Name: Phan Trần Thanh Huy

ID: ITCSIU22056

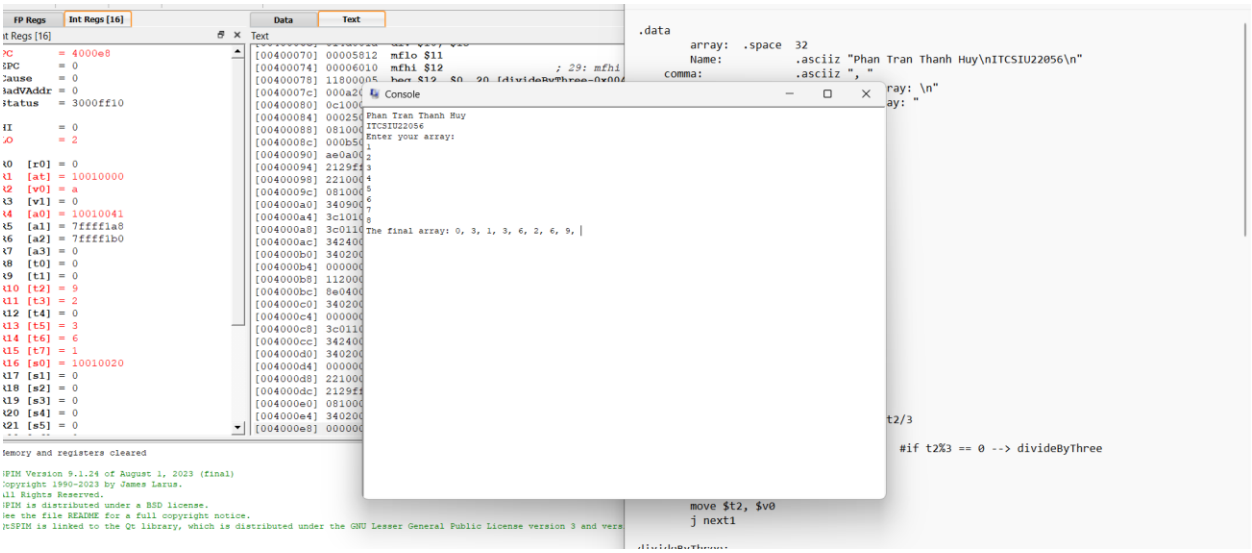
Lab 10

Exercise 1:

Code:

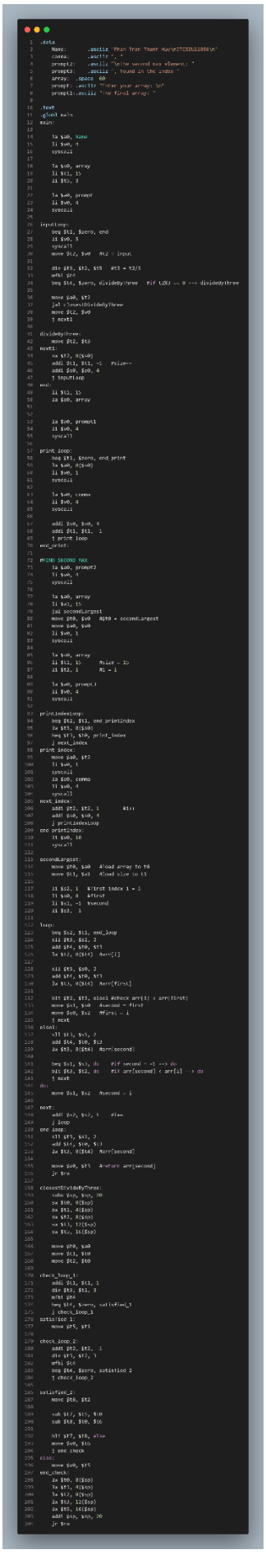
```
.data
    array:  .space  32
    Name:       .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
    comma:      .asciiz ", "
    prompt: .asciiz "Enter your array: \n"
    prompt1:.asciiz "The final array: "
.text
.globl main
main:
    la $a0, Name
    li $v0, 4
    syscall

    la $s0, array
    li $t1, 8
    li $t5, 3

    la $a0, prompt
    li $v0, 4
    syscall

loop:
    beq $t1, $zero, end
    li $v0, 5
    syscall
    move $t2, $v0   #t2 = input

    div $t3, $t2, $t5   #t3 = t2/3
    mfhi $t4
    beq $t4, $zero, divideByThree   #if t2%3 == 0 --> divideByThree

    move $a0, $t2
    jal closestDivideByThree
    move $t2, $v0
    j next1

divideByThree:
    move $t2, $t3
next1:
    sw $t2, 0($s0)
    addi $t1, $t1, -1   #size--
    addi $s0, $s0, 4
    j loop
end:
    li $t1, 8
    la $s0, array


    la $a0, prompt1
    li $v0, 4
    syscall

print_loop:
    beq $t1, $zero, end_print
    lw $a0, 0($s0)
    li $v0, 1
    syscall

    la $a0, comma
    li $v0, 4
    syscall

    addi $s0, $s0, 4
    addi $t1, $t1, -1
    j print_loop
end_print:

    li $v0, 10
    syscall

closestDivideByThree:
    subu $sp, $sp, 20
    sw $t0, 0($sp)
    sw $t1, 4($sp)
    sw $t2, 8($sp)
    sw $t3, 12($sp)
    sw $t5, 16($sp)

    move $t0, $a0
    move $t1, $t0
    move $t2, $t0

check_loop_1:
    addi $t1, $t1, 1
    div $t3, $t1, 3
    mfhi $t4
    beq $t4, $zero, satisfied_1
    j check_loop_1
satisfied_1:
    move $t5, $t1

check_loop_2:
    addi $t2, $t2, -1
    div $t3, $t2, 3
    mfhi $t4
    beq $t4, $zero, satisfied_2
    j check_loop_2

satisfied_2:
    move $t6, $t2

    sub $t7, $t5, $t0
    sub $t8, $t0, $t6

    blt $t7, $t8, else
    move $v0, $t6
    j end_check
else:
    move $v0, $t5
end_check:
    lw $t0, 0($sp)
    lw $t1, 4($sp)
    lw $t2, 8($sp)
    lw $t3, 12($sp)
    lw $t5, 16($sp)
    addi $sp, $sp, 20
    jr $ra
```

Test case:

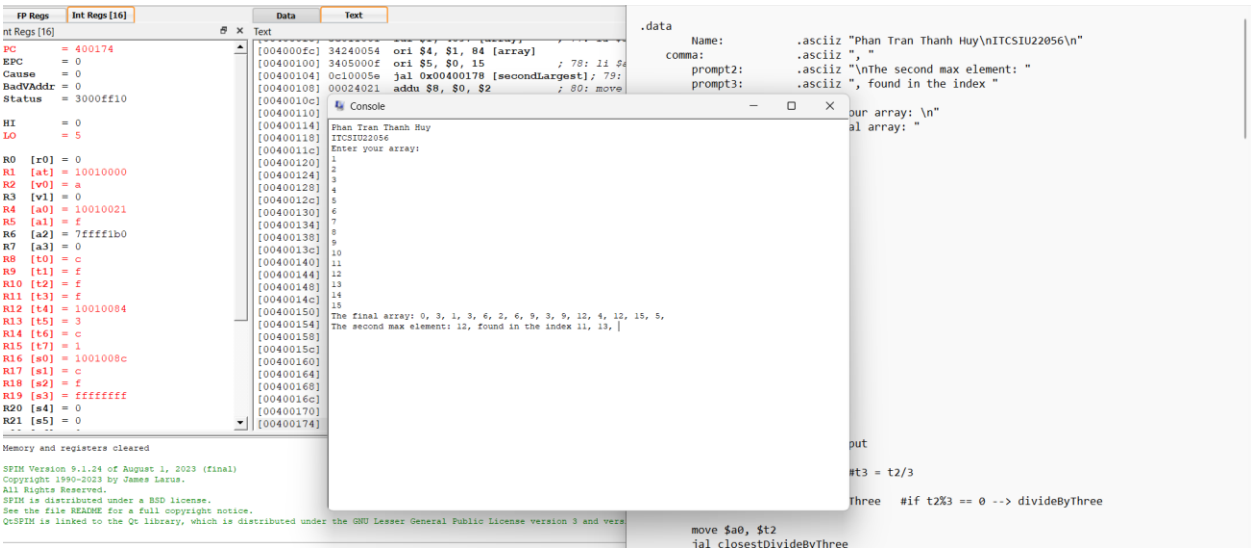

FP Regs
Int Regs [16]
Data
Text
Console
Phan Tran Thanh Huy
ITCSIU22056
Enter your array:
The final array: 0, 3, 1, 3, 6, 2, 6, 9,
.data
array: .space 32
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
comma: .asciiz ", "
#if t2%3 == 0 --> divideByThree
move $t2, $v0
j next1

