9d0] 4b534544 2d504f54 51334844 00464a56	
R24 [t8]	= 0	[7ffff9e0] 52455355 414d4f44 443d4e49 544b5345	
R25 [t9]	= 0	[7ffff9f0] 442d504f 56513348 5400464a 433d504d	
R26 [k0]	= 0	[7ffffa00] 73555c3a 5c737265 444e4143 5c317e41	
R27 [k1]	= 0	[7ffffa10] 44707041 5c617461 61636f4c 65545c6c	
R28 [gp]	= 268468224	[7ffffa20] 5400706d 3d504d45 555c3a43 73726573	
R29 [sp]	= 2147481680	[7ffffa30] 4e41435c 317e4144 7070415c 61746144	
R30 [s8]	= 0	[7ffffa40] 636f4c5c 545c6c61 00706d65 74737953	
R31 [ra]	= 0	[7ffffa50] 6f526d65 433d746f 49575c3a 574f444e	
		[7ffffa60] 79530053 6d657473 76697244 3a433d45	
		[7ffffa70] 53455300 4e4f4953 454d414e 6e6f433d	

Figure 5: Test 3: before

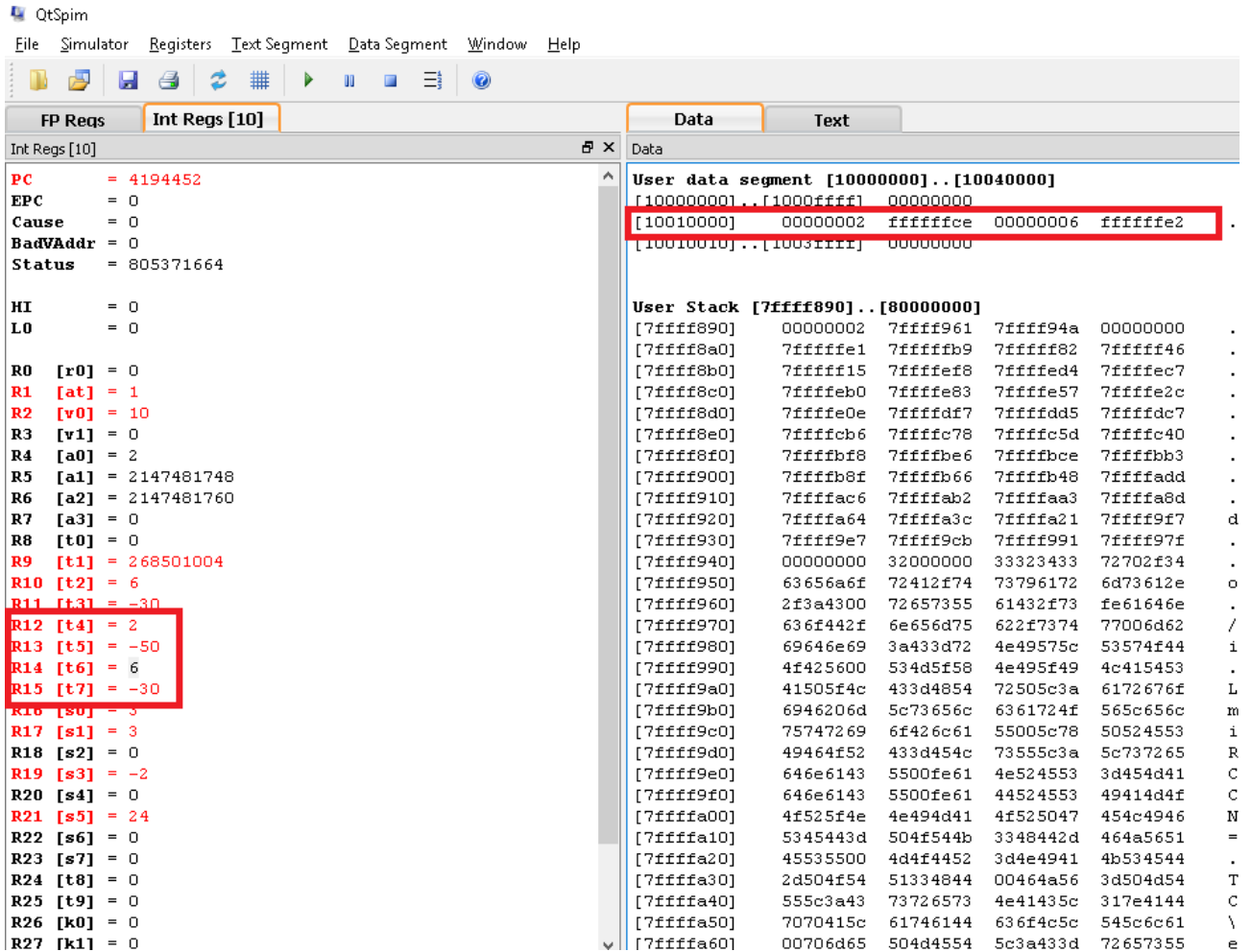


Figure 6: Test 3: after

Final state of array A is 2, -50, 6, -30 for Test3. I show results in registers too.

t4 = a[0]

t5 = a[1]

t6 = a[2]

t7 = a[3]

2 Problem: Function Calls

MIPS Assembly code for function.asm:

```
1 .data
2 x: .word 5          # input a
3 y: .word 3          # input b
4 .text
5
6 main:
7 lw $a0, x           # a0 = x I put it a0 beacuse i will use them for
