

MIPS Instruction Set & Programming:

# Introduction:

The purpose of this lab was to re-introduce students to MIPS Assembly language and challenge their technical knowledge of what it means at the machine level. This lab was to be completed in a MIPS assembler/simulator of the student’s choice.

The list of tasks were fully completed in lab:

- Installation of Mips Assembler

- Assemble provided MIPS code

- Verify Contents of code

- Complete table provided to student

# Design Methodology:

This lab consisted of code that was provided to the student to be used by the MIPS assembler.

# Procedure:

1. Download and install MARS MIPS Assembler
2. Copy and paste provided code into the editor.
3. Assemble the code and single-stem through it.
4. Verify registers contain expected values.
5. Fill out provided table and make note of any discrepancies.
6. Fix code so that registers contain expected values.

# Simulation Results:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Adr | Expected Machine Code | Actual Machine Code | PC | Registers | | | | | Memory Content | |
| $v0 | $v1 | $a0 | $a1 | $a3 | [80] | [84] |
| 00 | 20020005 | 20020005 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| 04 | 2003000c | 2003000c | 4 | 5 | c | 0 | 0 | 0 | 0 | 0 |
| 08 | 2067fff7 | 2067ffff | 8 | 5 | c | 0 | 0 | 3 | 0 | 0 |
| 0c | 00e22025 | 00e22025 | c | 5 | c | 7 | 0 | 3 | 0 | 0 |
| 10 | 00642824 | 00642824 | 10 | 5 | c | 7 | 4 | 3 | 0 | 0 |
| 14 | 00a42820 | 00a42820 | 14 | 5 | c | 7 | b | 3 | 0 | 0 |
| 18 | 10a7000a | 10e5000a | 18 | 5 | c | 7 | b | 3 | 0 | 0 |
| 1c | 0064202a | 0064202a | 1c | 5 | c | 0 | b | 3 | 0 | 0 |
| 20 | 10800001 | 10040001 | 20 | 5 | c | 0 | b | 3 | 0 | 0 |
| 24 | 20050000 | 20050000 |  |  |  |  |  |  |  |  |
| 28 | 00e2202a | 00e2202a | 28 | 5 | c | 1 | b | 3 | 0 | 0 |
| 2c | 00853820 | 00853820 | 2c | 5 | c | 1 | b | c | 0 | 0 |
| 30 | 00e23822 | 00e23822 | 30 | 5 | c | 1 | b | 7 | 0 | 0 |
| 34 | Ac670044 | Ac670044 | 34 | 5 | c | 1 | b | 7 | 7 | 0 |
| 38 | 8c020050 | 8c020050 | 38 | 7 | c | 1 | b | 7 | 7 | 0 |
| 3c | 08000011 | 08000011 | 3c | 7 | c | 1 | b | 7 | 7 | 0 |
| 40 | 20020001 | 20020001 |  |  |  |  |  |  |  |  |
| 44 | Ac020054 | Ac020054 | 44 | 7 | c | 1 | b | 7 | 7 | 7 |
| 48 | 08000000 | 08000000 | 48 | 7 | c | 1 | b | 7 | 7 | 7 |

# Source Code:

|  |
| --- |
| Provided Code |
| # mipstest.asm  # Test the following MIPS instructions.  # add, sub, and, or, slt, addi, lw, sw, beq, j  # Assembly Description Address Machine  main: addi $2, $0, 5 # initialize $2 = 5 0 20020005  addi $3, $0, 12 # initialize $3 = 12 4 2003000c  addi $7, $3, -9 # initialize $7 = 3 8 2067fff7  or $4, $7, $2 # $4 <= 3 or 5 = 7 c 00e22025  and $5, $3, $4 # $5 <= 12 and 7 = 4 10 00642824  add $5, $5, $4 # $5 = 4 + 7 = 11 14 00a42820  beq $5, $7, end # shouldn't be taken 18 10a7000a  slt $4, $3, $4 # $4 = 12 < 7 = 0 1c 0064202a  beq $4, $0, around # should be taken 20 10800001  addi $5, $0, 0 # shouldn't execute 24 20050000  around: slt $4, $7, $2 # $4 = 3 < 5 = 1 28 00e2202a  add $7, $4, $5 # $7 = 1 + 11 = 12 2c 00853820  sub $7, $7, $2 # $7 = 12 - 5 = 7 30 00e23822  sw $7, 68($3) # [80] = 7 34 ac670044  lw $2, 80($0) # $2 = [80] = 7 38 8c020050  j end # should be taken 3c 08000011  addi $2, $0, 1 # shouldn't execute 40 20020001  end: sw $2, 84($0) # write adr 84 = 7 44 ac020054  j main # go back to beginning 48 08000000 |

