Computer Science M151B, Homework 1

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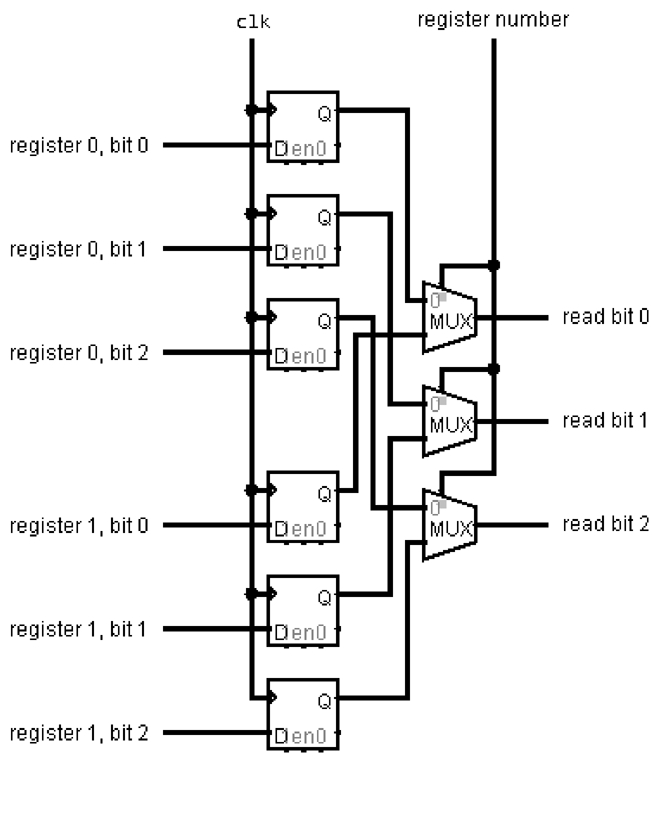
April 9th, 2018

Problem 1



Problem 2

```
addi $9,  $5,  -12
add  $10, $5,  $8
sll  $9,  $9,  2
sll  $10, $10, 2
lui  $11, 0x351C
slr  $11, $11, 16
lui  $11, 0x3B
add  $9,  $9,  $11
add  $10, $10, $11
lw   $12, 0($10)
sub  $12, $12, $13
sw   $12, 0($9)
```

Problem 3

```
addi $8,  $0,  0xFF
sll  $8,  $8,  10
and  $9,  $14, $8
sll  $9,  $9,  14
sll  $8,  $8,  14
nor  $8,  $8,  $0
and  $22, $22, $8
or   $22, $22, $9
```

Problem 4

```
slt  $20, $0,  $17 # $0 < $17, so $20=1
bne  $20, $0,  1   # $20 != $0, so increase program counter by 1
beq  $0,  $0,  1   # skipped
addi $20, $20, 2   # $20 = $20 + 2, so $20=3
```

The final value of register `$20` is 3. The flow of execution is such that the first instruction stores 1 in register `$20`, which then causes the next instruction to branch. This skips the third instruction, and finally the last instruction adds 2 to register `$20` and stores it, resulting in the value of 3.

Problem 5

The machine code in binary is

```
1001 0110 1100 1110 0000 0000 0010 1101
```

Problem 6

Address	op	rs	rt	rd	shamt	func	inst
0000 0001 1100 0100	001000	00000	01111	0000 0000 0010 0001			addi
0000 0001 1100 1000	000000	00000	00101	00100	00010	000000	sll
0000 0001 1100 1100	000000	01011	00100	00100	00000	100000	add
0000 0001 1101 0000	100011	00100	00100	0000 0000 0000 0000			lw
0000 0001 1101 0100	000100	00100	01111	0000 0000 0000 0111			beq
0000 0001 1101 1000	001000	00101	00101	0000 0000 0000 0001			addi
0000 0001 1101 1100	000000	00111	00100	00011	00000	101010	slt
0000 0001 1110 0000	000100	00011	00000	0000 0000 0000 0010			beq
0000 0001 1110 0100	000000	01100	00100	01100	00000	100000	add
0000 0001 1110 1000	000010	00 0000 0000 0000 0000 0111 0010					j
0000 0001 1110 1100	000000	01100	00111	01100	00000	100010	sub
0000 0001 1111 0000	000010	00 0000 0000 0000 0000 0111 0010					j

Problem 7

```
sltu $13, $25, $22
```

No assumptions are made, this exactly captures the functionality of `sgtu`.

Problem 8

```
lui  $8,  0x5D2C
slr  $8,  $8,  16
lui  $8,  0x34
lw   $8,  0($8)
lui  $9,  0x9878
slr  $9,  $9,  16
lui  $9,  0xDABA
```

```
beq  $5,  $8,  1
jr   $9
```

This code loads both 32-bit immediates into registers `$8` and `$9`, then uses a branch if equal to skip a jump instruction. The address stored at register `$8` is dereferenced using the load word instruction, and then compared to register `$5`. If register `$5` and the value at `$8` is equal, no jump happens due to the branch. Otherwise the values are not equal, and a jump will happen to the address given by the second immediate, which is stored in register `$9`. An assumption is that registers `$8` and `$9` are not already being used.

Problem 9

```
addi $4,  $0,  1
sll  $4,  $4,  24
sw   $4,  8($0)
lb   $4,  8($0)   # 0 if little endian, 1 if big endian
sb   $4,  129($0)
```

This code puts the hex value `0x01000000` into register `$4`, then stores register `$4` into main memory at addresses 8-11. Because this is done using a store word operation, the order of the bytes depend on whether the computer is little endian or big endian. The code then loads the byte at address 8 to check endianness. If the computer is big endian a 1 should have been loaded, otherwise a 0 should have been loaded. Finally the program stores the byte that was loaded into the byte at address 129.