Exercise 2:

Code:



Test case:


FP Regs
Int Regs [16]
Data
Text
PC = 400174
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 5
R0 [r0] = 0
R1 [at] = 10010000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 10010021
R5 [a1] = f
R6 [a2] = 7fffffb0
R7 [a3] = 0
R8 [t0] = c
R9 [t1] = f
R10 [t2] = f
R11 [t3] = f
R12 [t4] = 10010084
R13 [t5] = 3
R14 [t6] = c
R15 [t7] = 1
R16 [s0] = 1001008c
R17 [s1] = c
R18 [s2] = f
R19 [s3] = ffffffff
R20 [s4] = 0
R21 [s5] = 0
[004000fc] 34240054 ori $4, $1, 84 [array]
[00400100] 3405000f ori $5, $0, 15 ; 78: li $a
[00400104] 0c10005e jal 0x00400178 [secondLargest]; 79:
[00400108] 00024021 addu $8, $0, $2 ; 80: move
Console
Phan Tran Thanh Huy
ITCSIU22056
Enter your array:
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
The final array: 0, 3, 1, 3, 6, 2, 6, 9, 3, 9, 12, 4, 12, 15, 5,
The second max element: 12, found in the index 11, 13,
Memory and registers cleared
SPIM Version 9.1.24 of August 1, 2023 (final)
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See the file README for a full copyright notice.
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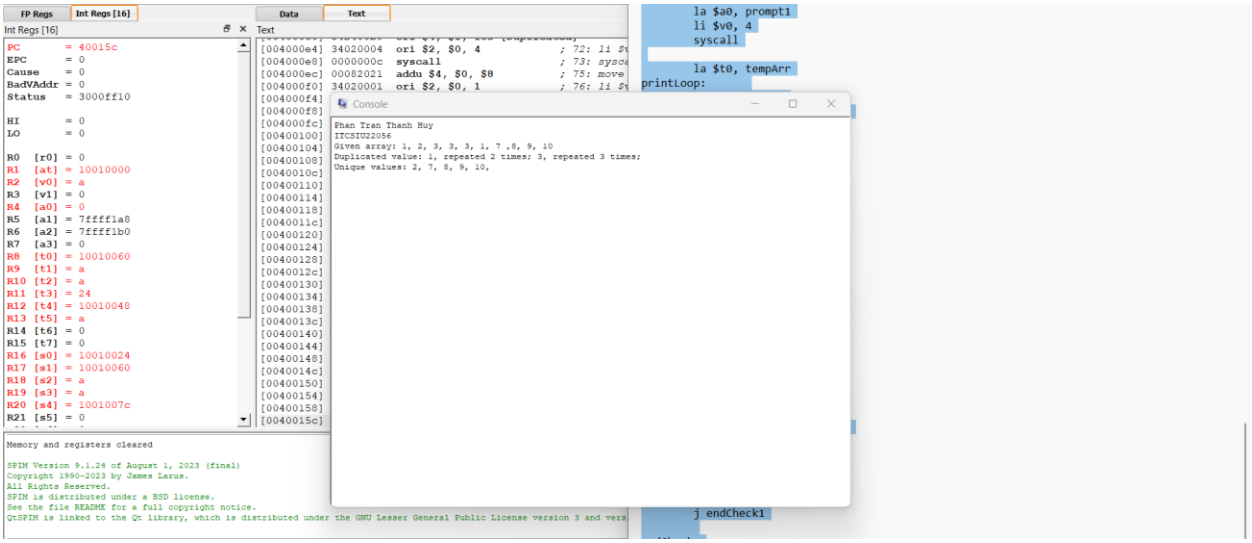
.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
comma: .asciiz ", "
prompt2: .asciiz "\nThe second max element: "
prompt3: .asciiz ", found in the index "
move $a0, $t2
jal closestDivideByThree

Exercise 3:

Code:

```
.data
    Name:   .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
    array:  .word 1, 2, 3, 3, 3, 1, 7 ,8, 9, 10
    tempArr:    .space 40
    duplicateArr:.space 50
    prompt: .asciiz "Duplicated value: "
    Duplicated: .asciiz ", repeated "
    comma1: .asciiz " times; "
    prompt1: .asciiz "\nUnique values: "
    comma : .asciiz ", "
    givenArray: .asciiz "Given array: 1, 2, 3, 3, 3, 1, 7 ,8, 9, 10\n"
.text
.globl main
main:
    la $a0, Name
    li $v0, 4
    syscall
    la $a0, givenArray
    li $v0, 4
    syscall

    la $s0, array
    la $s1, tempArr
    la $s4, duplicateArr

    li $s2, 10  #lastIndex = 9
    li $s3, -1  #i = 0

    la $a0, prompt
    li $v0, 4
    syscall

Loop:
    addi $s3, $s3, 1    #i++
    beq $s3, $s2, endLoop

    sll $t3, $s3, 2
    add $t4, $s0, $t3
    lw $t1, 0($t4)      # t1 = array[i]

    li $t5, 0   #j = 0
    li $t0, 0   #count = 0
    loop2:
    beq $t5, $s2, endSubloop
    sll $t3, $t5, 2
    add $t4, $s0, $t3
    lw $t2, 0($t4)      # t2 = array[j]

    bne $t1, $t2, next2
    addi $t0, $t0, 1    #count++
    next2:
    addi $t5, $t5, 1    #j++
    j loop2

    endSubloop:
    addi $t6, $t0, -1
    beq $t6, $zero, unique      #check count == 1 or not

    move $a0, $t1
    jal checkInsideArray        #check if that value is already in duplicate array or not
    beq $v0, $zero, printDuplicate
    j Loop
printDuplicate:
    sw $t1, 0($s4)
    addi $s4, $s4, 4

    move $a0, $t1
    li $v0, 1
    syscall

    la $a0, Duplicated
    li $v0, 4
    syscall

    move $a0, $t0
    li $v0, 1
    syscall

    la $a0, comma1
    li $v0, 4
    syscall

    j Loop
unique:
    sw $t1, 0($s1)
    addi $s1, $s1, 4
    j Loop
endLoop:

#print unique
    la $a0, prompt1
    li $v0, 4
    syscall

    la $t0, tempArr
printLoop:
    lw $a0, 0($t0)
    beq $a0, $zero, endPrint
    li $v0, 1
    syscall

    la $a0, comma
    li $v0, 4
    syscall

    addi $t0, $t0, 4
    j printLoop
endPrint:
    li $v0, 10
    syscall


checkInsideArray:
    subu $sp, $sp, 4
    sw $s4, 0($sp)

    la $s4, duplicateArr
checkLoop:
    lw $t4, 0($s4)
    beq $t4, $zero, endCheck
    beq $a0, $t4, isContain
    addi $s4, $s4, 4
    j checkLoop
isContain:
    li $v0, 1
    j endCheck1

endCheck:
    li $v0, 0
endCheck1:
    lw $s4, 0($sp)
    addi $sp, $sp, 4
    jr $ra
```

Test case:


