MONTCLAIR STATE UNIVERSITY

Department of CSIT

Information Technology

M8

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CSIT230_SP21

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1)

```
la $s0, 0xFFFF0010

li $t1,1

li $t2,2

li $t3,3

sw $t1, ($s0)

sw $t2, 4($s0)

sw $t3, 8($s0)

move $t4,$t1

move $t5,$t2

move $t6,$t3


add $t7,$t4,$t5
add $t7,$t7,$t6

sw $t7, 12($s0)

move $t8,$t7

li $v0,1
move $a0,$t8
syscall
```

2)

```
.data

  arrayA: .word 2, 3
  arrayB: .word 4, 5
  arrayC: .word 0, 0
  sentence: .asciiz
  newLine: .asciiz
```

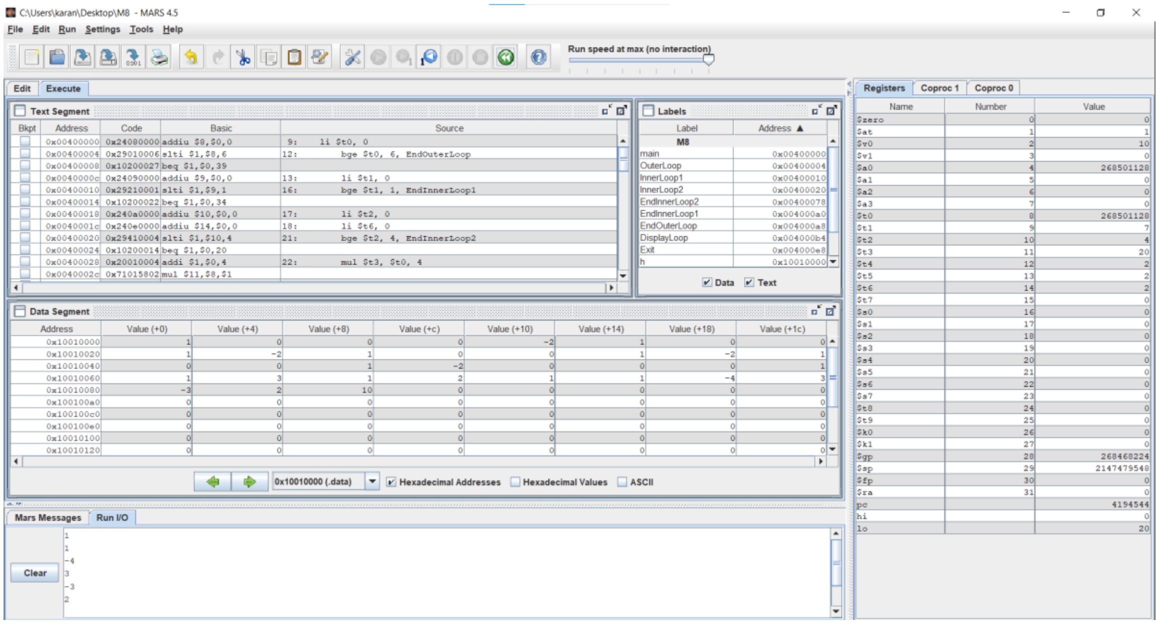
```
.text
  addi $t0,$zero,0
  li $s0,0

  findSum :
    lw $t1,arrayA($t0)
    lw $t2,arrayB($t0)
    add $s0,$t1,$t2
    sw $s0,arrayC($t0)
    beq $t0,4,finishLoop
    add $t0,$t0,4
    j findSum
  finishLoop :

    li $v0,4
    la $a0,sentence
    syscall
    li $t0,0
  printArrayC :

    lw $t1,arrayC($t0)
    li $v0,1
    move $a0,$t1
    syscall
    beq $t0,4,endProgram
    li $v0,4
    la $a0,newLine
    syscall
    add $t0,$t0,4
    j printArrayC


  endProgram :
    li $v0,10
    syscall
```

