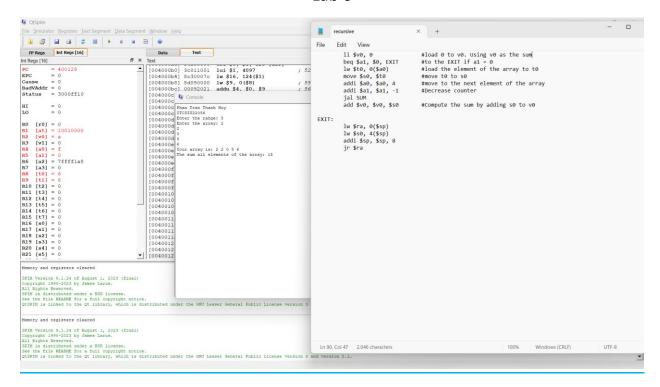
Name: Phan Tran Thanh Huy

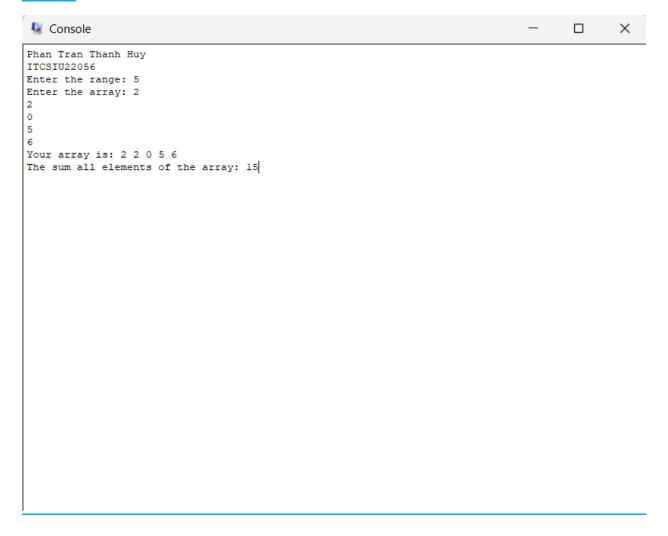
ID: ITCSIU22056

Lab 6



Code:

Result:



Explaination of the address:

Before calling the procedure SUM, the initial return address is stored in memory address [00400018] and the initial stack pointer address is stored in memory address [7ffff19c].

```
Int Regs [16]
Int Regs[16]

R8 [v0] = 4

R3 [v1] = 0

R4 [a0] = 10010080

R5 [a1] = 7ffffla0

R6 [a2] = 7ffffla0

R7 [a3] = 0

R8 [t0] = 10010094

R9 [t1] = 6

R10 [t2] = 0

R11 [t3] = 0

R12 [t4] = 0

R13 [t5] = 0

R14 [t6] = 0
                                                                                                                                                                                                                            [004000b8]
[004000bc]
                                                                                                                                                                                                                                                                                                                                                lw $9, 0($8)
addu $4, $0, $9
ori $2, $0, 1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           ; 55: lw $t1, 0($t0) #Load t0 to t1
; 56: move $a0, $t1 #Print the element of the array
; 57: li $v0, 1
                                                                                                                                                                                                                                                                                         00092021
                                                                                                                                                                                                                                                                                                                                         34020001
                                                                                                                                                                                                                               [004000c4]
                                                                                                                                                                                                                                                                                       0000000c
                                                                                                                                                                                                                               [004000c8] 3c011001
                                                                                                                                                                                                                            [004000c8] 3c011001
[004000cc] 34240054
[004000d0] 34020004
[004000d4] 0000000c
[004000d8] 21080004
[004000dc] 2210ffff
                                                                                                                                                                                                                               [004000e0] 1600fff6
| ALZ | L4| - U |
| ALZ | L4| - U |
| ALZ | L4| - U |
| ALZ | L5| = 0 |
| ALZ | L5| 
                                                                                                                                                                                                                               [004000e4] 3c011001
[004000e8] 34240056
                                                                                                                                                                                                                            [004000e8] 34240056
[004000ec] 34020004
[004000f0] 0000000c
[004000f4] 3c011001
[004000f8] 34240058
[004000fc] 34020004
                                                                                                                                                                                                                                                                                                                                          ori $2, $0, 4
sysoall
lui $1, 4097 [arr]
ori $4, $1, 128 [arr]
lui $1, 4097
lw $5, 124($1)
jal 0x0040012c [sUM]
addu $4, $0, $2
ori $2, $0, 1
sysoall
ori $2, $0, 10
                                                                                                                                                                                                                               [004001001
                                                                                                                                                                                                                                                                                       0000000c
                                                                                                                                                                                                                               [00400104] 3c011001
                                                                                                                                                                                                                               [00400108] 34240080
                                                                                                                                                                                                                                                                                       3c011001
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ; 75: lw $a1, n #load n to a1
                                                                                                                                                                                                                              [00400114] 86250076
[00400114] 0c10004b
[00400118] 00022021
[0040011c] 34020001
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ; 76: jal SUM #Call the recursive
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ; 76: 3a1 Sun *call the recursive
; 78: move $a0, $v0 #move v0 to ad;
; 79: 11 $v0, 1 #Print the result
; 80: syscall
; 82: 11 $v0, 10
; 83: syscall
; 86: addl $sp, $sp, -8
; 87: sw $ra, 0($sp)
                                                                                                                                                                                                                               [00400120] 0000000c
                                                                                                                                                                                                                                                                                                                                             syscall
ori $2, $0, 10
syscall
addi $29, $29, -8
sw $31, 0($29)
                                                                                                                                                                                                                               [00400124] 3402000a
                                                                                                                                                                                                                           [00400128] 00000000
[0040012c] 23bdfff8
[00400130] afbf0000
```