FP Regs
Int Regs [16]
Data
Text
Int Regs [16]
PC = 40015c
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 10010000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 0
R5 [a1] = 7fffffa8
R6 [a2] = 7fffffb0
R7 [a3] = 0
R8 [t0] = 10010060
R9 [t1] = a
R10 [t2] = a
R11 [t3] = 24
R12 [t4] = 10010048
R13 [t5] = a
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 10010024
R17 [s1] = 10010060
R18 [s2] = a
R19 [s3] = a
R20 [s4] = 1001007c
R21 [s5] = 0
Text
[004000e4] 34020004 ori $2, $0, 4 ; 72: li $v
[004000e8] 0000000c syscall ; 73: sysca
[004000ec] 00082021 addu $4, $0, $8 ; 75: move
[004000f0] 34020001 ori $2, $0, 1 ; 76: li $v
[004000f4]
[004000f8]
[004000fc]
[00400100]
[00400104]
[00400108]
[0040010c]
[00400110]
[00400114]
[00400118]
[0040011c]
[00400120]
[00400124]
[00400128]
[0040012c]
[00400130]
[00400134]
[00400138]
[0040013c]
[00400140]
[00400144]
[00400148]
[0040014c]
[00400150]
[00400154]
[00400158]
[0040015c]
Console
Phan Tran Thanh Huy
ITCSIU22056
Given array: 1, 2, 3, 3, 3, 1, 7 ,8, 9, 10
Duplicated value: 1, repeated 2 times; 3, repeated 3 times;
Unique values: 2, 7, 8, 9, 10,
Memory and registers cleared
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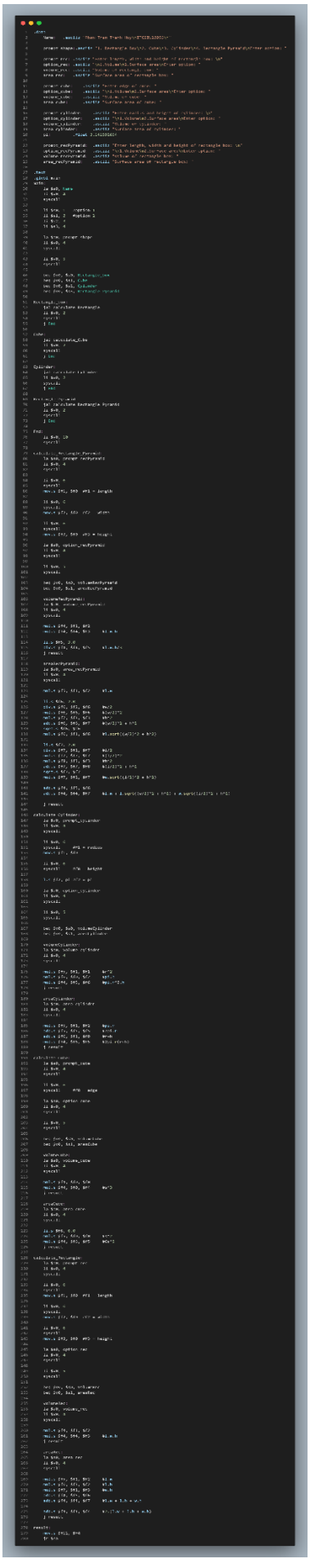
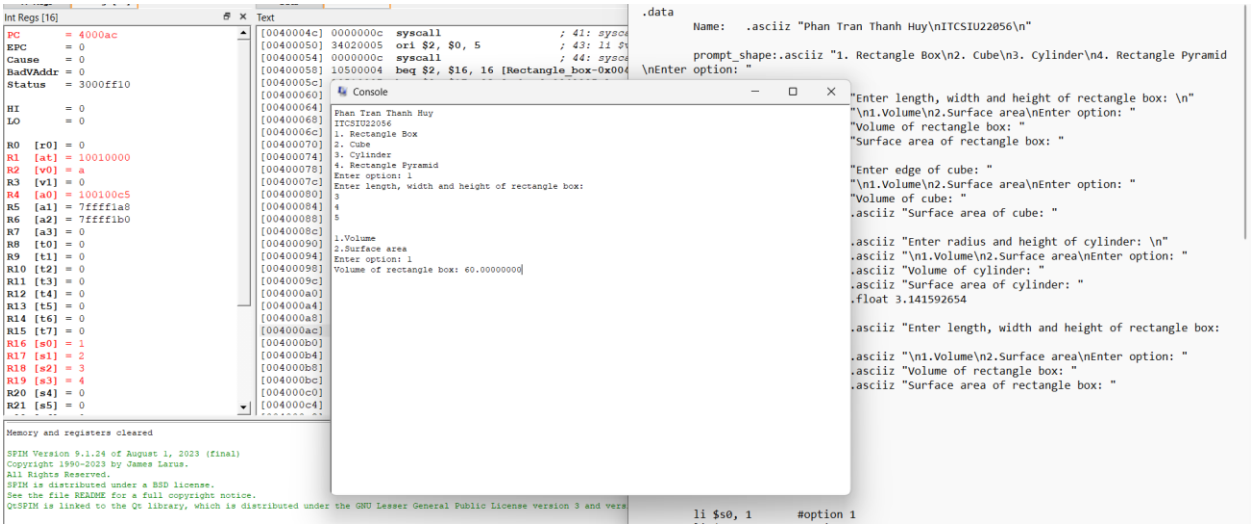
QtSPIM is linked to the Qt library, which is distributed under the GNU Lesser General Public License version 3 and vers
la $a0, prompt1
li $v0, 4
syscall
la $t0, tempArr
printLoop:
j endCheck1

Exercise 4:

Code:



Test case:


Int Regs [16]
Text
Console
Phan Tran Thanh Huy
ITCSIU22056
1. Rectangle Box
2. Cube
3. Cylinder
4. Rectangle Pyramid
Enter option: 1
Enter length, width and height of rectangle box:
3
4
5
1.Volume
2.Surface area
Enter option: 1
Volume of rectangle box: 60.00000000
Memory and registers cleared
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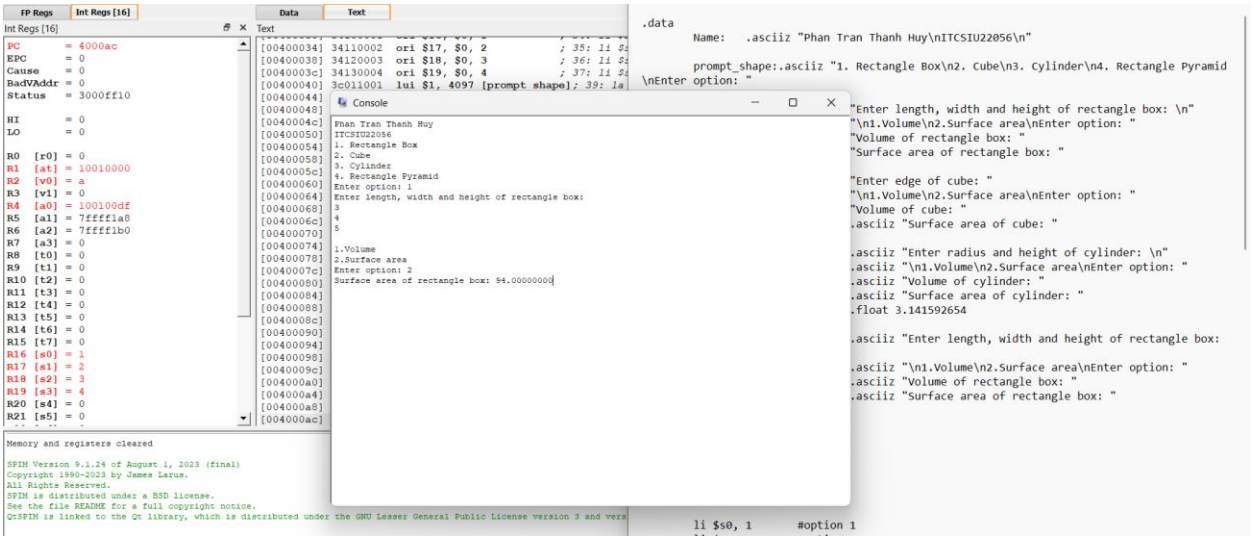
.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
li $s0, 1 #option 1