|  |
| --- |
| Fixed Code |
| # mipstest.asm  # Test the following MIPS instructions.  # add, sub, and, or, slt, addi, lw, sw, beq, j  # Assembly Description Address Machine  main: addi $2, $0, 5 # initialize $2 = 5 0 20020005  addi $3, $0, 12 # initialize $3 = 12 4 2003000c  addi $7, $3, -9 # initialize $7 = 3 8 2067fff7  or $4, $7, $2 # $4 <= 3 or 5 = 7 c 00e22025  and $5, $3, $4 # $5 <= 12 and 7 = 4 10 00642824  add $5, $5, $4 # $5 = 4 + 7 = 11 14 00a42820  beq $7, $5, end # shouldn't be taken 18 10a7000a  slt $4, $3, $4 # $4 = 12 < 7 = 0 1c 0064202a  beq $7, $5, around # should be taken 20 10800001  addi $5, $0, 0 # shouldn't execute 24 20050000  around: slt $4, $7, $2 # $4 = 3 < 5 = 1 28 00e2202a  add $7, $4, $5 # $7 = 1 + 11 = 12 2c 00853820  sub $7, $7, $2 # $7 = 12 - 5 = 7 30 00e23822  sw $7, 68($3) # [80] = 7 34 ac670044  lw $2, 80($0) # $2 = [80] = 7 38 8c020050  j end # should be taken 3c 08000011  addi $2, $0, 1 # shouldn't execute 40 20020001  end: sw $2, 84($0) # write adr 84 = 7 44 ac020054  j main # go back to beginning 48 08000000 |