After calling the procedure SUM, the return address is stored in memory address [00400118], which is the return address of the callee to the main function.

```
Int Regs [16]
                                                                                                                    ori $4, $1, 88 [printResult]
ori $2, $0, 4 ; 74
syscall ; 72
lui $1, 4097 [arr] ; 74
R2 [v0] = 4
R3 [v1] = 0
R4 [a0] = 10010080
R5 [a1] = 5
R6 [a2] = 7ffff1a8
                                                                                                                                                                          71: li $v0. 4
                                                                             [004000fc] 34020004
[004001001 0000000c
                                                                                                                                                                      ; 72: syscall
; 74: la $a0, arr #load the array to t0
                                                                             [00400100] 00000000
[00400104] 3c011001
[00400108] 34240080
                                                                                                                     ori $4, $1, 128 [arr]
lui $1, 4097
R7 [a3] = 0
R8 [t0] = 10010094
R9 [t1] = 6
R10 [t2] = 0
                                                                                                                                                                      ; 75: lw $a1, n #load n to a1
                                                                             [0040010c] 3c011001
                                                                                                                     lw $5, 124($1)
jal 0x0040012c [SUM]
                                                                             [00400110] 8c25007c
                                                                                                                                                                      ; 76: jal SUM #Call the recursive
                                                                                                                                                                     ; 78: move SaO, SvO #move vO to al
; 79: 11 $vO, 1 #Print the result
; 80: syscall
; 82: 11 $vO, 10
                                                                             [00400118] 00022021
[0040011c] 34020001
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
                                                                                                                     ori $2, $0, 1
syscall
ori $2, $0, 10
                                                                             [004001201 0000000c
                                                                              [00400124] 3402000a
                                                                                                                    ori $2, vo, --
syscall ; 83: syscall
addi $29, $29, -8 ; 86: addi $3p, $3p, -8
sw $31, 0($29) ; 87: sw $za, 0($zp)
sw $16, 4($29) ; 88: sw $z0, 4($zp)
ori $2, $0, 0 ; 90: li $v0, 0 #load 0 to v0. Using v0 as the sum
R15 [t7]
R16 [s0]
R17 [s1]
R18 [s2]
                                                                             [0040012cl 23bdfff8
                                                                                                                    [00400126] 235d1110
[00400130] afbf0000
[00400134] afb00004
[00400138] 34020000
                                                                                                 10a00007
R19 [s3]
                                                                             [0040013c]
                                                                                                                                                                      . 92: lw $t0, 0($a0) #load the element of the array to t0; 93: move $s0, $t0 #move t0 to $0; 94: addi $a0, $a0, 4 #move to the next element of the array; 95: addi $a1, $a1, -1 #Decrease counter
R20 [s4]
R21 [s5]
R22 [s6]
                                                                             [00400140] 8c880000
[00400144] 00088021
[00400148] 20840004
R23 [s7]
                                                                             [0040014cl 20a5ffff
R24 [t8]
R25 [t9]
R26 [k0]
                                                                                                                    jal 0x0040012c [SUM]
add $2, $2, $16
lw $31, 0($29)
lw $16, 4($29)
                                                                                                                                                                      , 30. addityal, val, 1. peoless Counted;
; 96: jal SUM
; 97: add $v0, $v0, $s0 $Compute the sum by adding s0 to v0
; 100: lw $ra, 0($sp)
; 101: lw $s0, 4($sp)
                                                                             [00400150] 0c10004b
                                                                             [00400154] 00501020
[00400158] 8fbf0000
R27 [k1] =
                                                                             [0040015c] 8fb00004
R28 [gp] = 10008000
R29 [sp] = 7ffff19c
R30 [s8] = 0
                                                                             [004001601 23bd0008
                                                                                                                      addi $29, $29, 8
                                                                                                                                                                      ; 102: addi $sp, $sp, 8
                                                                                                                                                                      Kernel Text Segment [80000000]..[80010000]; 90: move $k1 $at # Save $at
                                                                             [80000180] 0001d821 addu $27, $0, $1
```

And the stack pointer is stored in memory address [7ffff194]

```
lw $9, 0($8) ; 55: 1.
addu $4, $0, $9 ; 56: move $a0, *
ori $2, $0, 1 ; 57: li $v0, 1
syscall
lui $1, 4097 [stringSpace]; 59: la $a0, stringSpace
ori $4, $1, 84 [stringSpace]; 59: la $a0, stringSpace
ori $4, $1, 84 [stringSpace]
ori $2, $0, 4 ; 60: li $v0, 4
syscall ; 61: syscall
-44i $8, $8, 4 ; 62: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
$^{16}. -1 ; 63: addi $t0, $t0, 4 #move to the next element of the array
            ggs[6]

[v0] = 4

[v1] = 0

[a0] = 10010080

[a1] = 5

[a2] = 7ffff1a8

[a3] = 0

[t0] = 10010094

[t1] = 6

[t2] = 0

[t3] = 0

[t4] = 0

[t5] = 0

[t6] = 0
                                                                                                                            •
                                                                                                                                         [004000b8] 8d090000
                                                                                                                                          [004000bc]
                                                                                                                                                                             00092021
                                                                                                                                         [004000c0]
                                                                                                                                                                             34020001
                                                                                                                                         [004000c41
                                                                                                                                                                             00000000
                                                                                                                                         [004000c4]
[004000c8]
[004000cc]
[004000d0]
                                                                                                                                                                             3c011001
                                                                                                                                         [004000d4] 0000000c
                                                                                                                                                                                                           R10
R11
R12
                                                                                                                                         [004000d8] 21080004
                                                                                                                                        [004000dc] 2210ffff
[004000e0] 1600fff6
[004000e4] 3c011001
[004000e8] 34240056
 R14 [t6]
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
                                                                                                                                         [004000ec] 34020004
                                                                                                                                          004000f01 0000000c
                                                                                                                                       [004000f4] 3c011001
[004000f8] 34240058
[004000fc] 34020004
[00400100] 0000000c
              [s5] = 0
[s6] = 0
[s7] = 0
[t8] = 0
                                                                                                                                         [004001041 3c011001
                                                                                                                                         [00400104] 36011001
[00400108] 34240080
[0040010c] 3c011001
[00400110] 8c25007c
[00400114] 0c10004b
 R25
              [t9] = 0
 R26
              [k0] = 0
                                                                                                                                         [00400118] 00022021
                                                                                                                                         [0040011c] 34020001
 R28 [gp] = 10008000
                                                                                                                                          [004001120] 00000000c
[00400120] 3402000a
[00400124] 3402000a
[00400128] 0000000c
R30 [s8] = 0
R31 [ra] = 400118
                                                                                                                                                                                                              addi $29, $29, -8
sw $31, 0($29)
                                                                                                                                                                             23bdfff8
                                                                                                                                          [0040012c]
                                                                                                                                                                                                                                                                                                             86: addi $sp, $sp, -8
                                                                                                                                      [00400130] afbf0000
                                                                                                                                                                                                                                                                                                      ; 87: sw $ra, 0($sp)
```

In the first save, the stack pointer is stored in memory address [7ffff18c] and the return address is stored in memory address [00400154], which is the return address of the add operation.

```
Text
[004000f0] 0000000c
[004000f4] 3c011001
[004000f8] 34240058
                                                                                                          [v0] = 0
[v1] = 0
[a0] = 10
                                                                       [00400016] 34240036
[00400016] 34020004
[00400100] 00000006
[00400104] 36011001
                                                                                                                                                         ; 71: li $v0, 4
; 72: syscall
; 74: la $a0, arr #load the array to t0
        [a1] = 4
        [a2] = 7ffff1a8
       [a3] = 0
[t0] = 2
[t1] = 6
                                                                       [00400108] 34240080
                                                                       [00400108] 34240080
[0040010c] 3c011001
[00400110] 8c25007c
[00400114] 0c10004b
                                                                                                                                                          ; 75: lw $a1, n #load n to a1
R10 [t2] = 0
                                                                                                                                                          ; 76: jal SUM #Call the recursive
R10 [t2]
R11 [t3]
R12 [t4]
R13 [t5]
                                                                                                                                                         ; /e: jai SUM #Call the recursive; 78: move $a0, $v0 $move v0 to a0; 79: li $v0, 1 #Print the result; 80: syscall; 82: li $v0, 10; 83: syscall
                                                                       [00400118] 00022021
                                                                                                            addu $4, $0, $2
                                                                       [00400116] 34020001
[00400120] 0000000c
[00400124] 3402000a
[00400128] 0000000c
                                                                                                            ori $2, $0, 1
syscall
ori $2, $0, 10
R14 [t6]
                                                                                                             syscall
                                                                       [0040012c] 23bdfff8
[00400130] afbf0000
                                                                                                             addi $29, $29, -8
                                                                                                                                                          ; 86: addi $sp, $sp, -8
; 87: sw $ra, 0($sp)
R18 [s2]
R19 [s3]
R20 [s4]
R21 [s5]
                                                                                                             ori $2, $0, 0
                                                                                                                                                             90: li $v0, 0 #load 0 to v0. Using v0 as the sum
                                                                        [00400138] 34020000
                                                                       93: lw $t0, 0($a0) #load the element of the array to t0
93: move $s0, $t0 #move t0 to s0
94: addi $a0, $a0, 4 #move to the next element of the array
R22
       [s6]
R23
       [s7]
                                                                                                            addi $4, $4, 4
addi $5, $5, -1
                                                                        [0040014cl 20a5ffff
                                                                                                                                                              95: addi $a1, $a1, -1 #Decrease counter
                                                                       [0040014c] 20a5ffff addi $5, $5, -1 [00400150] 0c10004b jal 0x0040012c [sum] [00400154] 00501020 add $2, $2, $16 [00400158] 8fbf0000 lw $31, 0($29) [00400160] 23bd0008 addi $29, $29, 8 [00400164] 03e00008 jr $31
                                                                                                                                                             96: jal SUM
                                                                                                                                                         ; 97: add $v0, $v0, $
; 100: lw $ra, 0($sp)
; 101: lw $s0, 4($sp)
R27 [k1] = 0
R28 [gp] = 10008000
R29 [sp] = 7ffff18c
R30 [s8] = 0
R31 [ra] = 400154
                                                                                                                                                           ; 102: addi $sp, $sp, 8
                                                                                                                                                                        Kernel Text. Segment. [800000001..[800100001
```