FP Regs
Int Regs [16]
Data
Text
Console
Phan Tran Thanh Huy
ITCSIU22056
1. Rectangle Box
2. Cube
3. Cylinder
4. Rectangle Pyramid
Enter option: 1
Enter length, width and height of rectangle box:
3
4
5
1.Volume
2.Surface area
Enter option: 2
Surface area of rectangle box: 94.00000000
Memory and registers cleared
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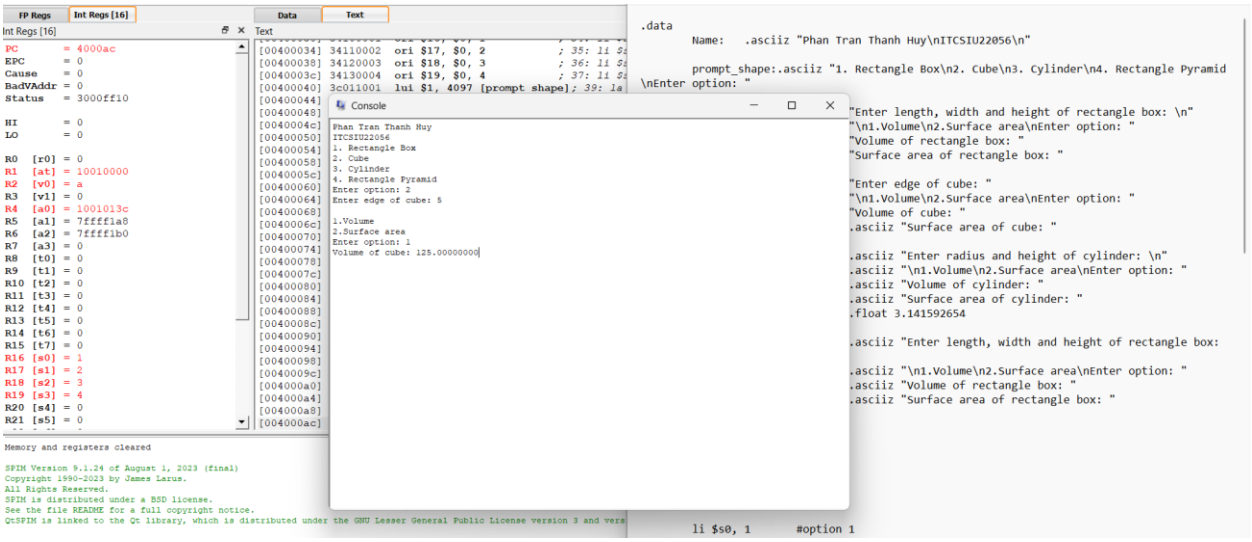
.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
li $s0, 1 #option 1


FP Regs
Int Regs [16]
Data
Text
PC = 4000ac
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 10010000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 1001013c
R5 [a1] = 7fffffa8
R6 [a2] = 7fffffb0
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 1
R17 [s1] = 2
R18 [s2] = 3
R19 [s3] = 4
R20 [s4] = 0
R21 [s5] = 0
[00400034] 34110002 ori $17, $0, 2 ; 35: li $s
[00400038] 34120003 ori $18, $0, 3 ; 36: li $s
[0040003c] 34130004 ori $19, $0, 4 ; 37: li $s
[00400040] 3c011001 lui $1, 4097 [prompt shape] ; 39: la
[004000ac]
Memory and registers cleared
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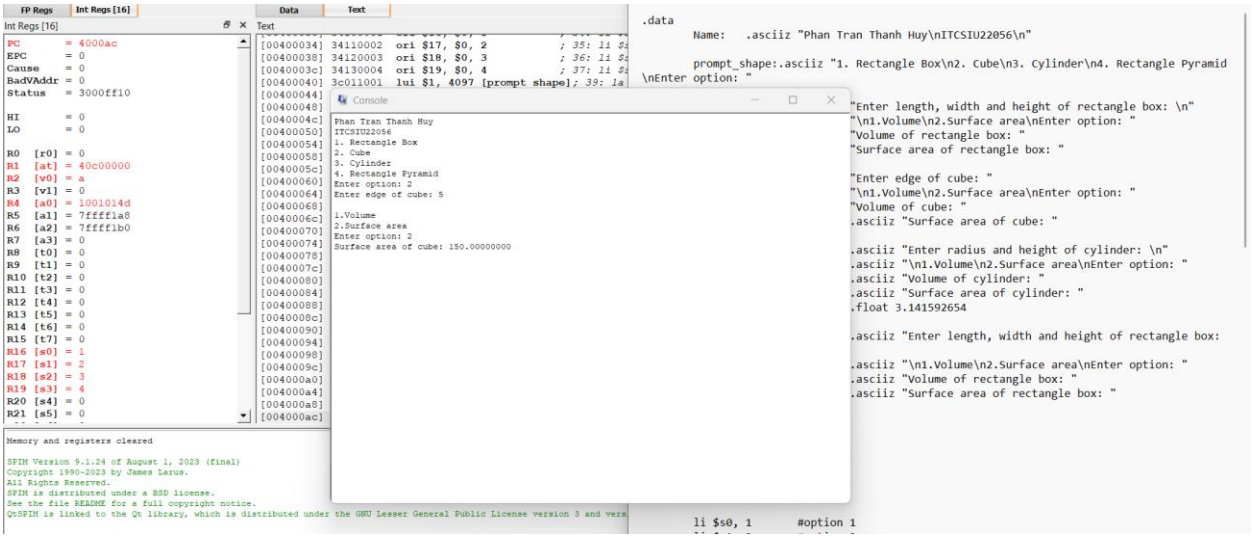
QtSPIM is linked to the Qt library, which is distributed under the GNU Lesser General Public License version 3 and vers
Console
Phan Tran Thanh Huy
ITCSIU22056
1. Rectangle Box
2. Cube
3. Cylinder
4. Rectangle Pyramid
Enter option: 2
Enter edge of cube: 5
1.Volume
2.Surface area
Enter option: 1
Volume of cube: 125.00000000
.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
prompt_shape:.asciiz "1. Rectangle Box\n2. Cube\n3. Cylinder\n4. Rectangle Pyramid
\nEnter option: "
"Enter length, width and height of rectangle box: \n"
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of rectangle box: "
"Surface area of rectangle box: "
"Enter edge of cube: "
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of cube: "
.asciiz "Surface area of cube: "
.asciiz "Enter radius and height of cylinder: \n"
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of cylinder: "
.asciiz "Surface area of cylinder: "
.float 3.141592654
.asciiz "Enter length, width and height of rectangle box:
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of rectangle box: "
.asciiz "Surface area of rectangle box: "
li $s0, 1 #option 1