3)

```
.data

  h: .word 1,0,0,0, -2,1,0,0, 1,-2,1,0, 0,1,-2,1, 0,0,1,-2, 0,0,0,1
  x: .word 1, 3, 1, 2
  y: .word 0:6
  newLine: .asciiz "\n"
.text
```

```
main:
  li $t0, 0
  OuterLoop:

     bge $t0, 6, EndOuterLoop
     li $t1, 0
  InnerLoop1:

     bge $t1, 1, EndInnerLoop1
     li $t2, 0
     li $t6, 0
  InnerLoop2:

     bge $t2, 4, EndInnerLoop2
     mul $t3, $t0, 4
     add $t3, $t3, $t2
     mul $t3, $t3, 4
     lw $t4, h($t3)
     mul $t3, $t2, 1
     add $t3, $t3, $t1
     mul $t3, $t3, 4
     lw $t5, x($t3)

     mul $t4, $t4, $t5
     add $t6, $t6, $t4
     addi $t2, $t2, 1
     b InnerLoop2
  EndInnerLoop2:

     mul $t3, $t0, 1
     add $t3, $t3, $t1
     mul $t3, $t3, 4
     sw $t6, y($t3)
     addi $t1, $t1, 1
     b InnerLoop1
  EndInnerLoop1:
     addi $t0, $t0,1
     b OuterLoop
  EndOuterLoop:

     la $t0, y
     li $t1, 1
  DisplayLoop:
     bgt $t1, 6, Exit
```

```
    li $v0, 1
    lw $a0, 0($t0)
    syscall

    li $v0, 4
    la $a0, newLine
    syscall

    addi $t1, $t1, 1
    add $t0, $t0, 4
    b DisplayLoop
  Exit:

    li $v0, 10
    syscall
```


C:\Users\karan\Desktop\M8 - MARS 4.5
File Edit Run Settings Tools Help
Run speed at max (no interaction)
Edit
Execute
Registers
Coproc 1
Coproc 0

Text Segment

Bkpt	Address	Code	Basic	Source
☐	0x00400000	0x24080000	addiu $8,$0,0	9: li $t0, 0
☐	0x00400004	0x29010006	slti $1,$8,6	12: bge $t0, 6, EndOuterLoop
☐	0x00400008	0x10200027	beq $1,$0,39	
☐	0x0040000c	0x24090000	addiu $9,$0,0	13: li $t1, 0
☐	0x00400010	0x29210001	slti $1,$9,1	16: bge $t1, 1, EndInnerLoop1
☐	0x00400014	0x10200022	beq $1,$0,34	
☐	0x00400018	0x240a0000	addiu $10,$0,0	17: li $t2, 0
☐	0x0040001c	0x240e0000	addiu $14,$0,0	18: li $t6, 0
☐	0x00400020	0x29410004	slti $1,$10,4	21: bge $t2, 4, EndInnerLoop2
☐	0x00400024	0x10200014	beq $1,$0,20	
☐	0x00400028	0x20010004	addi $1,$0,4	22: mul $t3, $t0, 4
☐	0x0040002c	0x71015802	mul $11,$8,$1	

Labels

Label	Address ▲
M8	
main	0x00400000
OuterLoop	0x00400004
InnerLoop1	0x00400010
InnerLoop2	0x00400020
EndInnerLoop2	0x00400078
EndInnerLoop1	0x004000a0
EndOuterLoop	0x004000a8
DisplayLoop	0x004000b4
Exit	0x004000e8
h	0x10010000

☑ Data ☑ Text

Data Segment

Address	Value (+0)	Value (+4)	Value (+8)	Value (+c)	Value (+10)	Value (+14)	Value (+18)	Value (+1c)
0x10010000	1	0	0	0	-2	1	0	0
0x10010020	1	-2	1	0	0	1	-2	1
0x10010040	0	0	1	-2	0	0	0	1
0x10010060	1	3	1	2	1	1	-4	3
0x10010080	-3	2	10	0	0	0	0	0
0x100100a0	0	0	0	0	0	0	0	0
0x100100c0	0	0	0	0	0	0	0	0
0x100100e0	0	0	0	0	0	0	0	0
0x10010100	0	0	0	0	0	0	0	0
0x10010120	0	0	0	0	0	0	0	0

0x10010000 (.data) ☑ Hexadecimal Addresses ☐ Hexadecimal Values ☐ ASCII

Mars Messages | Run I/O

Clear

```
1
1
-4
3
-3
2
```

Name	Number	Value
$zero	0	0
$at	1	1
$v0	2	10
$v1	3	0
$a0	4	268501128
$a1	5	0
$a2	6	0
$a3	7	0
$t0	8	268501128
$t1	9	7
$t2	10	4
$t3	11	20
$t4	12	2
$t5	13	2
$t6	14	2
$t7	15	0
$s0	16	0
$s1	17	0
$s2	18	0
$s3	19	0
$s4	20	0
$s5	21	0
$s6	22	0
$s7	23	0
$t8	24	0
$t9	25	0
$k0	26	0
$k1	27	0
$gp	28	268468224
$sp	29	2147479548
$fp	30	0
$ra	31	0
pc		4194544
hi		0
lo		20

