

Name-Last Name: _____ Student ID: _____

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BBM234 Computer Organization	Instructors: Assoc. Prof. Dr. Suleyman TOSUN
Midterm Exam	
Duration: 100 minutes	Exam Date: 27.03.2018

Questions	1	2	3	4	Total
Marks	30	20	30	20	100
Earned					

Q1. You are given the part of the MIPS code and addresses for each instruction. You also have the Opcode and Funct values given in decimal.

Address	Instruction	Opcode/Funct
0x00400000	lui \$16, 0x1000	15/.
0x00400004	jal Function	3/.
.....	
.....	
0x0040001C	Function addi \$16, \$16, 4	8/.
0x00400020	lw \$17, 0(\$16)	35/.
0x00400024	jr \$31	?/8

a) [20 points] Write the machine code for jal and jr instructions.

	Binary	Hexadecimal
	0000 0000 0100 0000 0000 0000 0001 1100	0x0040001C
jal	000011 00 0001 0000 0000 0000 0000 0111	0x 0C10 0007
jr	000000 11111 00000 00000 00000 001000	0x 03E0 0008
	opcode Rs (31) Rt (0) Rd (0) shamt funct	

b) [10 points] Write content of following registers in hexadecimal after the program executes.

\$16	0x1000 0004 (After lui, s0=0x10000000. After addi, s0=0x10000000+4=0x10000004)
\$31	0x 00400008 (The address after jal instruction)

Q2. Write the MIPS instruction(s) for the following pseudoinstructions.

	Description	Pseudoinstruction	MIPS Instruction(s)
a	[s0]=not [s1]	not \$s0, \$s1	nor \$s0, \$s1, \$0
b	Load 16-bit immediate to \$s0	li \$s0, 0x0005	addi \$s0, \$0, 0x0005 (ori \$s0, \$0, 0x0005)
c	Branch unconditionally (not jump)	b label	beq \$0, \$0, label
d	Multiply \$s1 and \$s2, put result into 32-bit register \$s0	mul \$s0, \$s1, \$s2	mult \$s1, \$s2 mflo \$s0

Q3. Write a MIPS code that counts the number of equal neighbors in an array. In another words, convert the following C code to the MIPS code. Suppose the base address of array A is 0x12348000.

```
int A[10];
int count=0;
for(i=0; i<9; i=i+1){
    if(A[i]==A[i+1])
        count=count+1;
}
```

```
lui $t0, 0x1234
ori $t0, $t0, 0x8000
addi $s0, $0, 0          #count
addi $s1, $0, 0          #i
addi $s2, $0, 9

loop: slt $t1, $s1, $s2
      beq $t1, $0, done

      sll $t2, $s1, 2      #t2=i*4
      add $t2, $t0, $t2

      lw $s3, 0($t2)
      lw $s4, 4($t2)

      bne $s3, $s4, not_eq
      addi $s0, $s0, 1      # count++

not_eq: addi $s1, $s1, 1     #i++
        j loop

done: ...
```

Q4. You are given following MIPS code:

- a) [8 points] In the following MIPS function, there are two mistakes on the instructions or their usage. Show them and write their correct version.

```

                                addi $s0, $0, A
                                addi $s1, $0, B
                                addi $s2, $0, 0
while: slt $t0, $s0, $s1
      bne $t0, $0, done
      sub $s0, $s0, $s1
      addi $s2, $s2, 1
      jr while
done:  add $v0, $s2, 0
      addi $v1, $s0, 0
```

	Wrong instruction	Corrected instruction
1	jr while	j while
2	add \$v0, \$s2, 0	add \$v0, \$s2, \$0 addi \$v0, \$s2, 0

- b) [8 points] Write the return values of the function (\$v0 and \$v1) for the following A and B values:

A=5, B=2	
v0= 2	v1= 1
A=9, B=3	
v0= 3	v1= 0

- c) [4 points] What does this function do? What does it return in \$v0 and \$v1?

Divides A to B (A/B). v0 and v1 hold the quotient (result) and remainder of the division.