FP Regs
Int Regs [16]
Data
Text
PC = 4000ac
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 40c00000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 1001014d
R5 [a1] = 7fffffa8
R6 [a2] = 7fffffb0
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 1
R17 [s1] = 2
R18 [s2] = 3
R19 [s3] = 4
R20 [s4] = 0
R21 [s5] = 0
[00400034] 34110002 ori $17, $0, 2 ; 35: li $s
[00400038] 34120003 ori $18, $0, 3 ; 36: li $s
[0040003c] 34130004 ori $19, $0, 4 ; 37: li $s
[00400040] 3c011001 lui $1, 4097 [prompt shape] ; 39: la
[004000ac]
Memory and registers cleared
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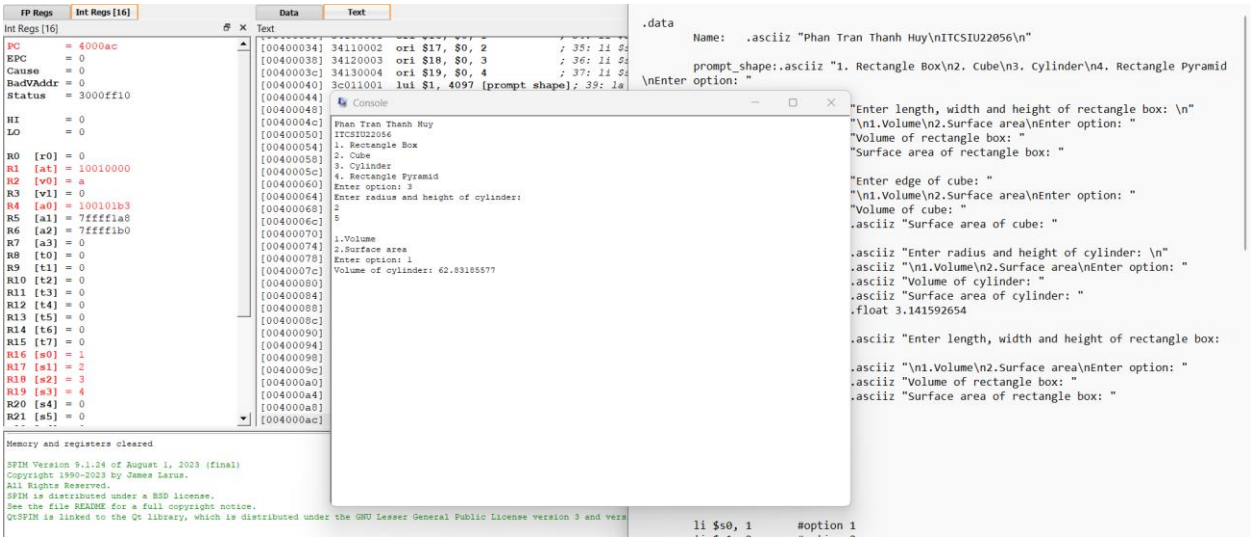
QtSPIM is linked to the Qt library, which is distributed under the GNU Lesser General Public License version 3 and vers
Console
Phan Tran Thanh Huy
ITCSIU22056
1. Rectangle Box
2. Cube
3. Cylinder
4. Rectangle Pyramid
Enter option: 2
Enter edge of cube: 5
1.Volume
2.Surface area
Enter option: 2
Surface area of cube: 150.00000000
.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
prompt_shape:.asciiz "1. Rectangle Box\n2. Cube\n3. Cylinder\n4. Rectangle Pyramid
\nEnter option: "
"Enter length, width and height of rectangle box: \n"
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of rectangle box: "
"Surface area of rectangle box: "
"Enter edge of cube: "
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of cube: "
.asciiz "Surface area of cube: "
.asciiz "Enter radius and height of cylinder: \n"
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of cylinder: "
.asciiz "Surface area of cylinder: "
.float 3.141592654
.asciiz "Enter length, width and height of rectangle box:
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of rectangle box: "
.asciiz "Surface area of rectangle box: "
li $s0, 1 #option 1


FP Regs
Int Regs [16]
Data
Text
PC = 4000ac
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 10010000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 100101b3
R5 [a1] = 7fffffa8
R6 [a2] = 7fffffb0
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 1
R17 [s1] = 2
R18 [s2] = 3
R19 [s3] = 4
R20 [s4] = 0
R21 [s5] = 0
[00400034] 34110002 ori $17, $0, 2 ; 35: li $s
[00400038] 34120003 ori $18, $0, 3 ; 36: li $s
[0040003c] 34130004 ori $19, $0, 4 ; 37: li $s
[00400040] 3c011001 lui $1, 4097 [prompt shape] ; 39: la
[004000ac]
Memory and registers cleared
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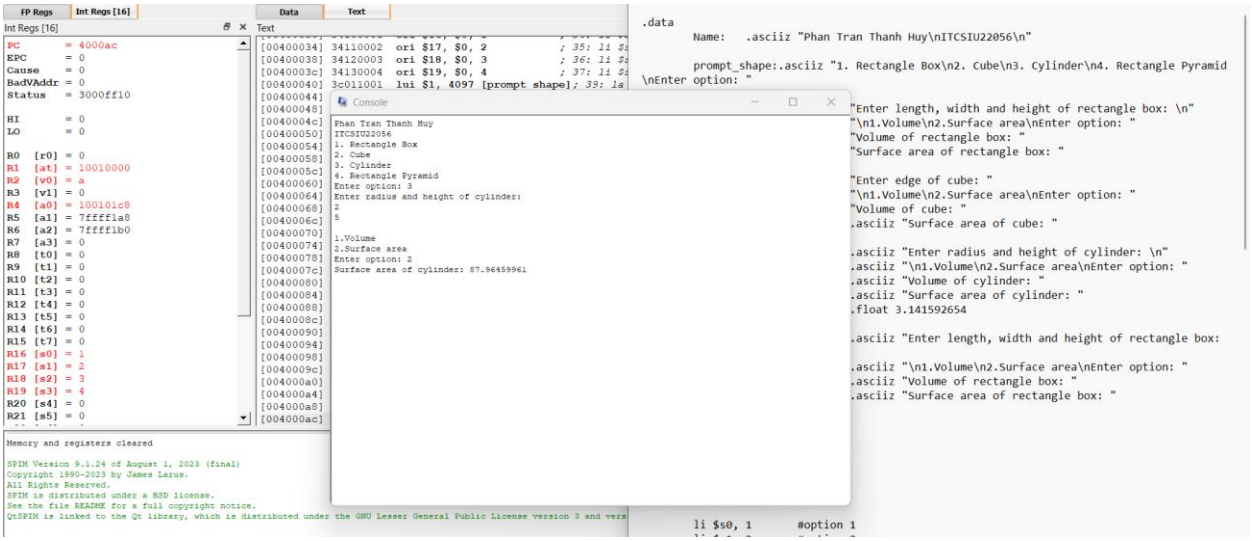
QtSPIM is linked to the Qt library, which is distributed under the GNU Lesser General Public License version 3 and vers
Console
Phan Tran Thanh Huy
ITCSIU22056
1. Rectangle Box
2. Cube
3. Cylinder
4. Rectangle Pyramid
Enter option: 3
Enter radius and height of cylinder:
2
5
1.Volume
2.Surface area
Enter option: 1
Volume of cylinder: 62.83185577
.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
prompt_shape:.asciiz "1. Rectangle Box\n2. Cube\n3. Cylinder\n4. Rectangle Pyramid
\nEnter option: "
"Enter length, width and height of rectangle box: \n"
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of rectangle box: "
"Surface area of rectangle box: "
"Enter edge of cube: "
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of cube: "
.asciiz "Surface area of cube: "
.asciiz "Enter radius and height of cylinder: \n"
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of cylinder: "
.asciiz "Surface area of cylinder: "
.float 3.141592654
.asciiz "Enter length, width and height of rectangle box:
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of rectangle box: "
.asciiz "Surface area of rectangle box: "
li $s0, 1 #option 1