   function arguments
8 lw $a1, y           # a1 = y
9 addi $s2, $s2, 0     # result = 0 I will show the result in register s2
10 beq $a0, $a1, IF    # If x = y then jump "IF"
11 j else              # Otherwise jump "else"
12
13 IF:
14 add $v0, $a0, $a1    # v0 = x + y
15 sll $v0, $v0, 3      # v0 = 8 * (x + y)
16 add $s2, $0, $v0     # s2 = 8 * (x + y) assign result in s2
17 li $v0, 10          # end of code
18 syscall
19 .end
20
21 else:
22 jal compare          # call compare function
23 add $s2, $0, $v0     # assign result in s2
24 li $v0, 10          # end of code
25 syscall
26 .end
27
28 compare:
29 slt $s0, $a0, $a1
30 beq $s0, 1, punish   # If a1(y) greater than a0(x) jump punish
31 add $v0, $a0, $a1    # v0 = x + y
32 sll $v0, $v0, 2      # v0 = 4 * (x + y)
33 jr $ra              # return result in v0
34
35 punish:
36 sub $v0, $a0, $a1    # v0 = x - y
37 sll $v0, $v0, 1      # v0 = 2 * (x - y)
38 jr $ra              # return result in v0
```

Test 1: a=3, b=3

Test 2: a=3, b=5

Test 3: a=5, b=3

Results for Test 1: a=3, b=3

before run: Fig. 7.

after run: Fig. 8.

