

EE 2310 Homework #9 – Shift, Rotate, Memory Access, Jump, Set, and Branch Instructions

Below are snapshots of MIPS registers, a data declaration, and a SPIM memory dump from the data section. All register/memory contents are shown in hexadecimal form. Given the data shown below, answer the following questions. **NOTE: Changes to a register or memory location made in one problem do not carry to any other problem.**

.data
n: .word
p: .word
q: .word
r: .word
s: .word
t: .word
u: .word
v: .word
w: .word
x: .word
y: .word
z: .word
str:
.asciiz
"hello
world\n"

MIPS Registers

R0 (r0): 0x00000000	R8 (t0): 0x0f0f0f0f	R16 (s0): 0x00000000	R24 (t8): 0x00000000
R1 (at): 0x10010000	R9 (t1): 0x0000ffff	R17 (s1): 0x00000000	R25 (t9): 0x00000000
R2 (v0): 0x0000000b	R10 (t2): 0x00000000	R18 (s2): 0x00000058	R26 (k0): 0x00000000
R3 (v1): 0x00000000	R11 (t3): 0x10010020	R19 (s3): 0x00000000	R27 (k1): 0x00000000
R4 (a0): 0x00000058	R12 (t4): 0x100100f0	R20 (s4): 0x00400020	R28 (gp): 0x10008000
R5 (a1): 0x10010010	R13 (t5): 0x10010030	R21 (s5): 0x00000000	R29 (sp): 0x7ffffeff0
R6 (a2): 0x0000000c	R14 (t6): 0x80000080	R22 (s6): 0x800c1001	R30 (s8): 0x00000000
R7 (a3): 0x00000010	R15 (t7): 0xffff0000	R23 (s7): 0x00000050	R31 (ra): 0x00400070

Data

[0x10000000]...[0x1000ffff] 0x00000000

[0x10010000]	0x5350494d	0x20697320	0x61207573	0x6566756c
[0x10010010]	0x2073696d	0x756c6174	0x6f722066	0x6f72206c
[0x10010020]	0x6561726e	0x696e6720	0x4d495053	0x20617373
[0x10010030]	0x68656c6c	0x6f20776f	0x726c640a	0x00000000
[0x10010040]	0x726f6772	0x616d6d69	0x6e672061	0x6e642063
[0x10010050]	0x6f6d7075	0x74657220	0x61726368	0x69746563

[0x10010060]...[0x10020000] 0x00000000

1. What is the value of variable r ? _____
2. What is the value of variable u ? _____
3. After `lw $t1, v`, what are the contents of $\$t1$? _____
4. After `lw $t6, x`, what are the contents of $\$t6$? _____
5. After `lw $t0, 20($t5)`, what are the contents of $\$t0$? _____
6. After `lw $t0, 12($a1)`, what are the contents of $\$t0$? _____
7. After `lb $t0, 10 ($a1)` , what are the contents of $\$t0$? _____
8. After `lui $t0, 0xffe8`, what are the contents of $\$t0$? _____
9. After `srl, $t0, $t7, 16`, what are the contents of $\$t7$ (yes, $\$t7$)? _____
10. After `srl, $t0, $sp, 16`, what are the contents of $\$t0$? _____
11. After `sra, $t0, $t6, 16`, what are the contents of $\$t0$? _____
12. After `rol, $t0, $t7, 8`, what are the contents of $\$t0$? _____
13. After `ror, $t0, $a1, 8`, what are the contents of $\$t0$? _____
14. After `ror, $t0, $t1, 24`, what are the contents of $\$t0$? _____
15. After `sra, $t0, $t6, 17`, what are the contents of $\$t0$? _____
16. After `sra, $t0, $sp, 16`, what are the contents of $\$t0$? _____
17. After `sll, $t0, $ra, 24`, what are the contents of $\$t0$? _____
18. After `rol, $t0, $sp, 10`, what are the contents of $\$t0$? _____
19. After `jr ($ra)`, what are the contents of the PC? _____
20. After `bgez $t0, go`, is the branch to “go” taken? _____
21. After `ble $t2, $t1, kloop`, is the branch to “kloop” taken? _____
22. After `bgtz $s6, calc`, is the branch to “calc” taken? _____
23. After `slt $t0, $t3, $t4; beqz $t0, loop`, is the branch to “loop” taken? _____
24. After `sgt $t2, $sp, $t0; bgtz $t2, on`, is the branch to “on” taken? _____
25. After `lw $t2, 12($t5); bltz $t2, loop4`, is the branch to “loop4” taken? _____

1. The program at the right does a mathematical and logical calculation. There is no data declaration shown, but you can use the one on page 1 of this homework.

Answer the following questions:

1.1. Where is the result stored?

1.2. What is the result (state in hex numbers)?

1.3. What do we call the number 0xffff in the third (andi) instruction with respect to the contents of the destination register?

```
.text
main: lw $t0,n
      andi $t0,$t0,0xffff
      srl $t0,$t0,12
      sll $t0,$t0,1
      add $t2,$t0,0x10
      li $v0,10
      syscall
```

2. Write a program to do the following (again, no data declaration is necessary):

- a. Load the data word v into \$t0.
- b. Do a left rotate six places.
- c. Test to see if the word is negative using a slt instruction.
- d. If negative, output to console using syscall 1, then stop.
- e. If positive or 0, simply stop.
- f. Is the resulting number in \$t1 negative?

```
.text
main:
```

3. Using the data declaration on page 1, write a loop program to do the following:

- a. Load the words “w” to “z” into \$t0, one after another.
- b. Output them to the console.
- c. Output “CR/LF” between words.
- d. Stop when finished.
- e. Hint: A counter will help.

```
.text
main:
```