4)

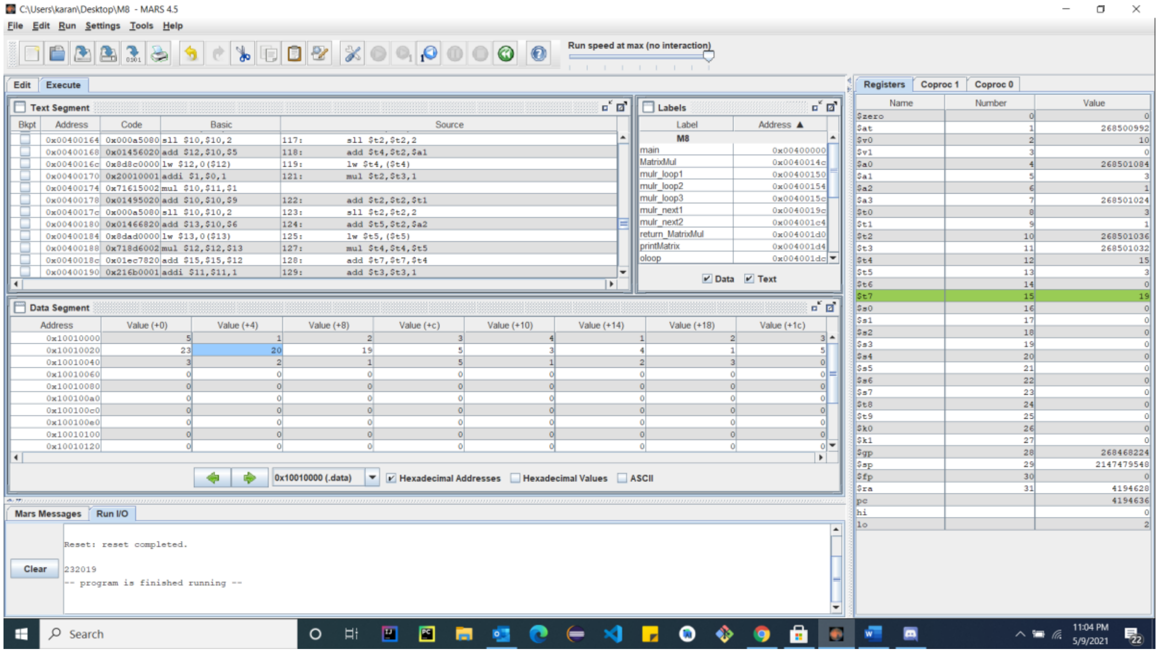
```
.data
a:   .word 5,1,2,3,4
x:  .word 1
  .word 2
  .word 3
y:  .word 0:1
  .word 0:1
  .word 0:1
A:  .word 0:3
```

```
  .word 0:3
  .word 0:3
X:   .word 0:1
  .word 0:1
  .word 0:1

message:.asciiz
space:    .asciiz
newline: .asciiz
.text
main:

  la $a0,a
  la $a1,A

  lw $t0,($a0)
  sw $t0,($a1)
  li $t1,4
  sll $t1,$t1,2
  add $t1,$t1,$a1
  sw $t0,($t1)
  li $t1,8
  sll $t1,$t1,2
  add $t1,$t1,$a1
  sw $t0,($t1)

  add $a0,$a0,4
  lw $t0,($a0)
  li $t1,3
  sll $t1,$t1,2
  add $t1,$t1,$a1
  sw $t0,($t1)
  li $t1,7
  sll $t1,$t1,2
  add $t1,$t1,$a1
  sw $t0,($t1)

  add $a0,$a0,4
  lw $t0,($a0)
  li $t1,6
  sll $t1,$t1,2
  add $t1,$t1,$a1
  sw $t0,($t1)
```

```
add $a0,$a0,4
lw $t0,($a0)
li $t1,1
sll $t1,$t1,2
add $t1,$t1,$a1
sw $t0,($t1)
li $t1,5
sll $t1,$t1,2
add $t1,$t1,$a1
sw $t0,($t1)

add $a0,$a0,4
lw $t0,($a0)
li $t1,2
sll $t1,$t1,2
add $t1,$t1,$a1
sw $t0,($t1)

la $a0,x
la $a1,X
lw $t0,($a0)
sw $t0,($a1)

add $a0,$a0,4
lw $t0,($a0)
li $t1,1
sll $t1,$t1,2
add $t1,$t1,$a1
sw $t0,($t1)

add $a0,$a0,4
lw $t0,($a0)
li $t1,2
sll $t1,$t1,2
add $t1,$t1,$a1
sw $t0,($t1)


li $a0,3
la $a1,A
la $a2,X
la $a3,y
jal MatrixMul
li $v0,4
```

```
  la $a0,message
  syscall
  la $a0,y
  li $a1,3
  li $a2,1
  jal printMatrix


  li $v0, 10
  syscall


MatrixMul:
     li $t0,0
mulr_loop1:   li $t1,0
mulr_loop2:   li $t3,0
     li $t7,0
mulr_loop3:   mul $t2,$t0,$a0
     add $t2,$t2,$t3
     sll $t2,$t2,2
     add $t4,$t2,$a1
     lw $t4,($t4)

     mul $t2,$t3,1
     add $t2,$t2,$t1
     sll $t2,$t2,2
     add $t5,$t2,$a2
     lw $t5,($t5)

     mul $t4,$t4,$t5
     add $t7,$t7,$t4
     add $t3,$t3,1
     beq $t3,$a0,mulr_next1
     j mulr_loop3
mulr_next1:
     mul $t2,$t0,1
     add $t2,$t2,$t1
     sll $t2,$t2,2
     add $t3,$t2,$a3
     sw $t7,($t3)

     add $t1,$t1,1
     beq $t1,1,mulr_next2
     j mulr_loop2
```

```
mulr_next2:   add $t0,$t0,1
      beq $t0,$a0,return_MatrixMul
      j mulr_loop1

return_MatrixMul: jr $ra
printMatrix :
      li $t0,0

      move $t2,$a0
oloop:
      li $t1,0
iloop:
      lw $a0, ($t2)
      li $v0,1
      syscall
      add $t2,$t2,4
      add $t0,$t0,1
      add $t1,$t1,1
      beq $t1,1,print_next
      la $a0,space
      li $v0,4
      syscall
      j iloop
print_next:   la $a0,newline
      li $v0,4
      syscall
      beq $t0,3,printingover
      j oloop

printingover:    la $a0,newline
      li $v0,4
      syscall
      jr $ra
```