FP Regs	Int Regs [10]	Data	Text
Int Regs [10]		Data	
PC	= 0	User data segment [10000000]..[10040000]	
EPC	= 0	[10000000]..[1000ffff] 00000000	
Cause	= 0	[10010000] 00000003 00000003 00000000 00000000	
BadVAddr	= 0	[10010010]..[1003ffff] 00000000	
Status	= 805371664		
HI	= 0	User Stack [7ffff850]..[80000000]	
L0	= 0	[7ffff850] 00000002 7ffff920 7ffff907 00000000	
R0 [r0]	= 0	[7ffff860] 7fffffe1 7fffffb9 7ffff82 7fffff46	
R1 [at]	= 0	[7ffff870] 7fffff15 7ffffef8 7ffffed4 7ffffec7	
R2 [v0]	= 0	[7ffff880] 7ffffeb0 7ffffe83 7ffffe57 7ffffec2	
R3 [v1]	= 0	[7ffff890] 7ffffe0e 7ffffdf7 7ffffdd5 7ffffdc7	
R4 [a0]	= 2	[7ffff8a0] 7ffffc75 7ffffc37 7ffffc1c 7ffffbff	
R5 [a1]	= 2147481684	[7ffff8b0] 7ffffbb7 7ffffba5 7ffffb8d 7ffffb72	
R6 [a2]	= 2147481696	[7ffff8c0] 7ffffb4e 7ffffb25 7ffffb07 7ffffa9c	
R7 [a3]	= 0	[7ffff8d0] 7ffffa85 7ffffa71 7ffffa62 7ffffa4c	
R8 [t0]	= 0	[7ffff8e0] 7ffffa23 7ffff9fb 7ffff9e0 7ffff9b6	
R9 [t1]	= 0	[7ffff8f0] 7ffff9a6 7ffff98a 7ffff950 7ffff93e	
R10 [t2]	= 0	[7ffff900] 00000000 32000000 702f3433 656a6f72	
R11 [t3]	= 0	[7ffff910] 662f7463 74636e75 2e6e6f69 006d7361	
R12 [t4]	= 0	[7ffff920] 552f3a43 73726573 6e61432f 2ffe6164	
R13 [t5]	= 0	[7ffff930] 75636f44 746e656d 62622f73 6977006d	
R14 [t6]	= 0	[7ffff940] 7269646e 5c3a433d 444e4957 0053574f	
R15 [t7]	= 0	[7ffff950] 584f4256 49534d5f 534e495f 4c4c4154	
R16 [s0]	= 0	[7ffff960] 5441505f 3a433d48 6f72505c 6d617267	
R17 [s1]	= 0	[7ffff970] 6c694620 4f5c7365 6c636172 69565c65	
R18 [s2]	= 0	[7ffff980] 61757472 786f426c 5355005c 52505245	
R19 [s3]	= 0	[7ffff990] 4c49464f 3a433d45 6573555c 435c7372	
R20 [s4]	= 0	[7ffff9a0] 61646e61 535500fe 414e5245 433d454d	
R21 [s5]	= 0	[7ffff9b0] 61646e61 535500fe 4f445245 4e49414d	
R22 [s6]	= 0	[7ffff9c0] 414f525f 474e494d 464f5250 3d454c49	
R23 [s7]	= 0	[7ffff9d0] 4b534544 2d504f54 51334844 00464a56	
R24 [t8]	= 0	[7ffff9e0] 52455355 414d4f44 443d4e49 544b5345	
R25 [t9]	= 0	[7ffff9f0] 442d504f 56513348 5400464a 433d504d	
R26 [k0]	= 0	[7ffffa00] 73555c3a 5c737265 444e4143 5c317e41	
R27 [k1]	= 0	[7ffffa10] 44707041 5c617461 61636f4c 65545c6c	
		[7ffffa20] 5400706d 3d504d45 555c3a43 73726573	

Figure 7: Test 1: before

PC	= 4194384	User data segment [10000000]..[10040000]			
EPC	= 0	[10000000] .. [1000ffff]	00000000		
Cause	= 0	[10010000]	00000003	00000003	00000000 00000000
BadVAddr	= 0	[10010010] .. [1003ffff]	00000000		
Status	= 805371664	User Stack [7ffff890]..[80000000]			
HI	= 0	[7ffff890]	00000002	7ffff961	7ffff947 00000000
L0	= 0	[7ffff8a0]	7fffffe1	7fffffb9	7fffff82 7fffff46
R0 [r0]	= 0	[7ffff8b0]	7fffff15	7ffffef8	7ffffed4 7ffffec7
R1 [at]	= 268500992	[7ffff8c0]	7ffffeb0	7ffffe83	7ffffe57 7ffffe2c
R2 [v0]	= 10	[7ffff8d0]	7ffffe0e	7ffffdf7	7ffffdd5 7ffffdc7
R3 [v1]	= 0	[7ffff8e0]	7ffffcb6	7ffffc78	7ffffc5d 7ffffc40
R4 [a0]	= 3	[7ffff8f0]	7ffffbf8	7ffffbe6	7ffffbce 7ffffbb3
R5 [a1]	= 3	[7ffff900]	7ffffb8f	7ffffb66	7ffffb48 7ffffadd
R6 [a2]	= 2147481760	[7ffff910]	7ffffac6	7ffffab2	7ffffaa3 7ffffa8d
R7 [a3]	= 0	[7ffff920]	7ffffa64	7ffffa3c	7ffffa21 7ffff9f7
R8 [t0]	= 0	[7ffff930]	7ffff9e7	7ffff9cb	7ffff991 7ffff97f
R9 [t1]	= 0	[7ffff940]	00000000	32000000	702f3433 656a6f72
R10 [t2]	= 0	[7ffff950]	462f7463	74636e75	736e6f69 6d73612e
R11 [t3]	= 0	[7ffff960]	2f3a4300	72657355	61432f73 fe61646e
R12 [t4]	= 0	[7ffff970]	636f442f	6e656d75	622f7374 77006d62
R13 [t5]	= 0	[7ffff980]	69646e69	3a433d72	4e49575c 53574f44
R14 [t6]	= 0	[7ffff990]	4f425600	534d5f58	4e495f49 4c415453
R15 [t7]	= 0	[7ffff9a0]	41505f4c	433d4854	72505c3a 6172676f
R16 [s0]	= 0	[7ffff9b0]	6946206d	5c73656c	6361724f 565c656c
R17 [s1]	= 0	[7ffff9c0]	75747269	6f426c61	55005c78 50524553
R18 [s2]	= 48	[7ffff9d0]	49464f52	433d454c	73555c3a 5c737265
R19 [s3]	= 0	[7ffff9e0]	646e6143	5500fe61	4e524553 3d454d41
R20 [s4]	= 0	[7ffff9f0]	646e6143	5500fe61	44524553 49414d4f