FP Regs
Int Regs [16]
Data
Text
PC = 4000ac
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 10010000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 100101c8
R5 [a1] = 7fffffa8
R6 [a2] = 7fffffb0
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 1
R17 [s1] = 2
R18 [s2] = 3
R19 [s3] = 4
R20 [s4] = 0
R21 [s5] = 0
[00400034] 34110002 ori $17, $0, 2 ; 35: li $s1, 2 #option 2
[00400038] 34120003 ori $18, $0, 3 ; 36: li $s2, 3
[0040003c] 34130004 ori $19, $0, 4 ; 37: li $s3, 4
[00400040] 3c011001 lui $1, 4097 [prompt_shape] ; 39: la $a0, prompt_shape #Enter option:
Console
Phan Tran Thanh Huy
ITCSIU22056
1. Rectangle Box
2. Cube
3. Cylinder
4. Rectangle Pyramid
Enter option: 3
Enter radius and height of cylinder:
2
5
1.Volume
2.Surface area
Enter option: 2
Surface area of cylinder: 87.96459961
Memory and registers cleared
SPIM Version 9.1.24 of August 1, 2023 (final)
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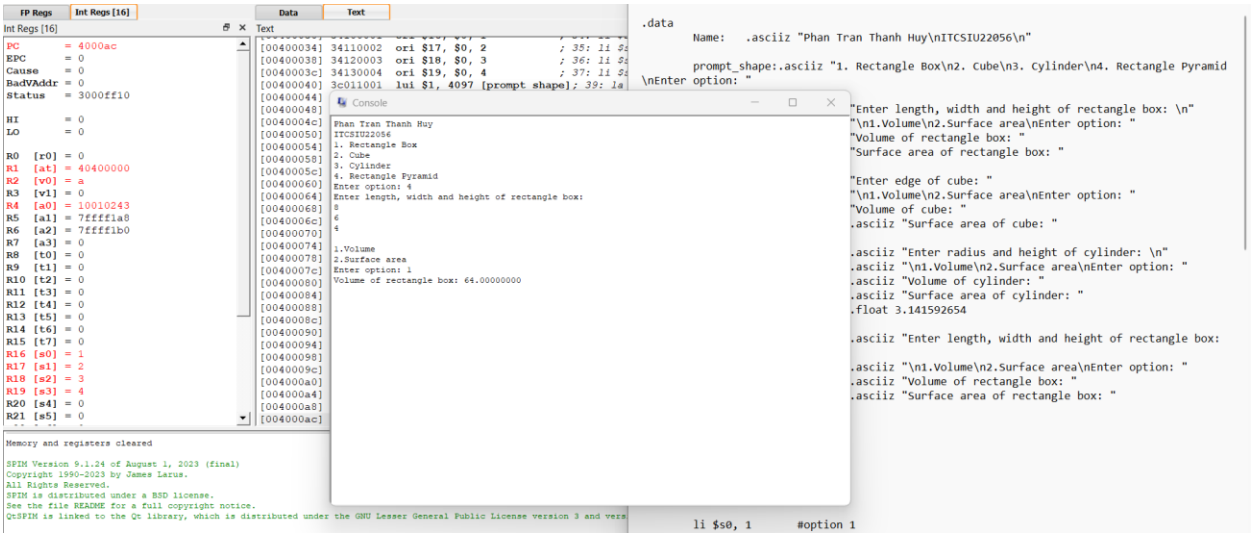
.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
prompt_shape:.asciiz "1. Rectangle Box\n2. Cube\n3. Cylinder\n4. Rectangle Pyramid
\nEnter option: "
"Enter length, width and height of rectangle box: \n"
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of rectangle box: "
"Surface area of rectangle box: "
"Enter edge of cube: "
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of cube: "
.asciiz "Surface area of cube: "
.asciiz "Enter radius and height of cylinder: \n"
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of cylinder: "
.asciiz "Surface area of cylinder: "
.float 3.141592654
.asciiz "Enter length, width and height of rectangle box:
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of rectangle box: "
.asciiz "Surface area of rectangle box: "
li $s0, 1 #option 1


FP Regs
Int Regs [16]
Data
Text
PC = 4000ac
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 40400000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 10010243
R5 [a1] = 7fffffa8
R6 [a2] = 7fffffb0
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 1
R17 [s1] = 2
R18 [s2] = 3
R19 [s3] = 4
R20 [s4] = 0
R21 [s5] = 0
[00400034] 34110002 ori $17, $0, 2 ; 35: li $s1, 2 #option 2
[00400038] 34120003 ori $18, $0, 3 ; 36: li $s2, 3
[0040003c] 34130004 ori $19, $0, 4 ; 37: li $s3, 4
[00400040] 3c011001 lui $1, 4097 [prompt_shape] ; 39: la $a0, prompt_shape #Enter option:
Console
Phan Tran Thanh Huy
ITCSIU22056
1. Rectangle Box
2. Cube
3. Cylinder
4. Rectangle Pyramid
Enter option: 4
Enter length, width and height of rectangle box:
8
6
4
1.Volume
2.Surface area
Enter option: 1
Volume of rectangle box: 64.00000000
Memory and registers cleared
SPIM Version 9.1.24 of August 1, 2023 (final)
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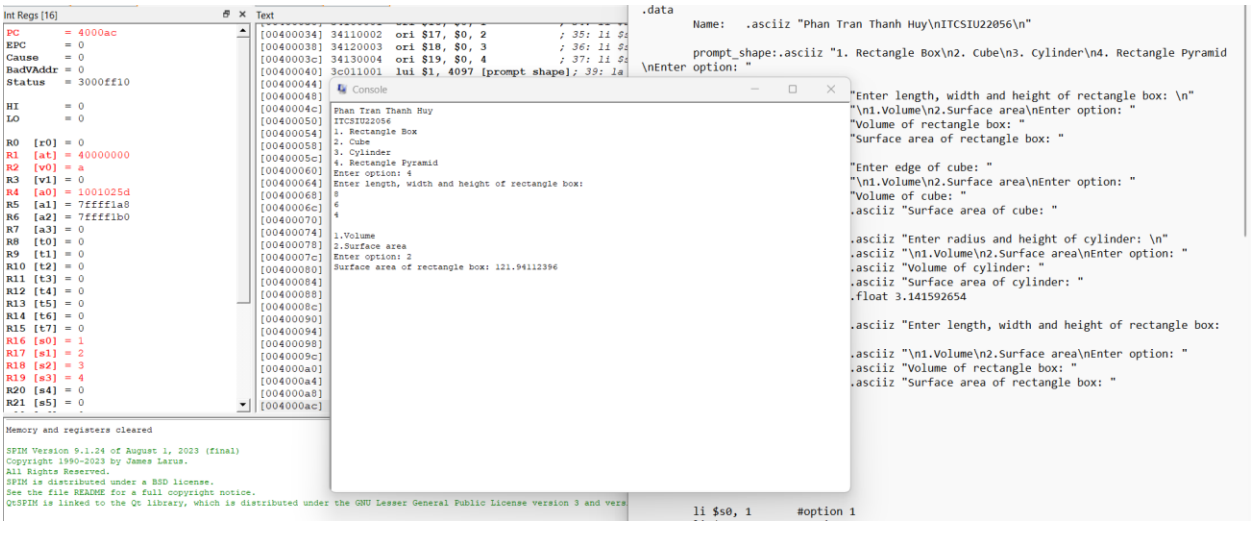
.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
prompt_shape:.asciiz "1. Rectangle Box\n2. Cube\n3. Cylinder\n4. Rectangle Pyramid
\nEnter option: "
"Enter length, width and height of rectangle box: \n"
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of rectangle box: "
"Surface area of rectangle box: "
"Enter edge of cube: "
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of cube: "
.asciiz "Surface area of cube: "
.asciiz "Enter radius and height of cylinder: \n"
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of cylinder: "
.asciiz "Surface area of cylinder: "
.float 3.141592654
.asciiz "Enter length, width and height of rectangle box:
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of rectangle box: "
.asciiz "Surface area of rectangle box: "
li $s0, 1 #option 1