In the second save, the stack pointer is stored in memory address [7ffff184]

```
Int Regs [16]
                                                                                                                                                                            [v0] = 0

[v1] = 0

[a0] = 10010088

[a1] = 3

[a2] = 7ffff1a8
                                                                                                                                                 3c011001
34240058
34020004
0000000c
3c011001
                                                                                                                    [004000£4]
                                                                                                                    [004000£8]
                                                                                                                    [00400108]
                                                                                                                                                 34240080
                                                                                                                    [0040010c]
                                                                                                                                                  3c011001
                                                                                                                    [00400110]
                                                                                                                                                  8c25007c
                                                                                                                                                                                                                                                      ; 76: jal SUM #Call the recursive
; 78: move Sa0, Sv0 #move v0 to a0
; 79: li Sv0, 1 #Print the result
; 80: syscall
; 82: li Sv0, 10
; 83: syscall
; 86: addl Ssp, Ssp, -8
                                                                                                                    [00400114]
                                                                                                                                                  0c10004b
                                                                                                                    [00400114] 0010004B
[00400118] 00022021
[0040011c] 34020001
[00400120] 0000000c
[00400124] 3402000a
R12 [t4] = 0

R13 [t5] = 0

R14 [t6] = 0

R15 [t7] = 0

R16 [s0] = 2

R17 [s1] = 0

R18 [s2] = 0

R20 [s4] = 0

R20 [s4] = 0

R21 [s5] = 0

R22 [s6] = 0

R22 [s6] = 0

R23 [s7] = 0

R24 [t8] = 0

R25 [t9] = 0

R27 [k1] = 0

R27 [k1] = 0

R28 [gp] = 10008000
                                                                                                                    [00400128] 0000000c
[0040012c] 23bdfff8
                                                                                                                                                                               addi $29, $29, -8
                                                                                                                                                                             sw $11, 0($29) ; 87: 8w $ra, 0($59)
sw $16, 4($29) ; 88: sw $20, 4($59)
ori $2, $0, 0 ; 90: li $v0, 0 #load 0 to v0. Using v0 as the sum
beq $5, $0, 28 [EXIT-0x0040013c]
lw $8, 0($4) ; 92: lw $50, 0($a0) #load the element of the array to t0
addu $16, $0, $8 ; 93: move $50, $50 #move t0 to $0
addi $4, $4, 4 ; 94: addi $a0, $a0, 4 #move to the next element of the array
addi $5, $5, -1 ; 95: addi $a1, $a1, -1 #Decrease counter
                                                                                                                    [00400134] afb00004
[00400138] 34020000
[0040013c] 10a00007
[00400140] 8c880000
[00400144] 00088021
                                                                                                                    [00400148] 20840004
                                                                                                                    [0040014c] 20a5ffff
                                                                                                                                                                             addi $5, $5, -1
jal 0x0040012c [SUM]
add $2, $2, $16
lw $31, 0($29)
lw $16, 4($29)
addi $29, $29, 8
jr $31
                                                                                                                                                                                                                                                           95: addi $a1, $a1, -1 #Decrease counter
96: ja1 SUM
97: add $v0, $v0, $s0 #Compute the sum by adding s0 to v0
100: lw $ra, 0($sp)
101: lw $s0, 4($sp)
102: addi $sp, $sp, 8
103: addi $sp, $sp, 8
                                                                                                                    [00400150] 0c10004b
[00400154] 00501020
                                                                                                                   [00400154] 00501020
[00400158] 8fbf0000
[0040015c] 8fb00004
[00400160] 23bd0008
[00400164] 03e00008
  R30 [s8] = 0
R31 [ra] = 400154
                                                                                                                                                                                                                                                        ; 103: jr $ra
                                                                                                                                                                                                                                                                              Kernel Text. Seament. [800000001..[80010000]
```

In the third save, the stack pointer is stored in memory address [7ffff17c]

```
Int Regs [16]
                                                                                                                                  syscall
lui $1, 4097 [printResult]; 70: la $a0, printResult
ori $4, $1, 88 [printResult];
ori $2, $0, 4
; 71: li $v0, 4
syscall
| ; 72: syscall
| lui $1, 4097 [arr] ; 74: la $a0, arr fload the array to t0
ori $4, $1, 128 [arr]
| lui $1, 4097 | ; 75: lw $a1, n fload n to a1
| w $5. 124($1)
        [v0] = 0
[v1] = 0
[a0] = 1001008c
[a1] = 2
                                                                                      [004000f4] 3c011001
[004000f8] 34240058
[004000fc] 34020004
         [a2] = 7fffff1a8
[a3] = 0
[t0] = 0
                                                                                       [00400100] 0000000c
                                                                                      [00400104] 3c011001
[00400108] 34240080
[0040010c] 3c011001
        [t1]
[t2]
[t3]
                                                                                                                                   lw $5, 124($1)
                                                                                       [004001101 8c25007c
                                                                                                                                   iw $5, 124($1)
jal 0x0040012c [SUM]
addu $4, $0, $2
ori $2, $0, 1
syscall
                                                                                                                                                                                           ; 76: jal SUM #Call the recursive
                                                                                       [00400114] 0c10004b
                                                                                                                                                                                          ; 76: jal SUM #Call the recursive
; 78: move $a0, $v0 #move v0 to a0
; 79: li $v0, 1 #Print the result
; 80: syscall
; 82: li $v0, 10
; 83: syscall
; 86: addi $sp, $sp, -8
                                                                                      [00400114] 0010004B
[00400118] 00022021
[0040011c] 34020001
R12 [t4] = 0
 R13 [t5]
R14 [t6]
R15 [t7]
                                                                                      [00400120] 0000000c
                                                                                                                                   ori $2, $0, 10
syscall
addi $29, $29, -8
                                                                                      [00400124] 3402000a
[00400128] 0000000c
[0040012c] 23bdfff8
R16 [s0]
 R17 [s1]
                                                                                                                                                                                       ; 88: sw $50, 4($5p)
; 90: li $v0, 0 #load 0 to v0. Using v0 as the sum
                                                                                       [00400134] afb00004 sw $16, 4($29)
                                                                                                                                  sw $16, 4($29) ; 88: sm

ori $2, $0, 0 ; 90: 11

beq $5, $0, 28 [EXIT-0x0040013c]

lw $8, 0($4) ; 92: ln

addu $16, $0, $8 ; 93: mo

addi $4, $4, 4 ; 94: ac

addi $5, $5, -1 ; 95: ac
                                                                                      [00400134] a1500004
[00400138] 34020000
[0040013c] 10a00007
[00400140] 8c880000
R20 [s4] = 0
R20 [s4]
R21 [s5]
R22 [s6]
R23 [s7]
                                                                                                                                                                                         040013c];
; 92: lw $t0, 0($a0) #load the element of the array to t0;
; 93: move $s0, $t0 #move t0 to s0;
; 94: addi $a0, $a0, 4 #move to the next element of the array;
$5: addi $a1, $a1, -1 #Decrease counter
                                                                                       [00400144] 00088021
                                                                                      [00400144] 00000021
[00400148] 20840004
[0040014c] 20a5ffff
 R24 [t8]
 R25
        [t9]
                                                                                                                                   jal 0x0040012c [SUM]
                                                                                       [00400150] 0c10004b
                                                                                                                                                                                           ; 96: jal SUM
                                                                                                                                  add $2, $2, $16
lw $31, 0($29)
lw $16, 4($29)
                                                                                                                                                                                           , 30. 341 Sv0, $v0, $s0 #Compute the sum by adding s0 to v0 ; 100: lw $ra, 0($sp) ; 101: lw $s0, 4($sp)
                                                                                       [00400154] 00501020
 R27 [k1]
                                                                                      [00400154] 00501020
[00400158] 8fbf0000
[0040015c] 8fb00004
[00400160] 23bd0008
R28 [qp] = 10008000
R30 [s8] = 0
R31 [ra] = 400154
                                                                                                                                   addi $29, $29, 8
                                                                                                                                                                                           ; 102: addi $sp, $sp, 8
                                                                                       [00400164] 03e00008 jr $31
                                                                                                                                                                                           ; 103: jr $ra
                                                                                                                                                                                                            Kernel Text. Seament. [800000001..[80010000]
```