Figure 8: Test 1: after

I keep the result in s2 register. Result of test1 is 48

Results for Test 1: a=3, b=5

before run: Fig. 9.

after run: Fig. 10.

FP Reqs	Int Regs [10]	Data	Text
Int Regs [10]		Data	
PC	= 0	User data segment [10000000]..[10040000]	
EPC	= 0	[10000000]..[1000ffff] 00000000	
Cause	= 0	[10010000] 00000003 00000005 00000000 00000000	
BadVAddr	= 0	[10010010]..[1003ffff] 00000000	
Status	= 805371664		
HI	= 0	User Stack [7ffff850]..[80000000]	
L0	= 0	[7ffff850] 00000002 7ffff920 7ffff907 00000000	
R0 [r0]	= 0	[7ffff860] 7fffffe1 7fffffb9 7fffff82 7fffff46 F . . .	
R1 [at]	= 0	[7ffff870] 7fffff15 7ffffef8 7ffffed4 7ffffec7	
R2 [v0]	= 0	[7ffff880] 7ffffeb0 7ffff83 7ffff57 7ffff2c W . . .	
R3 [v1]	= 0	[7ffff890] 7ffffe0e 7ffffdf7 7ffffdd5 7ffffdc7	
R4 [a0]	= 2	[7ffff8a0] 7ffffc75 7ffffc37 7ffffc1c 7ffffbf7 7 . . .	
R5 [a1]	= 2147481684	[7ffff8b0] 7ffffb7 7ffffba5 7ffffb8d 7ffffb72 E . . .	
R6 [a2]	= 2147481696	[7ffff8c0] 7ffffb4e 7ffffb25 7ffffb07 7ffffa9c N . . .	
R7 [a3]	= 0	[7ffff8d0] 7ffffa85 7ffffa71 7ffffa62 7ffffa4c q . . .	
R8 [t0]	= 0	[7ffff8e0] 7ffffa23 7ffff9fb 7ffff9e0 7ffff9b6 # . . .	
R9 [t1]	= 0	[7ffff8f0] 7ffff9a6 7ffff98a 7ffff950 7ffff93e P . . .	
R10 [t2]	= 0	[7ffff900] 00000000 32000000 702f3433 656a6f72 2 3 4 / p r o j e	
R11 [t3]	= 0	[7ffff910] 662f7463 74636e75 2e6e6f69 006d7361 c t / f u n c t i o n . a s m .	
R12 [t4]	= 0	[7ffff920] 552f3a43 73726573 6e61432f 2ffe6164 C : / U s e r s / C a n d a . /	
R13 [t5]	= 0	[7ffff930] 75636f44 746e656d 62622f73 6977006d D o c u m e n t s / b b m . w i	
R14 [t6]	= 0	[7ffff940] 7269646e 5c3a433d 444e4957 0053574f n d i r = C : \ W I N D O W S .	
R15 [t7]	= 0	[7ffff950] 584f4256 49534d5f 534e495f 4c4c4154 V B O X _ M S I _ I N S T A L L	
R16 [s0]	= 0	[7ffff960] 5441505f 3a433d48 6f72505c 6d617267 - P A T H = C : \ P r o g r a m	
R17 [s1]	= 0	[7ffff970] 6c694620 4f5c7365 6c636172 69565c65 F i l e s \ O r a c l e \ V i	
R18 [s2]	= 0	[7ffff980] 61757472 786f426c 5355005c 52505245 r t u a l B o x \ . U S E R P R	
R19 [s3]	= 0	[7ffff990] 4c49464f 3a433d45 6573555c 435c7372 O F I L E = C : \ U s e r s \ C	
R20 [s4]	= 0	[7ffff9a0] 61646e61 535500fe 414e5245 433d454d a n d a . . U S E R N A M E = C	
R21 [s5]	= 0	[7ffff9b0] 61646e61 535500fe 4f445245 4e49414d a n d a . . U S E R D O M A I N	
R22 [s6]	= 0	[7ffff9c0] 414f525f 474e494d 464f5250 3d454c49 _ R O A M I N G P R O F I L E =	
R23 [s7]	= 0	[7ffff9d0] 4b534544 2d504f54 51334844 00464a56 D E S K T O P - D H 3 Q V J F .	
R24 [t8]	= 0	[7ffff9e0] 52455355 414d4f44 443d4e49 544b5345 U S E R D O M A I N = D E S K T	
R25 [t9]	= 0	[7ffff9f0] 442d504f 56513348 5400464a 433d504d O P - D H 3 Q V J F . T M P = C	
R26 [k0]	= 0	[7ffffa00] 735553a 5c737265 444e4143 5c317e41 : \ U s e r s \ C A N D A ~ 1 \	
R27 [k1]	= 0	[7ffffa10] 44707041 5c617461 61636f4c 65545c6c A p p D a t a \ L o c a l \ T e	
R28 [gp]	= 268468224	[7ffffa20] 5400706d 3d504d45 555c3a43 73726573 m p . T E M P = C : \ U s e r s	
R29 [sp]	= 2147481680	[7ffffa30] 4e41435c 317e4144 7070415c 61746144 \ C A N D A ~ 1 \ A p p D a t a	
R30 [s8]	= 0	[7ffffa40] 636f4c5c 545c6c61 00706d65 74737953 \ L o c a l \ T e m p . S y s t	
R31 [ra]	= 0	[7ffffa50] 6f526d65 433d746f 49575c3a 574f444e e m R o o t = C : \ W I N D O W	
		[7ffffa60] 79530053 6d657473 76697244 3a433d65 S . S y s t e m D r i v e = C :	
		[7ffffa70] 53455300 4e4f4953 454d414e 6e6f433d S E S S I O N N A M E = C o n	