Int Regs [16]
PC = 4000ac
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 40000000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 1001025d
R5 [a1] = 7fffffa8
R6 [a2] = 7fffffb0
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 1
R17 [s1] = 2
R18 [s2] = 3
R19 [s3] = 4
R20 [s4] = 0
R21 [s5] = 0
[00400034] 34110002 ori $17, $0, 2 ; 35: li $s1, 2 #option 2
[00400038] 34120003 ori $18, $0, 3 ; 36: li $s2, 3
[0040003c] 34130004 ori $19, $0, 4 ; 37: li $s3, 4
[00400040] 3c011001 lui $1, 4097 [prompt_shape] ; 39: la $a0, prompt_shape #Enter option:
Console
Phan Tran Thanh Huy
ITCSIU22056
1. Rectangle Box
2. Cube
3. Cylinder
4. Rectangle Pyramid
Enter option: 4
Enter length, width and height of rectangle box:
8
6
4
1.Volume
2.Surface area
Enter option: 2
Surface area of rectangle box: 121.94112396
Memory and registers cleared
SPIM Version 9.1.24 of August 1, 2023 (final)
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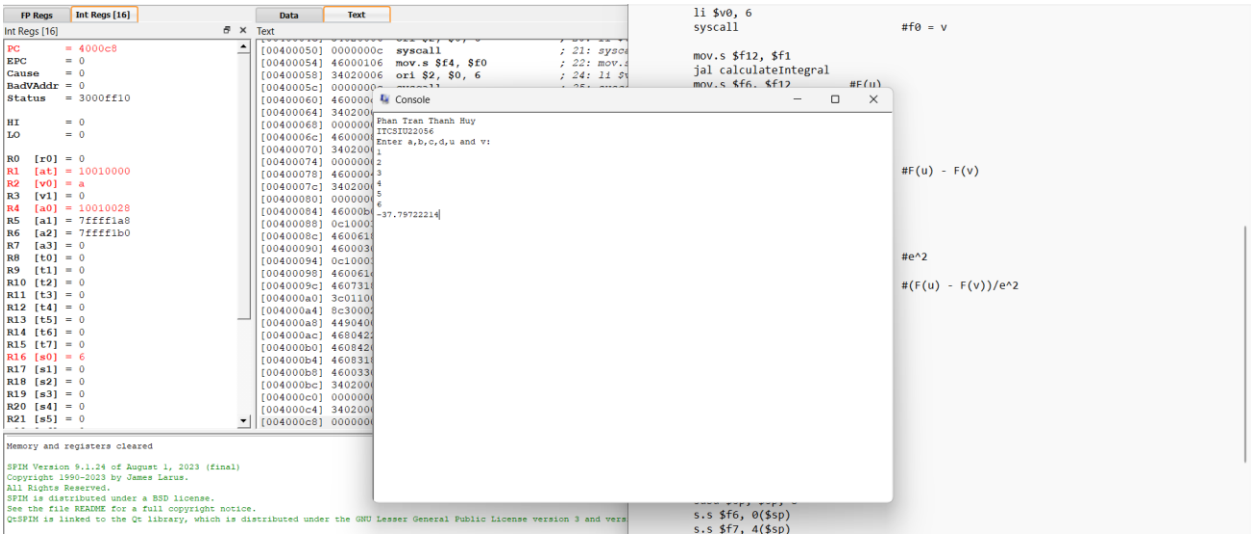
.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
prompt_shape:.asciiz "1. Rectangle Box\n2. Cube\n3. Cylinder\n4. Rectangle Pyramid
\nEnter option: "
"Enter length, width and height of rectangle box: \n"
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of rectangle box: "
"Surface area of rectangle box: "
"Enter edge of cube: "
"\n1.Volume\n2.Surface area\nEnter option: "
"Volume of cube: "
.asciiz "Surface area of cube: "
.asciiz "Enter radius and height of cylinder: \n"
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of cylinder: "
.asciiz "Surface area of cylinder: "
.float 3.141592654
.asciiz "Enter length, width and height of rectangle box:
.asciiz "\n1.Volume\n2.Surface area\nEnter option: "
.asciiz "Volume of rectangle box: "
.asciiz "Surface area of rectangle box: "
li $s0, 1 #option 1

Exercise 5:

Code:

```
.data
    Name:   .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
    e: .word 6
    prompt: .asciiz "Enter a,b,c,d,u and v:\n"
    printResult: .asciiz "The result is: "
.text
.globl main
main:
    la $a0, Name
    li $v0, 4
    syscall

    la $a0, prompt
    li $v0, 4
    syscall

    li $v0, 6
    syscall
    mov.s $f5, $f0      #f5 = a

    li $v0, 6
    syscall
    mov.s $f4, $f0      #f4 = b

    li $v0, 6
    syscall
    mov.s $f3, $f0      #f3 = c

    li $v0, 6
    syscall
    mov.s $f2, $f0      #f2 = d

    li $v0, 6
    syscall
    mov.s $f1, $f0      #f1 = u

    li $v0, 6
    syscall             #f0 = v

    mov.s $f12, $f1
    jal calculateIntegral
    mov.s $f6, $f12     #F(u)

    mov.s $f12, $f0
    jal calculateIntegral
    mov.s $f7, $f12     #F(v)

    sub.s $f6, $f6, $f7     #F(u) - F(v)

    lw $s0, e
    mtc1 $s0, $f8
    cvt.s.w $f8, $f8

    mul.s $f8, $f8, $f8     #e^2

    div.s $f6, $f6, $f8     #(F(u) - F(v))/e^2

    la $a0, printResult
    li $v0, 4
    syscall

    mov.s $f12, $f6
    li $v0, 2
    syscall

    li $v0, 10
    syscall


calculateIntegral:
    subu $sp, $sp, 8
    s.s $f6, 0($sp)
    s.s $f7, 4($sp)

    li.s $f6, 5.0
    mul.s $f7, $f12, $f12   #x*x
    mul.s $f7, $f7, $f7     #x^4
    mul.s $f7, $f7, $f12    #x^5
    mul.s $f7, $f7, $f5     #ax^5
    div.s $f7, $f7, $f6     #ax^5 / 5


    li.s $f6, 4.0
    mul.s $f8, $f12, $f12
    mul.s $f8, $f8, $f8     #x^4
    mul.s $f8, $f8, $f4     #bx^4
    div.s $f8, $f8, $f6     #bx^4 / 4

    li.s $f6, 3.0
    mul.s $f9, $f12, $f12
    mul.s $f9, $f9, $f12    #x^3
    mul.s $f9, $f9, $f3
    div.s $f9, $f9, $f6     #cx^3 / 3

    mul.s $f10, $f12, $f2   #dx

    add.s $f10, $f10, $f9
    add.s $f10, $f10, $f8
    add.s $f10, $f10, $f7
    mov.s $f12, $f10

    l.s $f6, 0($sp)
    l.s $f7, 4($sp)
    addi $sp, $sp, 8
    jr $ra
```

Test case:


FP Regs
Int Regs [16]
Data
Text
Int Regs [16]
PC = 4000c8
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 10010000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 10010028
R5 [a1] = 7fffffa8
R6 [a2] = 7fffffb0
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 6
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
Text
[00400050] 0000000c syscall ; 21: sysc
[00400054] 46000106 mov.s $f4, $f0 ; 22: mov.
[00400058] 34020006 ori $2, $0, 6 ; 24: li $
[0040005c] 0000000
[00400060] 4600000
[00400064] 3402000
[00400068] 0000000
[0040006c] 4600000
[00400070] 3402000
[00400074] 0000000
[00400078] 4600000
[0040007c] 3402000
[00400080] 0000000
[00400084] 46000b
[00400088] 0c1000
[0040008c] 4600610
[00400090] 460003
[00400094] 0c1000
[00400098] 4600610
[0040009c] 4607310
[004000a0] 3c0110
[004000a4] 8c3000
[004000a8] 4490400
[004000ac] 4680422
[004000b0] 4608420
[004000b4] 4608310
[004000b8] 4600330
[004000bc] 3402000
[004000c0] 0000000
[004000c4] 3402000
[004000c8] 0000000
Console
Phan Tran Thanh Huy
ITCSIU22056
Enter a,b,c,d,u and v:
1
2
3
4
5
6
-37.79722214
Memory and registers cleared
SPIM Version 9.1.24 of August 1, 2023 (final)
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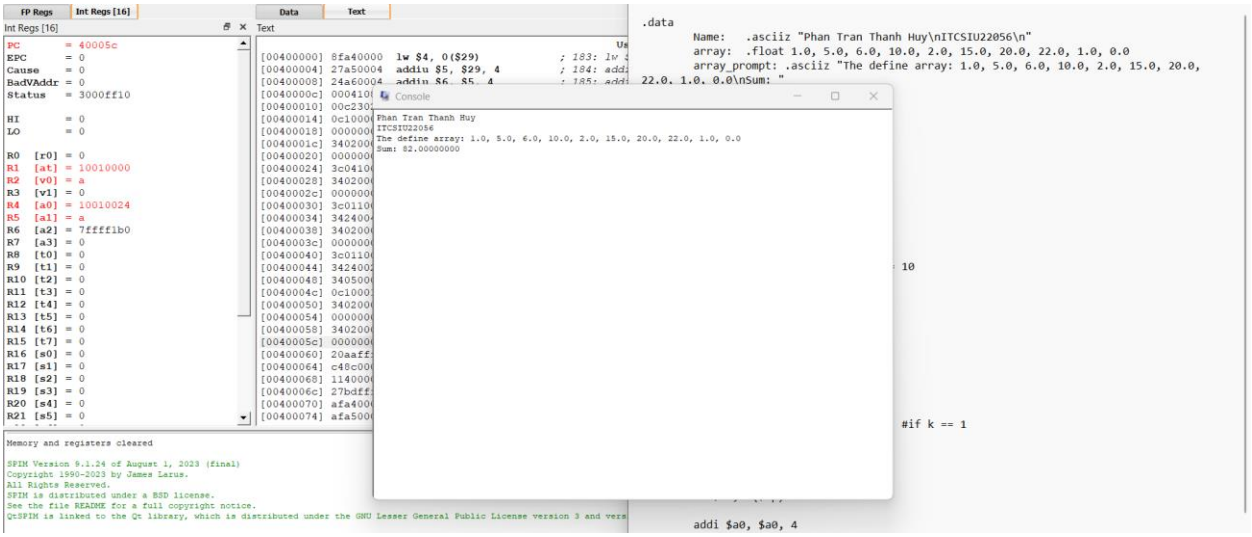
li $v0, 6
syscall #f0 = v
mov.s $f12, $f1
jal calculateIntegral
#F(u) - F(v)
#e^2
#(F(u) - F(v))/e^2
s.s $f6, 0($sp)
s.s $f7, 4($sp)