***Appendix***

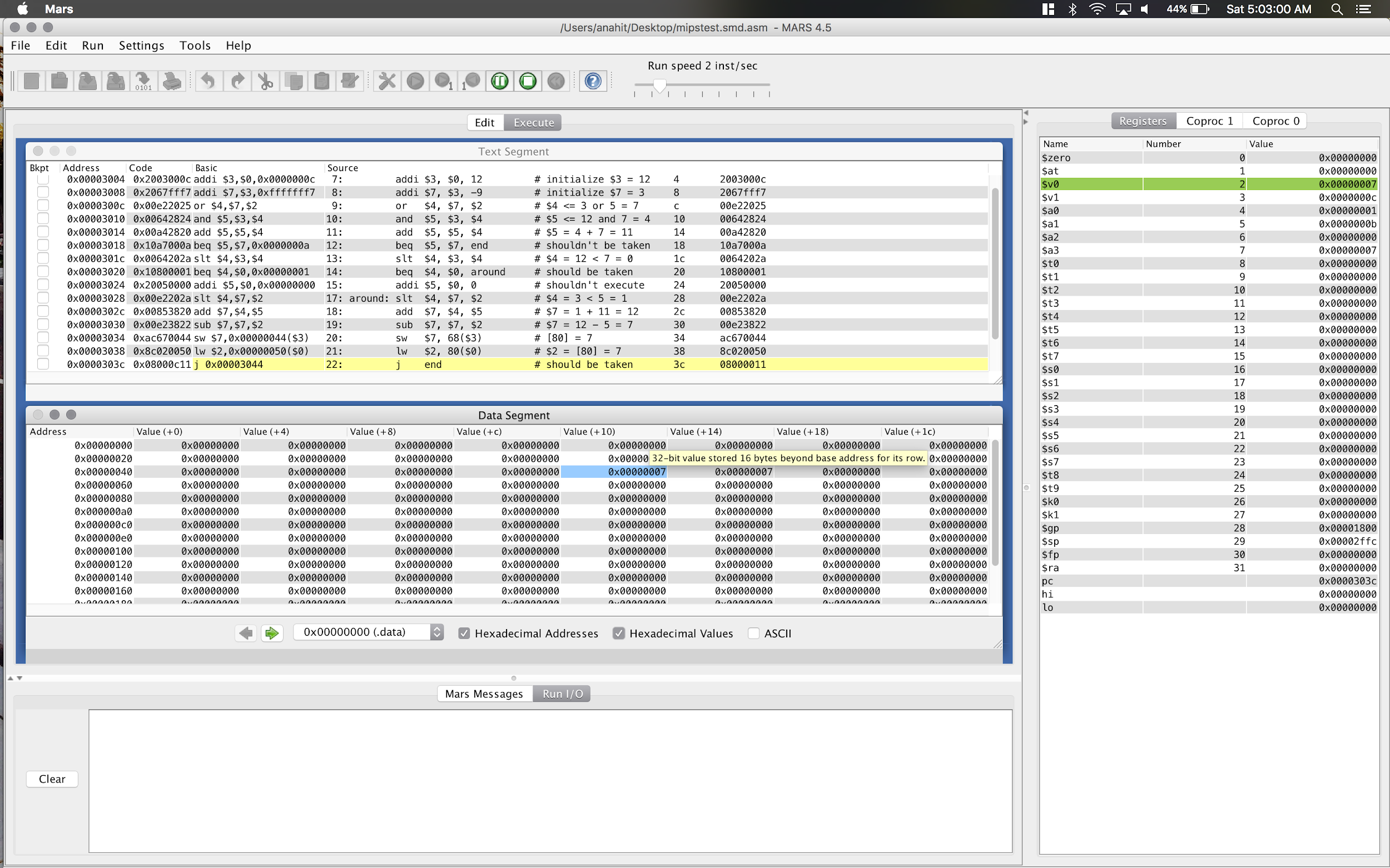


FIgure 1. Mars MIPS Code Execution

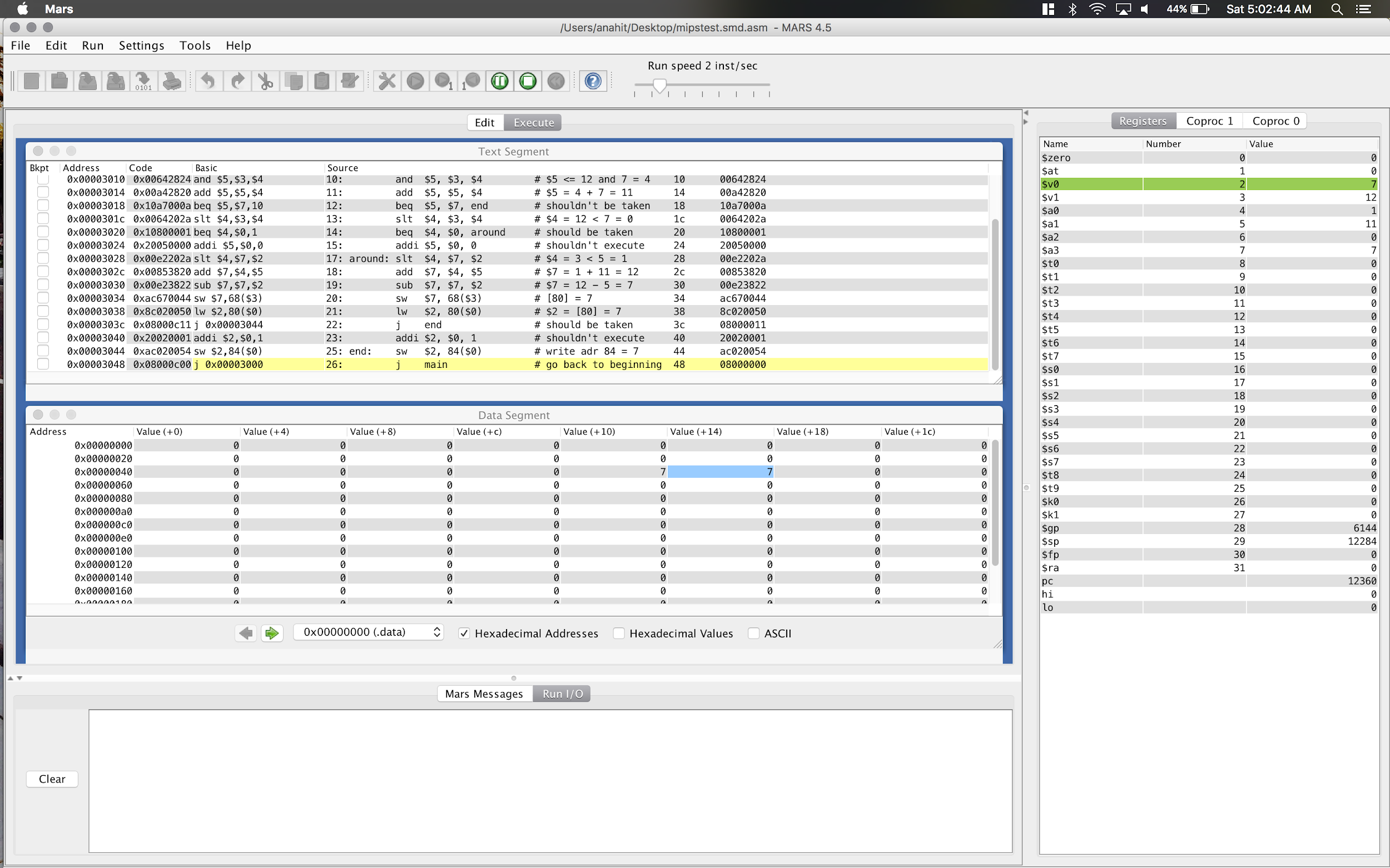


FIgure 2. Mars MIPS Code Execution