C:\Users\karan\Desktop\M8 - MARS 4.5
File Edit Run Settings Tools Help
Run speed at max (no interaction)
Edit Execute

Text Segment

Bkpt	Address	Code	Basic	Source
□	0x00400164	0x000a5080	sll $10,$10,2	117: sll $t2,$t2,2
□	0x00400168	0x01456020	add $12,$10,$5	118: add $t4,$t2,$a1
□	0x0040016c	0x8d8c0000	lw $12,0($12)	119: lw $t4,($t4)
□	0x00400170	0x20010001	addi $1,$0,1	121: mul $t2,$t3,1
□	0x00400174	0x71615002	mul $10,$11,$1	
□	0x00400178	0x01495020	add $10,$10,$9	122: add $t2,$t2,$t1
□	0x0040017c	0x000a5080	sll $10,$10,2	123: sll $t2,$t2,2
□	0x00400180	0x01466820	add $13,$10,$6	124: add $t5,$t2,$a2
□	0x00400184	0x8dad0000	lw $13,0($13)	125: lw $t5,($t5)
□	0x00400188	0x718d6002	mul $12,$12,$13	127: mul $t4,$t4,$t5
□	0x0040018c	0x01ec7820	add $15,$15,$12	128: add $t7,$t7,$t4
□	0x00400190	0x216b0001	addi $11,$11,1	129: add $t3,$t3,1

Labels

Label	Address ▲
M8	
main	0x00400000
MatrixMul	0x0040014c
mulr_loop1	0x00400150
mulr_loop2	0x00400154
mulr_loop3	0x0040015c
mulr_next1	0x0040019c
mulr_next2	0x004001c4
return_MatrixMul	0x004001d0
printMatrix	0x004001d4
oloop	0x004001dc