Exercise 6:

Code:

```
.data
    Name:   .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
    array:  .float 1.0, 5.0, 6.0, 10.0, 2.0, 15.0, 20.0, 22.0, 1.0, 0.0
    array_prompt: .asciiz "The define array: 1.0, 5.0, 6.0, 10.0, 2.0, 15.0, 20.0, 22.0, 1.0, 0.0\nSum: "
.text
.globl main
main:
    la $a0, Name
    li $v0, 4
    syscall

    la $a0, array_prompt
    li $v0, 4
    syscall

    la $a0, array
    li $a1, 10      #size = 10
    jal sum
    li $v0, 2
    syscall

    li $v0, 10
    syscall

sum:
    addi $t2, $a1, -1
    l.s $f12, 0($a0)
    beq $t2, $zero, return      #if k == 1

    subu $sp, $sp, 12
    sw $a0, 0($sp)  #save array
    sw $a1, 4($sp)  #save size
    sw $ra, 8($sp)

    addi $a0, $a0, 4
    addi $a1, $a1, -1
    jal sum

    lw $a0, 0($sp)  #load array
    lw $a1, 4($sp)  #load size
    lw $ra, 8($sp)
    addi $sp, $sp, 12

    l.s $f0, 0($a0)
    add.s $f12, $f0, $f12

    jr $ra
return:
    jr $ra
```

Test case:


FP Regs
Int Regs [16]
Int Regs [16]
PC = 40005c
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 10010000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 10010024
R5 [a1] = a
R6 [a2] = 7fffffb0
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
Data
Text
Text
[00400000] 8fa40000 lw $4, 0($29)
[00400004] 27a50004 addiu $5, $29, 4
[00400008] 24a60004 addiu $6, $5, 4
Console
Phan Tran Thanh Huy
ITCSIU22056
The define array: 1.0, 5.0, 6.0, 10.0, 2.0, 15.0, 20.0, 22.0, 1.0, 0.0
Sum: 82.00000000
Memory and registers cleared
SPIM Version 9.1.24 of August 1, 2023 (final)
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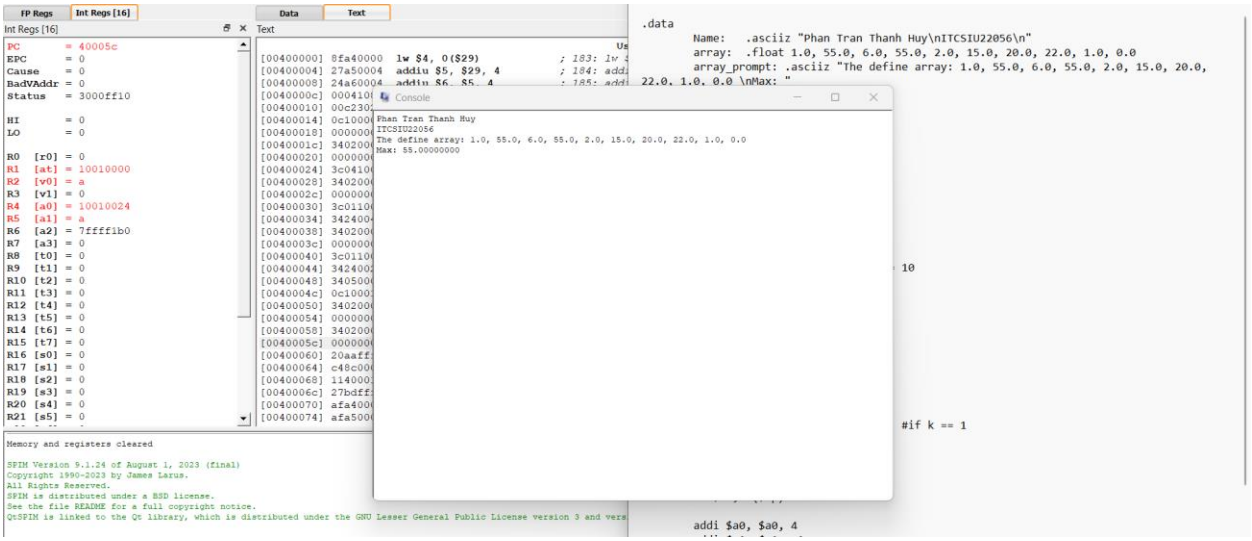
QtSPIM is linked to the Qt library, which is distributed under the GNU Lesser General Public License version 3 and vers
.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
array: .float 1.0, 5.0, 6.0, 10.0, 2.0, 15.0, 20.0, 22.0, 1.0, 0.0
array_prompt: .asciiz "The define array: 1.0, 5.0, 6.0, 10.0, 2.0, 15.0, 20.0,
22.0, 1.0, 0.0\nSum: "
10
#if k == 1
addi $a0, $a0, 4

Exercise 7:

Code:

```
.data
    Name:   .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
    array:  .float 1.0, 55.0, 6.0, 55.0, 2.0, 15.0, 20.0, 22.0, 1.0, 0.0
    array_prompt: .asciiz "The define array: 1.0, 55.0, 6.0, 55.0, 2.0, 15.0, 20.0, 22.0, 1.0, 0.0 \nMax: "
.text
.globl main
main:
    la $a0, Name
    li $v0, 4
    syscall

    la $a0, array_prompt
    li $v0, 4
    syscall

    la $a0, array
    li $a1, 10      #size = 10
    jal max
    li $v0, 2
    syscall

    li $v0, 10
    syscall

max:
    addi $t2, $a1, -1
    l.s $f12, 0($a0)
    beq $t2, $zero, return      #if k == 1

    subu $sp, $sp, 12
    sw $a0, 0($sp)  #save array
    sw $a1, 4($sp)  #save size
    sw $ra, 8($sp)

    addi $a0, $a0, 4
    addi $a1, $a1, -1
    jal max

    lw $a0, 0($sp)  #load array
    lw $a1, 4($sp)  #load size
    lw $ra, 8($sp)
    addi $sp, $sp, 12

    l.s $f0, 0($a0)     #load v[0]

    c.lt.s $f0, $f12    #if v[0] < temp --> return
    bc1t return

    mov.s $f12, $f0
    jr $ra
return:
    jr $ra
```

Test case:


FP Regs
Int Regs [16]
Data
Text
PC = 40005c
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 10010000
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 10010024
R5 [a1] = a
R6 [a2] = 7ffff1b0
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
[00400000] 8fa40000 lw $4, 0($29)
[00400004] 27a50004 addiu $5, $29, 4
[00400008] 24a60004 addiu $6, $5, 4
Console
Phan Tran Thanh Huy
ITCSIU22056
The define array: 1.0, 55.0, 6.0, 55.0, 2.0, 15.0, 20.0, 22.0, 1.0, 0.0
Max: 55.00000000
Memory and registers cleared
SPIM Version 9.1.24 of August 1, 2023 (final)
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.data
Name: .asciiz "Phan Tran Thanh Huy\nITCSIU22056\n"
array: .float 1.0, 55.0, 6.0, 55.0, 2.0, 15.0, 20.0, 22.0, 1.0, 0.0
array_prompt: .asciiz "The define array: 1.0, 55.0, 6.0, 55.0, 2.0, 15.0, 20.0,
22.0, 1.0, 0.0 \nMax: "
10
#if k == 1
addi $a0, $a0, 4