Figure 9: Test 1: before

Int Regs [10]		Data	
PC	= 4194400	User data segment [10000000]..[10040000]	
EPC	= 0	[10000000]..[1000ffff] 00000000	
Cause	= 0	[10010000] 00000003 00000005 00000000 00000000	
BadVAddr	= 0	[10010010]..[1003ffff] 00000000	
Status	= 805371664		
HI	= 0	User Stack [7ffff890]..[80000000]	
L0	= 0	[7ffff890] 00000002 7ffff961 7ffff947 00000000	
R0 [r0]	= 0	[7ffff8a0] 7fffffe1 7fffffb9 7fffff82 7fffff46	
R1 [at]	= 1	[7ffff8b0] 7fffff15 7ffffef8 7ffffed4 7ffffec7	
R2 [v0]	= 10	[7ffff8c0] 7ffffeb0 7ffffe83 7ffffe57 7ffffe2c	
R3 [v1]	= 0	[7ffff8d0] 7ffffe0e 7ffffdf7 7ffffdd5 7ffffdc7	
R4 [a0]	= 3	[7ffff8e0] 7ffffcb6 7ffffc78 7ffffc5d 7ffffc40	
R5 [a1]	= 5	[7ffff8f0] 7ffffbf8 7ffffbe6 7ffffbce 7ffffbb3	
R6 [a2]	= 2147481760	[7ffff900] 7ffffb8f 7ffffb66 7ffffb48 7ffffadd	
R7 [a3]	= 0	[7ffff910] 7ffffac6 7ffffab2 7ffffaa3 7ffffa8d	
R8 [t0]	= 0	[7ffff920] 7ffffa64 7ffffa3c 7ffffa21 7ffff9f7	
R9 [t1]	= 0	[7ffff930] 7ffff9e7 7ffff9cb 7ffff991 7ffff97f	
R10 [t2]	= 0	[7ffff940] 00000000 32000000 702f3433 656a6f72	
R11 [t3]	= 0	[7ffff950] 462f7463 74636e75 736e6f69 6d73612e	
R12 [t4]	= 0	[7ffff960] 2f3a4300 72657355 61432f73 fe61646e	
R13 [t5]	= 0	[7ffff970] 636f442f 6e656d75 622f7374 77006d62	
R14 [t6]	= 0	[7ffff980] 69646e69 3a433d72 4e49575c 53574f44	
R15 [t7]	= 0	[7ffff990] 4f425600 534d5f58 4e495f49 4c415453	
R16 [s0]	= 1	[7ffff9a0] 41505f4c 433d4854 72505c3a 6172676f	
R17 [s1]	= 0	[7ffff9b0] 6946206d 5c73656c 6361724f 565c656c	
R18 [s2]	= -4	[7ffff9c0] 75747269 6f426c61 55005c78 50524553	
R19 [s3]	= 0	[7ffff9d0] 49464f52 433d454c 73555c3a 5c737265	
R20 [s4]	= 0	[7ffff9e0] 646e6143 5500fe61 4e524553 3d454d41	
R21 [s5]	= 0	[7ffff9f0] 646e6143 5500fe61 44524553 49414d4f	
R22 [s6]	= 0	[7ffffa00] 44524553 44524553 44524553 44524553	

Figure 10: Test 2: after
I keep the result in s2 register. Result of test2 is -4

Results for Test 1: a=5, b=3

before run: Fig. 11.

after run: Fig. 12.

FP Regs	Int Regs [10]	Data	Text
Int Regs [10]		Data	
PC	= 0	User data segment [10000000]..[10040000]	