☑ Data ☑ Text

Data Segment

Address	Value (+0)	Value (+4)	Value (+8)	Value (+c)	Value (+10)	Value (+14)	Value (+18)	Value (+1c)
0x10010000	5	1	2	3	4	1	2	3
0x10010020	23	20	19	5	3	4	1	5
0x10010040	3	2	1	5	1	2	3	0
0x10010060	0	0	0	0	0	0	0	0
0x10010080	0	0	0	0	0	0	0	0
0x100100a0	0	0	0	0	0	0	0	0
0x100100c0	0	0	0	0	0	0	0	0
0x100100e0	0	0	0	0	0	0	0	0
0x10010100	0	0	0	0	0	0	0	0
0x10010120	0	0	0	0	0	0	0	0

0x10010000 (.data) ☑ Hexadecimal Addresses □ Hexadecimal Values □ ASCII

Mars Messages | Run I/O

Clear

```
Reset: reset completed.

232019
-- program is finished running --
```

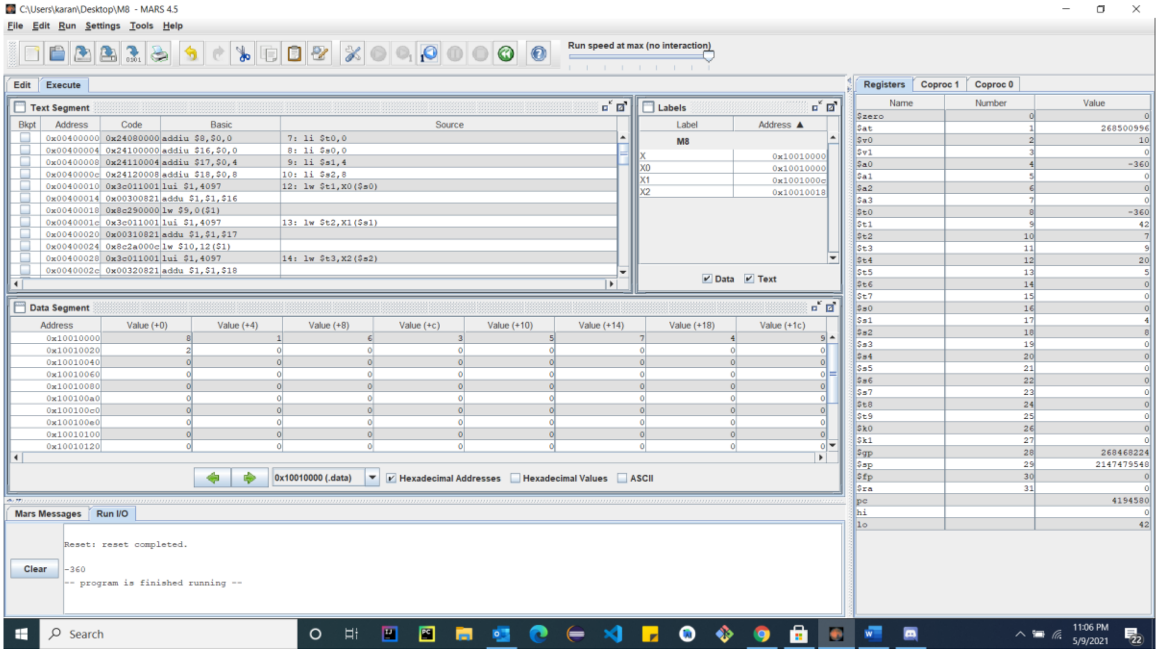
Registers | Coproc 1 | Coproc 0

Name	Number	Value
$zero	0	0
$at	1	268500992
$v0	2	10
$v1	3	0
$a0	4	268501084
$a1	5	3
$a2	6	1
$a3	7	268501024
$t0	8	3
$t1	9	1
$t2	10	268501036
$t3	11	268501032
$t4	12	15
$t5	13	3
$t6	14	0
$t7	15	19
$s0	16	0
$s1	17	0
$s2	18	0
$s3	19	0
$s4	20	0
$s5	21	0
$s6	22	0
$s7	23	0
$t8	24	0
$t9	25	0
$k0	26	0
$k1	27	0
$gp	28	268468224
$sp	29	2147479548
$fp	30	0
$ra	31	4194628
pc		4194636
hi		0
lo		2