In the fourth save, the stack pointer is stored in memory address [7ffff174]

```
F X Text

[004000f0] 0000000c
[004000f4] 3c011001
         [v0] = 0
        [v1] = 0
[a0] = 10010090
[a1] = 1
[a2] = 7ffff1a8
                                                                                     [004000f81 34240058
                                                                                    [004000E8] 34240058
[004000F6] 34020004
[00400100] 0000000c
[00400104] 3c011001
[00400108] 34240080
[00400106] 3c011001
[00400110] 8c25007c
                                                                                                                                                                                     ; 71: li $v0, 4
; 72: syscall
; 74: la $a0, arr #load the array to t0
        [a3] = 0
[t0] = 5
[t1] = 6
                                                                                                                                                                                      ; 75: 1w $a1, n #load n to a1
R9 [t1] = 6
R10 [t2] = 0
                                                                                   [00400114] UCL.

[00400118] 00022021 adm.

[00400112] 340220001 ori $2, $0, 1

[00400124] 34022000 ori $2, $0, 10

syscall ori $2, $0, 10

syscall addi $29, $29, -8

$31, 0($25) $259
                                                                                                                                                                                      ; 76: jal SUM #Call the recursive
                                                                                                                                                                                     ; 78: move $a0, $v0 #move v0 to a0; 79: li $v0, 1 #Print the result; 80: sysoall; 82: li $v0, 10
R13 [t5] = 0
R14 [t6]
R15 [t7]
R16 [s0]
                                                                                                                                                                                      ; 83: syscall
; 86: addi $sp,
R17 [s1]
R18 [s2]
R19 [s3]
R20 [s4]
                                                                                                                                                                                     ; 88: Sw $s0, 4($sp)
; 90: li $v0, 0 #load 0 to v0. Using v0 as the sum
                                                                                                                              sw $16, 4($29) ; 88: sr

ori $2, $0, 0 ; 90: 1.

beq $5, $0, 28 [EXIT-0x0040013c]

lw $8, 0($4) ; 92: lr

addu $16, $0, $8 ; 93: m

addi $4, $4, 4 ; 94: ac

addi $5, $5, -1 ; 95: ac
                                                                                    [00400134] alb00004
[00400138] 34020000
[0040013c] 10a00007
[00400140] 8c880000
R21 [s5] = 0
                                                                                                                                                                                    040013c];
; 92: lw st0, 0($a0) #load the element of the array to t0;
; 93: move $s0, $t0 #move t0 to s0;
; 94: addi $a0, $a0, 4 #move to the next element of the array;
$5: addi $a1, $a1, -1 #Decrease counter;
R22 [s6]
R23 [s7]
R24 [t8]
                                                                                     [00400144] 00088021
                                                                                    [00400144] 00000021
[00400148] 20840004
[0040014c] 20a5ffff
[00400150] 0c10004b
R25 [t.9] = 0
R26 [k0]
R27 [k1]
                                                                                                                               ial 0x0040012c [SUM]
                                                                                                                                                                                      ; 96: ial SUM
                                                                                                                                                                                     ; 96: jal 5000
; 97: add 5v0, 5v0, $s0 #Compute the sum by adding s0 to v0
; 100: lw $ra, 0($sp)
; 101: lw $s0, 4($sp)
                                                                                    [00400154] 00501020
[00400158] 8fbf0000
[0040015c] 8fb00004
                                                                                                                               add $2, $2, $16
lw $31, 0($29)
lw $16, 4($29)
R28 [gp] = 10008000
R30 [s8] = 0
R31 [ra] = 400154
                                                                                     [00400160] 23bd0008
                                                                                                                                addi $29, $29, 8
                                                                                                                                                                                      ; 102: addi $sp, $sp, 8
                                                                                                                                                                                      ; 103: jr $ra
                                                                                     [00400164] 03e00008 jr $31
```

In the fifth save, the stack pointer is stored in memory address [7ffff16c]

```
syscall
lui $1, 4097 [printResult]; 70: la $a0, printResult
ori $4, $1, 88 [printResult]
ori $2, $0, 4 ; 71: li $v0, 4
syscall
lui $1, 6000
                                                                                                                 Text [004000f0] 0000000c [004000f4] 3c011001 [004000f8] 34240058
           [v0] = 0

[v1] = 0

[a0] = 10010094

[a1] = 0

[a2] = 7ffff1a8
 R2
                                                                                                         •
                                                                                                                                                                                                                                                         111;
; 71: li $v0, 4
; 72: syscall
; 74: la $a0, arr #load the array to t0
                                                                                                                    [004000fc] 34020004
[00400100] 0000000c
[00400104] 3c011001
                                                                                                                                                                               syscall
lui $1, 4097 [arr]
ori $4, $1, 128 [arr]
lui $1, 4097
lw $5, 124($1)
jal 0x0040012c [SUM]
 R7 [a3] = 0
R8 [t0] = 6
R9 [t1] = 6
R10 [t2] = 0
                                                                                                                    [00400108] 34240080
                                                                                                                    [00400106] 34240080
[00400106] 3c011001
[00400110] 8c25007c
[00400114] 0c10004b
[00400118] 00022021
                                                                                                                                                                                                                                                        ; 75: lw $a1, n #load n to a1
                                                                                                                                                                                                                                                        ; 76: jal SUM #Call the recursive
                                                                                                                                                                               addu $4, $0, $2
ori $2, $0, 1
syscall
                                                                                                                                                                                                                                                         , 78: move $a0, $v0 #move v0 to a0; 79: li $v0, 1 #Print the result; 80: syscall; 82: li $v0, 10
                                                                                                                    [0040011c] 34020001
[00400120] 0000000c
[00400124] 3402000a
  R14 [t6] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 6
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
R22 [s6] = 0
                                                                                                                                                                               ori $2, $0, 10
                                                                                                                                                                                                                                                        ; 82: 11 $V0, 10;

; 83: syscall

; 86: addi $sp, $sp, -8;

; 87: sw $ra, 0($sp)

; 88: sw $ra0, 4($sp)

; 90: li $v0, 0 #load 0 to v0. Using v0 as the sum
                                                                                                                                                                               syscall
addi $29, $29, -8
sw $31, 0($29)
sw $16, 4($29)
                                                                                                                    [00400128] 0000000c
[0040012c] 23bdfff8
[00400130] afbf0000
[00400134] afb00004
                                                                                                                                                                               ori $2, $0, 0 ; 90: 1.
beq $5, $0, 28 [EXIT-0x0040013c]
lw $8, 0($4) ; 92: 1:
addu $16, $0, $8 ; 93: me
                                                                                                                     [00400138] 34020000
                                                                                                                    [0040013c] 10a00007
[00400140] 8c880000
[00400144] 00088021
                                                                                                                                                                                                                                                        ; 92: lw $t0, 0($a0) #load the element of the array to t0
                                                                                                                                                                                                                                                        ; 92: IN StU, 0($40) #108d the element of the array to to 

; 93: move $50, $t0 #move to to 50 

; 94: addi $a0, $a0, 4 #move to the next element of the array 

; 95: addi $a1, $a1, -1 #Decrease counter 

; 96: ja1 SUM 

; 97: add $v0, $v0, $s0 #Compute the sum by adding s0 to v0
                                                                                                                   [00400144] 00088021
[0040014e] 2085ffff
[00400150] 0c10004b
[00400154] 00501020
[00400158] 8fbf0000
[00400156] 8fb00004
[00400160] 23bd0008
[00400164] 03e00008
                                                                                                                                                                                addi $4, $4, 4
addi $5, $5, -1
                                                                                                                                                                              addi $5, $5, -1
jal 0x0040012c [SUM]
add $2, $2, $16
lw $31, 0($29)
lw $16, 4($29)
  R26 [k0] = 0
 R26 [k0] = 0
R27 [k1] = 0
R28 [gp] = 10008000
R29 [sp] = 7ffff16c
R30 [s8] = 0
R31 [ra] = 400154
                                                                                                                                                                                                                                                        ; 100: lw $ra, O($sp)
; 101: lw $so, 4($sp)
; 102: addi $sp, $sp, 8
; 103: jr $ra
                                                                                                                                                                               jr $31
```