EPC	= 0	[10000000]..[1000ffff] 00000000	
Cause	= 0	[10010000] 00000005 00000003 00000000 00000000	
BadVAddr	= 0	[10010010]..[10031111] 00000000	
Status	= 805371664		
HI	= 0	User Stack [7ffff850]..[80000000]	
L0	= 0	[7ffff850] 00000002 7ffff920 7ffff90a 00000000	
R0 [r0]	= 0	[7ffff860] 7fffffe1 7fffffb9 7fffff82 7fffff46	
R1 [at]	= 0	[7ffff870] 7fffff15 7fffffe8 7ffffed4 7ffffec7	
R2 [v0]	= 0	[7ffff880] 7ffffeb0 7ffffe83 7ffffe57 7ffffe2c	
R3 [v1]	= 0	[7ffff890] 7ffffe0e 7ffffdf7 7ffffdd5 7ffffdc7	
R4 [a0]	= 2	[7ffff8a0] 7ffffc75 7ffffc37 7ffffc1c 7ffffbff	
R5 [a1]	= 2147481684	[7ffff8b0] 7ffffb77 7ffffba5 7ffffb8d 7ffffb72	
R6 [a2]	= 2147481696	[7ffff8c0] 7ffffb4e 7ffffb25 7ffffb07 7ffffa9c	
R7 [a3]	= 0	[7ffff8d0] 7ffffa85 7ffffa71 7ffffa62 7ffffa4c	
R8 [t0]	= 0	[7ffff8e0] 7ffffa23 7ffff9fb 7ffff9e0 7ffff9b6	
R9 [t1]	= 0	[7ffff8f0] 7ffff9a6 7ffff98a 7ffff950 7ffff93e	
R10 [t2]	= 0	[7ffff900] 00000000 00000000 33320000 72702f34	
R11 [t3]	= 0	[7ffff910] 63656a6f 72612f74 2e796172 006d7361	
R12 [t4]	= 0	[7ffff920] 552f3a43 73726573 6e61432f 2ffe6164	
R13 [t5]	= 0	[7ffff930] 75636f44 746e656d 62622f73 6977006d	
R14 [t6]	= 0	[7ffff940] 7269646e 5c3a433d 444e4957 0053574f	
R15 [t7]	= 0	[7ffff950] 584f4256 49534d5f 534e495f 4c4c4154	
R16 [s0]	= 0	[7ffff960] 5441505f 3a433d48 6f72505c 6d617267	
R17 [s1]	= 0	[7ffff970] 6c694620 4f5c7365 6c636172 69565c65	
R18 [s2]	= 0	[7ffff980] 61757472 786f426c 5355005c 52505245	
R19 [s3]	= 0	[7ffff990] 4c49464f 3a433d45 6573555c 435c7372	
R20 [s4]	= 0	[7ffff9a0] 61646e61 535500fe 414e5245 433d454d	
R21 [s5]	= 0	[7ffff9b0] 61646e61 535500fe 4f445245 4e49414d	
R22 [s6]	= 0	[7ffff9c0] 414f525f 474e494d 464f5250 3d454c49	
R23 [s7]	= 0	[7ffff9d0] 4b534544 2d504f54 51334844 00464a56	
R24 [t8]	= 0	[7ffff9e0] 52455355 414d4f44 443d4e49 544b5345	
R25 [t9]	= 0	[7ffff9f0] 442d504f 56513348 5400464a 433d504d	
R26 [k0]	= 0	[7ffffa00] 73555c3a 5c737265 444e4143 5c317e41	
R27 [k1]	= 0	[7ffffa10] 44707041 5c617461 61636f4c 65545c6c	
		[7ffffa20] 5400706d 3d504d45 555c3a43 73726573	