5)

```
.data

X:
X0: 8 1 6
X1: 3 5 7
X2: 4 9 2

.text
li $t0,0 # The final det

li $s0,0
li $s1,4
li $s2,8

# The first computation
lw $t1,X0($s0)
lw $t2,X1($s1)
lw $t3,X2($s2)
lw $t4,X2($s1)
lw $t5,X1($s2)
mul $t2,$t2,$t3
mul $t4,$t4,$t5
sub $t2,$t2,$t4
mul $t1,$t1,$t2

add $t0,$t0,$t1
```

```
# The Second computation
lw $t1,X0($s1)
lw $t2,X1($s0)
lw $t3,X2($s2)
lw $t4,X2($s0)
lw $t5,X1($s2)
mul $t2,$t2,$t3
mul $t4,$t4,$t5
sub $t2,$t2,$t4
mul $t1,$t1,$t2

sub $t0,$t0,$t1

# The Third computation
lw $t1,X0($s2)
lw $t2,X1($s0)
lw $t3,X2($s1)
lw $t4,X2($s0)
lw $t5,X1($s1)
mul $t2,$t2,$t3
mul $t4,$t4,$t5
sub $t2,$t2,$t4
mul $t1,$t1,$t2

add $t0,$t0,$t1
# print to console
move $a0,$t0
li $v0,1
syscall

#exit the program:
li $v0,10
syscall
```



Text Segment

Bkpt	Address	Code	Basic	Source
□	0x00400000	0x24080000	addiu $8,$0,0	7: li $t0,0
□	0x00400004	0x24100000	addiu $16,$0,0	8: li $s0,0
□	0x00400008	0x24110004	addiu $17,$0,4	9: li $s1,4
□	0x0040000c	0x24120008	addiu $18,$0,8	10: li $s2,8
□	0x00400010	0x3c011001	lui $1,4097	12: lw $t1,X0($s0)
□	0x00400014	0x00300821	addu $1,$1,$16	
□	0x00400018	0x8c290000	lw $9,0($1)	
□	0x0040001c	0x3c011001	lui $1,4097	13: lw $t2,X1($s1)
□	0x00400020	0x00310821	addu $1,$1,$17	
□	0x00400024	0x8c2a000c	lw $10,12($1)	
□	0x00400028	0x3c011001	lui $1,4097	14: lw $t3,X2($s2)
□	0x0040002c	0x00320821	addu $1,$1,$18	

Labels

Label	Address ▲
M8	
X	0x10010000
X0	0x10010000
X1	0x1001000c
X2	0x10010018

☑ Data ☑ Text

Data Segment

Address	Value (+0)	Value (+4)	Value (+8)	Value (+c)	Value (+10)	Value (+14)	Value (+18)	Value (+1c)
0x10010000	8	1	6	3	5	7	4	9
0x10010020	2	0	0	0	0	0	0	0
0x10010040	0	0	0	0	0	0	0	0
0x10010060	0	0	0	0	0	0	0	0
0x10010080	0	0	0	0	0	0	0	0
0x100100a0	0	0	0	0	0	0	0	0
0x100100c0	0	0	0	0	0	0	0	0
0x100100e0	0	0	0	0	0	0	0	0
0x10010100	0	0	0	0	0	0	0	0
0x10010120	0	0	0	0	0	0	0	0

0x10010000 (.data) ☑ Hexadecimal Addresses □ Hexadecimal Values □ ASCII

Mars Messages | Run I/O

Clear

```
Reset: reset completed.

-360
-- program is finished running --
```

Name	Number	Value
$zero	0	0
$at	1	268500996
$v0	2	10
$v1	3	0
$a0	4	-360
$a1	5	0
$a2	6	0
$a3	7	0
$t0	8	-360
$t1	9	42
$t2	10	7
$t3	11	9
$t4	12	20
$t5	13	5
$t6	14	0
$t7	15	0
$s0	16	0
$s1	17	4
$s2	18	8
$s3	19	0
$s4	20	0
$s5	21	0
$s6	22	0
$s7	23	0
$t8	24	0
$t9	25	0
$k0	26	0
$k1	27	0
$gp	28	268468224
$sp	29	2147479548
$fp	30	0
$ra	31	0
pc		4194580
hi		0
lo		42