Now using all the value contain in the stack. The stack pointer is stored back to memory address [7ffff174]

```
egs(16)
[v0] = 0
[v1] = 0
[a0] = 10010094
[a1] = 0
[a2] = 7ffff1a8
[a3] = 0
[t0] = 6
[t1] = 6
                                                                                                                                                    ori $2, $0, 4 ; 67: li $v0, 4

syscall ; 68: syscall

lui $1, 4097 [printResult]; 70: la $a0, printResult
                                                                                                  [004000f4]
                                                                                                                            3c011001
                                                                                                                                                    lui $1, 4097 [printkesuit], /v. la vov, r-
ori $4, $1, 88 [printResult]
ori $2, $0, 4 ; 71: 1i $v0, 4

syscall ; 72: syscall
lui $1, 4097 [arr] ; 74: la $a0, arr #load the array to t0
                                                                                                  [004000f8]
                                                                                                                            34240058
                                                                                                                                                  [004000fc] 34020004
[00400100] 0000000c
[00400104] 3c011001
[00400108] 34240080
           [t2] = 0
[t3] = 0
[t4] = 0
[t5] = 0
 R10
                                                                                                                                                                                                                  : 75: 1w Sal. n #load n to al
                                                                                                  [0040010c1
                                                                                                                            3c011001
8c25007c
                                                                                                   [00400110]
                                                                                                  [00400114] 0c10004b
[00400118] 00022021
[0040011c] 34020001
                                                                                                                                                                                                                  ; 76: jal SUM #Call the recursive
; 78: move $a0, $v0 #move v0 to a0
; 79: li $v0, 1 #Print the result
R13 [t5] = 0

R14 [t6] = 0

R15 [t7] = 0

R16 [s0] = 6

R17 [s1] = 0

R18 [s2] = 0

R29 [s3] = 0

R20 [s4] = 0

R21 [s5] = 0

R22 [s6] = 0

R23 [s7] = 0

R24 [t8] = 0
                                                                                                  [00400120]
                                                                                                                                                                                                                   ; 80: syscall
; 82: li $v0, 10
                                                                                                  [00400124] 3402000a
                                                                                                 [00400124] 3402000a
[00400128] 0000000c
[0040012c] 23bdfff8
[00400130] afbf0000
[00400134] afb00004
[00400138] 34020000
                                                                                                                                                                                                                  ; 82: 11 $v0, 10
; 83: syscall
; 86: addi $sp, $sp, -8
; 87: sw $ra, 0($sp)
; 88: sw $s0, 4($sp)
; 90: 11 $v0, 0 #load 0 to v0. Using v0 as the sum
                                                                                                   [0040013c1
                                                                                                                                                                                                                  040013c]; 92: lw $t0, 0($a0) #load the element of the array to t0; 93: move $s0, $t0 #move t0 to $0; 93: move $s0, $t0 #move t0 to s0; 94: addi $a0, $a0, 4 #move to the next element of the array; 95: addi $a1, $a1, -1 #Decrease counter
                                                                                                  [00400132] 10400007
[00400140] 8c880000
[00400144] 00088021
[00400148] 20840004
 R24 [t8] = 0
 R25 [t9] = 0
 R26 [k0] = 0
                                                                                                  [0040014c] 20a5ffff
                                                                                                  [00400150] 0c10004b jal 0x0040012c [sum] 
[00400154] 00501020 add $2, $2, $16 
[00400156] 8fb00004 lw $1, 0($29)
                                                                                                                                                                                                                   , 30: addited; , 401, 1; pectrase Counter; 96: jal SUM; 97: add $v0, $v0, $s0 #Compute the sum by adding $0 to $v0; 100: lw $ra, $0($sp); 101: lw $s0, $4($sp)
 R28 [gp] = 10008000
R30 [s8] = 0
R31 [ra] = 400154
                                                                                                                                                      addi $29, $29,
                                                                                                   [00400160]
                                                                                                                            23bd0008
                                                                                                                                                                                                                        102: addi $sp, $sp, 8
103: jr $ra
```