Figure 11: Test 3: before

```

PC      = 4194400
EPC     = 0
Cause   = 0
BadVAddr = 0
Status  = 805371664

```

```

HI      = 0
LO      = 0

```

```

R0 [r0] = 0
R1 [at] = 1
R2 [v0] = 10
R3 [v1] = 0
R4 [a0] = 5
R5 [a1] = 3
R6 [a2] = 2147481760
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 32
R19 [s3] = 0
R20 [s4] = 0

```

```

User data segment [10000000]..[10040000]
[10000000]..[1000ffff] 00000000
[10010000] 00000005 00000003 00000000 00000000
[10010010]..[1003ffff] 00000000

User Stack [7ffff890]..[80000000]
[7ffff890] 00000002 7ffff961 7ffff947 00000000
[7ffff8a0] 7fffffe1 7fffffb9 7fffff82 7fffff46
[7ffff8b0] 7fffff15 7ffffef8 7ffffed4 7ffffec7
[7ffff8c0] 7ffffeb0 7ffffe83 7ffffe57 7ffffe2c
[7ffff8d0] 7ffffe0e 7ffffdf7 7ffffdd5 7ffffdc7
[7ffff8e0] 7ffffcb6 7ffffc78 7ffffc5d 7ffffc40
[7ffff8f0] 7ffffbf8 7ffffbe6 7ffffbce 7ffffbb3
[7ffff900] 7ffffb8f 7ffffb66 7ffffb48 7ffffadd
[7ffff910] 7ffffac6 7ffffab2 7ffffaa3 7ffffa8d
[7ffff920] 7ffffa64 7ffffa3c 7ffffa21 7ffff9f7
[7ffff930] 7ffff9e7 7ffff9cb 7ffff991 7ffff97f
[7ffff940] 00000000 32000000 702f3433 656a6f72
[7ffff950] 462f7463 74636e75 736e6f69 6d73612e
[7ffff960] 2f3a4300 72657355 61432f73 fe61646e
[7ffff970] 636f442f 6e656d75 622f7374 77006d62
[7ffff980] 69646e69 3a433d72 4e49575c 53574f44
[7ffff990] 4f425600 534d5f58 4e495f49 4c415453
[7ffff9a0] 41505f4c 433d4854 72505c3a 6172676f
[7ffff9b0] 6946206d 5c73656c 6361724f 565c656c
[7ffff9c0] 75747269 6f426c61 55005c78 50524553
[7ffff9d0] 49464f52 433d454c 73555c3a 5c737265
[7ffff9e0] 646e6143 5500fe61 4e524553 3d454d41

```

Figure 12: Test 3: after
I keep the result in s2 register. Result of test3 is 32 .