After the add operation, the stack pointer is stored back to memory address [7ffff17c]

```
Int Regs [16]
                                                                                                  ₽ × Text
                                                                                                        [004000ec] 34020004 ori $2, $0, 4 ; 67: li $v0, 4 [004000f0] 0000000c syscall ; 68: syscall [004000f4] 3c011001 lui $1, 4097 [printResult]; 70: la $a0, printResult
            [\mathbf{v}0] = 6[\mathbf{v}1] = 0
           [a0] = 10010094
[a1] = 0
[a2] = 7ffff1a8
                                                                                                                                                                               Iui $1, 4037 [printresuit] ... a ..., printresuit] ori $4, $1, 86 [printresuit] ori $2, $0, 4 ; 71: 1i $v0, 4 syscall ; 72: syscall lui $1, 4097 [arr] ; 74: la $a0, arr #load the array to t0
                                                                                                                    [004000f8] 34240058
[004000fc] 34020004
[00400100] 0000000c
           [a1] = 0

[a2] = 7fffff1a8

[a3] = 0

[t0] = 6
                                                                                                                                                                               syscall
lui $1, 4097 [arr]
ori $4, $1, 128 [arr]
lui $1, 4097
lw $5, 124($1)
                                                                                                                   [00400104] 3c011001
[00400108] 34240080
[0040010c] 3c011001
[00400110] 8c25007c
                                                                                                                                                                                                                                                          ; 75: lw $a1, n #load n to a1
           [t3] = 0
[t4] = 0
R11
R12
                                                                                                                   [00400114] 0c10004b
[00400118] 00022021
[0040011c] 34020001
[00400120] 0000000c
                                                                                                                                                                                                                                                          ; 76: jal SUM #Call the recursive
                                                                                                                                                                                jal 0x0040012c [SUM]
                                                                                                                                                                                                                                                        ; 76: jal SUM #Call the recursive

; 78: move $a0, $v0 #move v0 to a0

; 79: li $v0, 1 #Print the result

; 80: syscall

; 82: li $v0, 10

; 83: syscall

; 86: addi $sp, $sp, -8

; 87: sw $ra, 0($sp)

; 88: sw $ra, 0($sp)

; 90: li $v0, 0 #load 0 to v0. Using v0 as the sum

040013c]
           [t5]
[t6]
                                                                                                                                                                                addu $4, $0, $2
ori $2, $0, 1
syscall
                                                                                                                                                                             uri $z, $v, 1 ; 79: li $v0, 1 #Print the result
syscall ; 80: syscall
ori $2, $0, 10 ; 82: li $v0, 10
syscall
addi $29, $29, -8 ; 86: addi $sp, $sp, -8
sw $31, 0($29) ; 87: sw $ra, 0($sp)
sw $16, 4($29) ; 88: sw $ra, 0($sp)
ori $2, $0, 0 ; 90: li $v0, 0 #load 0 to v0. Using v0 as the sum
beq $5, $0, 28 [EXIT-0x0040013c]
lw $8, 0($4) ; 92: lw $t0, 0($a0) #load the element of the array to t0
addi $4, $0, $8 ; 93: move $s0, $t0 #move t0 to s0
addi $4, $4, 4 ; 94: addi $a0, $a0, 4 #move to the next element of the array
addi $5, $5, -1 ; 95: addi $a1, $a1, -1 #Decrease counter
jal 0x0040012c [SUM] ; 96: jal $U0.
R15 [t7]
                                                                                                                  [00400120] 00000000
[00400124] 3402000a
[00400128] 00000000
[00400120] 23bdfff8
[00400130] afbf0000
[00400134] afb0000
[00400133] 3402000
[00400136] 10a00007
[00400140] 8c880000
[00400144] 00088021
R16 [s0]
R17 [s1]
R18 [s2]
R19 [s3] = 0
R20 [s4] =
R21 [s5] =
R22 [s6] =
R23 [s71 =
                                                                                                                   [00400148] 20840004
[0040014c] 20a5ffff
R26 [k0] = 0
R27 [k1] = 0
                                                                                                                                                                                                                                                          ; 96: jal SUM
; 97: add $v0, $v0, $s0 #Compute the sum by adding s0 to v0
; 100: lw $ra, 0($sp)
; 101: lw $s0, 4($sp)
                                                                                                                   [004001501 0c10004b
R28 [gp] = 10008000
                                                                                                                   [00400154] 00501020
[00400158] 8fbf0000
[0040015c] 8fb00004
                                                                                                                                                                              add $2, $2, $16
lw $31, 0($29)
lw $16, 4($29)
R29 [sp] = 7ffff1'
R30 [s8] = 0
R31 [ra] = 400154
                                                                                                                      004001601 23bd0008
                                                                                                                                                                                addi $29, $29,
                                                                                                                                                                                                                                                               102: addi $sp, $sp,
103: jr $ra
```

After the add operation, the stack pointer is stored back to memory address [7ffff184]

```
[v0] = b

[v1] = 0

[a0] = 10010094

[a1] = 0

[a2] = 7ffff1a8

[a3] = 0

[t0] = 6
                                                                                                                                                                                                                ori $2, $0, 4 ; 67: li $v0, 4

syscall ; 68: syscall

lui $1, 4097 [printResult]; 70: la $a0, printResult
                                                                                                                                       [004000ec] 34020004
[004000f0] 0000000c
                                                                                                                                         [004000f4] 3c011001
[004000f8] 34240058
                                                                                                                                       [00400014] 3c011001
[00400018] 34240058
[00400016] 34240058
[00400104] 3c011001
[00400104] 3c011001
[00400106] 3c011001
[00400110] 8c25007c
[00400110] 8c25007c
[00400110] 3c02021
[00400110] 3d020001
[00400110] 0c880010
[00400110] 0c100014
                                                                                                                                                                                                               Ini 31, 4097 [printkesult] 70: 1a 3a0, F ori $4, $1, 88 [printkesult] ori $2, $0, 4 syscall ; 72: syscall lui $1, 4097 [arr] ; 74: la $a0, az ori $4, $1, 128 [arr] lui $1, 4097 ; 75: lw $a1, n
                                                                                                                                                                                                                                                                                                        ; 71: 1i $v0, 4
; 72: syscall
; 74: la $a0, arr #load the array to t0
               [t1] =
 R10
              [t2] = 0
                                                                                                                                                                                                                                                                                                        ; 75: lw $a1, n #load n to a1
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
                                                                                                                                                                                                              lui $1, 4097
lw $5, 124($1)
jal 0x0040012c [SUM]
addu $4, $0, $2
ori $2, $0, 1
syscal1
ori $2, $0, 10
syscal1
                                                                                                                                                                                                                                                                                                       ; 76: jal SUM #Call the recursive
; 78: move $a0, $v0 #move v0 to a0
; 79: li $v0, 1 #Print the result
; 80: syscall
; 82: li $v0, 10
R16 [s0] =
R17 [s1] =
R18 [s2] =
R19 [s3] =
R20 [s4] =
R21 [s5] =
R22 [s6] =
                                                                                                                                                                                                              syscall
addi $29, $29, -8
                                                                                                                                                                                                                                                                                                         ; 83: syscall
 R23 [s7] = 0

R24 [t8] = 0
 R28 [gp] = 10008000
 R30 [s8] = 0
R31 [ra] = 400154
                                                                                                                                                                                                                  addi $29, $29, 8
                                                                                                                                                                                                                                                                                                                                addi $sp, $sp, 8
                                                                                                                                        [004001641 03e00008
                                                                                                                                                                                                                jr $31
                                                                                                                                                                                                                                                                                                         ; 103: jr $ra
```

After the add operation, the stack pointer is stored back to memory address [7ffff18c]

```
Int Regs [16]
                                                                                       ygs [16]

[v0] = b

[v1] = 0

[a0] = 10010094

[a1] = 0

[a2] = 7ffff1a8

[a3] = 0

[t0] = 6

[t1] = 6

[t2] = 0
                                                                                             [004000ec] 34020004
[004000f0] 0000000c
                                                                                                                                                           ori $2, $0, 4 ; 67: li $v0, 4

syscall ; 68: syscall

lui $1, 4097 [printResult]; 70: la $a0, printResult

ori $4, $1, 88 [printResult]

ori $2, $0, 4 ; 71: li $v0, 4

syscall ; 72: syscall

lui $1, 4097 [arr] ; 74: la $a0, arr $load the array to t0

ori $4, $1, 128 [arr]
                                                                                                       [004000f4] 3c011001
[004000f8] 34240058
[004000fc] 34020004
                                                                                                                                                           ori $2, $0, 4
syscall
lui $1, 4097 [arr]
ori $4, $1, 128 [arr]
lui $1, 4097
lw $5, 124($1)
jal 0x0040012c [SUM]
addu $4, $0, $2
ori $2, $0, 1
syscall
ori $2, $0, 10
                                                                                                       [004001001
                                                                                                                                  0000000c
                                                                                                       [00400104] 3c011001
                                                                                                       [00400104] 3c011001
[00400108] 34240080
[0040010c] 3c011001
[00400110] 8c25007c
            [t2] =
                                                                                                                                                                                                                             ; 75: lw $a1, n #load n to a1
 R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
                                                                                                                                                                                                                            ; 76: jal SUM #Call the recursive
; 78: move $a0, $v0 #move v0 to a:
; 79: li $v0, 1 #Print the result
                                                                                                       [004001141
                                                                                                                                  0c10004b
                                                                                                       [00400114] 0610004B
[00400118] 00022021
[0040011c] 34020001
[00400120] 0000000c
 R15 [t7] = 0
R15 [t7] = 0

R16 [s0] = 2

R17 [s1] = 0

R18 [s2] = 0

R19 [s3] = 0

R20 [s4] = 0

R21 [s5] = 0

R22 [s6] = 0

R23 [s7] = 0
                                                                                                                                                                                                                             ; 80: syscall
; 82: li $v0, 10
                                                                                                                                                           syscall
ori $2, $0, 10
syscall
addi $29, $29, -8
sw $31, 0($29)
sw $16, 4($29)
                                                                                                       [00400124] 3402000a
                                                                                                     [00400124] 3402000a
[00400128] 0000000c
[0040012c] 23bdfff8
[00400130] afbf0000
[00400134] afb00004
[00400138] 34020000
                                                                                                                                                                                                                            ; 82: 11 5v0, 10
; 83: syscall
; 86: addi $sp, $sp, -8
; 87: sw $ra, 0 ($sp)
; 88: sw $s0, 4($sp)
; 90: li $v0, 0 #load 0 to v0. Using v0 as the sum
                                                                                                                                                          [0040013c] 10a00007
[00400140] 8c880000
[00400144] 00088021
 R24 [t8] = 0
 R25 [t91 = 0]
                                                                                                       [00400148] 20840004
 R26 [k0] = 0
R27 [k1] = 0
                                                                                                       [0040014c] 20a5ffff
                                                                                                                                                          addi $5, $5, -1
jal 0x0040012c [SUM]
add $2, $2, $16
lw $31, 0($29)
lw $16, 4($29)
addi $29, $29, 8
                                                                                                      [00400146] 20a5ffff
[00400150] 0c10004b
[00400154] 00501020
[00400158] 8fbf0000
[0040015c] 8fb00004
                                                                                                                                                                                                                             ; 93: addi val, val, -1 #becrease counter; 96: jal 50M; 96: jal 50M; 97: add 5v0, 5v0, 5s0 #Compute the sum by adding s0 to v0; 100: lw 5re, 0(Ssp); 101: lw 5s0, 4(Ssp)
 R28 [gp] = 10008000
R30 [s8] = 0
R31 [ra] = 400154
                                                                                              [00400160] 23bd0008 addi $:
[00400164] 03e00008 jr $31
                                                                                                                                                                                                                             ; 102: addi $sp, $sp, 8
; 103: jr $ra
```

After the add operation, the stack pointer is stored back to memory address [7ffff194]

```
Int Regs [16]
         [v0] = d
[v1] = 0
[a0] = 10
                                                                                            [004000ec] 34020004
                                                                                                                                            ori $2, $0, 4
                                                                                                                                                                                                       ; 67: li $v0, 4
                                                                                                                                             syscall
                                                                                             [004000f0]
                                                                                                                     00000000
                                                                                                                                                                                                         ; 68: syscall
                                                                                                                                           syscall
lui $1, 4097 [printResult]; 70: la $a0, printResult
ori $4, $1, 88 [printResult]
ori $2, $0, 4 ; 71: li $v0, 4
syscall
lui $1, 4097 [arr] ; 74: la $a0, arr #load the array to t0
ori $4, $1, 128 [arr]
lui $1, 4097 ; 75: lw $a1, n #load n to al
lw $5, 124($1)
                                                                                            [004000f4] 3c011001
[004000f8] 34240058
[004000fc] 34020004
          [a1] =
          [a2] = 7ffff1a8
                                                                                            [004001001 00000000
                                                                                            [00400104] 3c011001
[00400108] 34240080
          [t1]
R10 \text{ [t2]} = 0
                                                                                            [0040010c] 3c011001
R10 [t2]
R11 [t3]
R12 [t4]
R13 [t5]
                                                                                            [004001101 8c25007c
                                                                                                                                                                                                      ; 76: jal SUM #Call the recursive

; 78: move $a0, $v0 #move v0 to a0

; 79: li $v0, 1 #Print the result

; 80: syscall

; 82: li $v0, 10

; 83: syscall

; 86: addi $sp, $sp, -8

; 87: sw $ra, 0($sp)

; 88: sw $s0, 4($sp)

; 90: li $v0, 0 #load 0 to v0. Using v0 as the sum

040013c]
                                                                                                                                           lw $5, 124($1)
jal 0x0040012c [SUM]
addu $4, $0, $2
ori $2, $0, 1
syscall
ori $2, $0, 10
syscall
addi $29, $29, -8
                                                                                            [00400110] 86230076
[00400114] 0c10004b
[00400118] 00022021
[0040011c] 34020001
 R14 [t6]
R15 [t7]
R16 [s0]
R17 [s1]
                                                                                            [004001201 00000000c
                                                                                            [00400120] 00000008
[00400124] 3402000a
[00400128] 0000000c
[0040012c] 23bdfff8
 R18 [s2]
                                                                                                                                            addi $29, $29, -8
R19 [s3]
R20 [s4]
R21 [s5]
                                                                                                                                            sw $31, 0($29) ; 87: ss
sw $16, 4($29) ; 88: ss
ori $2, $0, 0 ; 90: li
beq $5, $0, 28 [EXIT-0x0040013c]
                                                                                            [00400130] afbf0000
                                                                                            [00400134] afb00004
[00400138] 34020000
[0040013c] 10a00007
 R22 [s6]
R23 [s7]
R24 [t8]
R25 [t9]
                                                                                                                                                                                                      040013c]; $2: IW $50, 0($a0) #load the element of the array to t0; $3: move $50, $10 #move t0 to $0; $4: addi $a0, $a0, $4 #move to the next element of the array; $5: addi $a1, $a1, -1 #Pecrease counter
                                                                                                                                            lw $8, 0($4)
addu $16, $0, $8
addi $4, $4, 4
addi $5, $5, -1
                                                                                            [00400140] 8c880000
                                                                                            [00400144] 00088021
[00400148] 20840004
[0040014c] 20a5ffff
 R26 [k0] = 0
 R27 [k1] = 0
                                                                                                                                            jal 0x0040012c [SUM]
add $2, $2, $16
lw $31, 0($29)
lw $16, 4($29)
                                                                                                                                                                                                       , 36: 341 SUM
; 96: 341 SUM
; 97: add $v0, $v0, $s0 #Compute the sum by adding s0 to v0
; 100: lw $ra, 0($sp)
; 101: lw $s0, 4($sp)
                                                                                            [00400150] 0c10004b
 R28 [gp]
                                                                                            [00400154] 00501020
                                                                                            [00400158] 8fbf0000
[0040015c] 8fb00004
R30 [s8] = 0
R31 [ra] = 400154
                                                                                             [004001601
                                                                                                                    23bd0008
                                                                                                                                            addi $29, $29, 8
                                                                                                                                                                                                           102: addi $sp, $sp,
                                                                                     ▼ [00400164] 03e00008
```

After the add operation, the stack pointer is stored back to memory address [7ffff19c] and the return address is stored back to memory address [00400118] as callee of the main function.

```
Int Regs [16]
                                                                                                                                                                                                                                                                ori $2, $0, 4 ; 67: li $v0, 4

syscall
lui $1, 4097 [printResult]; 70: la $a0, printResult
ori $4, $1, 88 [printResult]
ori $2, $0, 4 ; 71: li $v0, 4

syscall
lui $1, 4097 [arr] ; 74: la $a0, arr #load the array to t0
ori $4, $1, 128 [arr]
lui $1, 4097 ; 75: lw $a1, n #load n to a1
lw $5, 124($1)
lal 0x00400120 [SUM] ; 76: lal SUM #Call the recursive
                 [v0] = f
[v1] = 0
                                                                                                                                                           1 [004000ec] 34020004
                                                                                                                                                                           [004000f01 0000000c
                  [a0] = 10010094
[a1] = 0
                                                                                                                                                                           [004000f41 3c011001
                  [a1] = 0
[a2] = 7ffff1a8
                                                                                                                                                                          [00400014] 38011001
[00400018] 34240058
[00400016] 34020004
[00400100] 00000006
                  [a3] = 0
[t0] = 6
[t1] = 6
                                                                                                                                                                           [00400104] 3c011001
 R9 [t1] = 6
R10 [t2] = 0
R11 [t3] = 0
                                                                                                                                                                          [00400104] 38011001
[00400108] 34240080
[0040010c] 36011001
[00400110] 8625007c
 R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
                                                                                                                                                                                                                                                                   iw $3, 124($1)
jal 0x0040012c [SUM]
addu $4, $0, $2
ori $2, $0, 1
syscall
                                                                                                                                                                                                                                                                                                                                                                              ; 76: jal SUM #Call the recursive
; 78: move $a0, $v0 #move v0 to au
; 79: li $v0, 1 #Print the result
; 80: syscall
                                                                                                                                                                           [004001141 0c10004b
                                                                                                                                                                           [00400114] 0010004B
[00400118] 00022021
[0040011c] 34020001
[00400120] 0000000c
                                                                                                                                                        [0040011c] 34020001 ori $2, $0, 1 ; 79: 11 $v0, 1 #Print the result
[0040012d] 0000000c syscall ; 80: syscall
[0040012d] 3402000a ori $2, $0, 10 ; 82: 1i $v0, 10
[0040012d] 3402000a ori $2, $0, 10 ; 82: 1i $v0, 10
[0040012d] 25bdffff addi $29, $29, -8 ; 86: addi $29, $29, -8
[00400130] afbf0000 sw $31, 0($29) ; 87: sw $ra, 0($sp)
[0040013d] afb00004 sw $16, 4($29) ; 88: sw $ra, 0($sp)
[0040013d] 34020000 ori $2, $0, 0 ; 90: 1i $v0, 0 #load 0 to v0. Using v0 as the sum
[0040013d] 10a00007 beq $5, $0, 28 [EXIT-0x0040013c]
[0040014d] 8c880000 lw $8, 0($4) ; 92: lw $t0, 0($a0) #load the element of the array to t0
[0040014d] 00088021 addu $16, $0, $8 ; 93: move $s0, $t0 #move t0 to s0
[0040014d] 20a5ffff addi $4, $4, 4 ; 94: addi $a0, $a0, 4 #move to the next element of the array
[0040014c] 20a5ffff addi $5, $5, -1 ; 95: addi $a1, $a1, -1 #Decrease counter
[00400150] 0c10004b ja1 0x0040012c [SUM] ; 96: ja1 SUM
[00400150] 0c10004b ja1 0x0040012c [SUM] ; 97: add $v0, $v0, $v0, $v0 #compute the sum by adding s0 to v0
[00400150] 8fbf0000 lw $16, 4($29) ; 100: lw $ra, 0($sp)
[00400150] 23bd0008 addi $29, $29, 8 ; 102: addi $sp, $sp, 8
[0040016d] 03e00008 jr $31 ; 103: jr $ra
  R15 [t7]
 R16 [s0]
R17 [s1]
R18 [s2]
  R19 [s3] = 0
 R20 [s4]
R21 [s5]
R22 [s6]
  R23 [s7]
R24 [t8]
  R27 [k1] =
 R28 [gp] = 10008000
R29 [sp] = 7ffff194
R30 [s8] = 0
```

```
X Text

[004000ec] 34020004 ori $2, $0, 4 ; 67: ii - ...
[004000f0] 0000000c syscall ; 68: syscall
[004000f1] 3c011001 lui $1, 4097 [printResult]; 70: la $a0, printResult
[004000f6] 34020004 ori $4, $1, $8 [printResult]

[004000f6] 34020004 ori $2, $0, 4 ; 71: li $v0, 4
[004000f6] 34020004 ori $2, $0, 4 ; 71: ysycall
[004000f6] 34020004 ori $2, $0, 4 ; 71: li $v0, 4
[004000f6] 34020004 ori $2, $0, 4 ; 71: li $v0, 4
[004000f6] 34020004 ori $2, $0, 4 ; 71: li $v0, 4
[004000f6] 34020004 ori $2, $0, 4 ; 71: li $v0, 4
[004000f6] 34020004 ori $2, $0, 4 ; 71: li $v0, 4
[004000f6] 34020004 ori $2, $0, 4 ; 71: li $v0, 4
[004000f6] 34020004 ori $2, $0, 4 ; 71: li $v0, 4
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: li $v0, 4
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 34020004 ori $2, $0, 4 ; 72: syscall
[004000f6] 3402004 ori $2, $0, 4 ; 72: syscall
[004000f6] 3402004 ori $2, $0, 4 ; 72: syscall
[004000f6] 3402004 ori $2, $0, 4 ; 72: syscall
[004000f6] 3402004 ori $2, $0, 4 ;
                                                                                                                                                                                                                                                                                                           ∄ × Text
Int Regs [16]
                                    [v0] = f
[v1] = 0
[a0] = 10010094
[a1] = 0
                                    [a2] = 7ffff1a8
[a3] = 0
[t0] = 6
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  O ori $4, $1, 128 [arr]

1 lui $1, 4097

1 lui $1, 4097

1 lui $1, 4097

2 lw $5, 124($1)

5 jal 0x0040012c [SUM]

5 jal 0x0040012c [SUM]

1 cri $2, $0, 1

2 cri $2, $0, 1

3 cri $2, $0, 10

3 cri $2, $0, 0

4 cri $2, $0, 0

4 cri $2, $0, 0

5 cri $2, $0
                                         [t1] =
  R10
                                    [t2] = 0
                                    [t3]
[t4]
[t5]
                                                                                                                                                                                                                                                                                                                                                                 [00400114] 0c10004b
[00400118] 00022021
[0040011c] 34020001
  R14 [t6] = 0
  R15 [t7] = 0
                                                                                                                                                                                                                                                                                                                                                               [00400120]
                                                                                                                                                                                                                                                                                                                                                                                                                                                             0000000c
                                                                                                                                                                                                                                                                                                                                                               [004001241 3402000a
                                                                                                                                                                                                                                                                                                                                                               [00400124] 3402000a
[0040012c] 23bdfff8
[0040013c] afbf0000
[0040013d] afb00004
[0040013d] afb00004
[0040013c] 10a00007
[0040014d] 80880000
[0040014d] 80880000
  R18 [s2]
  R19 [s3] = 0
  R23 [s7] = 0

R24 [t8] = 0
                                                                                                                                                                                                                                                                                                                                                                 [00400144] 00088021
  R25
R26
R27
                                                                                                                                                                                                                                                                                                                                                                 [00400148] 20840004
                                                                                                                                                                                                                                                                                                                                                                    [0040014c] 20a40004
[0040014c] 20a5ffff
[00400150] 0c10004b
[00400154] 00501020
                                       [k1] =
  R28 [gp] = 10008000
R29 [sp] = 7ffff19c
                                                                                                                                                                                                                                                                                                                                                                    [00400158] 8fbf0000
  R30 [s8] = 0
R31 [ra] = 400118
                                                                                                                                                                                                                                                                                                                                                                      0040015cl 8fb00004
```

The register v0 and a0 now contain the result

```
| Interpretation | Inte
```