



United International University

Department of Computer Science and Engineering

CSE-3313: Computer Architecture

Midterm Examination: Fall 2023

Total Marks: 30 Time: 1 hour and 45 minutes

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

Answer all questions. Numbers to the right of the questions denote their marks.

1. (a) Consider three different processors P1, P2, and P3 executing the same instruction set architecture (ISA). P1 has a $3GHz$ clock rate and a CPI of 1.5. P2 has a $2.5GHz$ clock rate and a CPI of 1.0. P3 has a $4.0GHz$ clock rate and has a CPI of 2.2.
 - i. **Find** out which processor performs better by calculating CPU time. [3]
 - ii. If each processor's execute a program in 10 seconds, **find** the number of clock cycles and the number of instructions. [3]
- (b) Consider a program running on a computer that requires $280ns$, with $80ns$ spent executing FP instructions, $180ns$ executed L/S instructions, and $20ns$ spent executing branch instructions.
 - i. By how much is the total time reduced if the time for FP operations is reduced by 20? [1]
 - ii. What is the improvement factor using Amdahl's law if we only improve the performance of L/S instructions using a better ALU to get the program completion time improved by $2x$? [3]

2. Consider the following C function. Assume necessary registers.

```
1 2000: int check_func(int a[],int x){
2     if(x%2){
3         a[x] = a[x]-x;
4         return a[x];
5     }
6 }
7 3000: int get_sum(int a[],int b[],int k){
8     int sum = 0;
9     for(int i=0;i<k;i++){
10        if(check_func(a[i+1],i)){
11            b[i] = sum + (a[i]-b[i])/2;
12            sum = b[i];
13        }
14    }
15    return sum;
16 }
17 int main() {
18 PC->5000: int res=0,n=10;
19     int a[n],b[n];
20     res = get_sum(a,b,n);
21     res = res*9;
22     return 0;
23 }
```

- (a) **Convert** the code to the corresponding MIPS assembly instructions. [8]
 - (b) **Convert** the first 12 lines of get_sum() function's assembly instructions to the corresponding machine code. No need to convert it to binary. [6]
 - (c) Monica claims that the `sll $t0, $s1, 40` instruction is correct in the MIPS architecture, but Joey disagrees with Monica's claim. **Justify** your opinion with a proper explanation. [2]
3. Using the optimized multiplication algorithm, **show** each step of the multiplication of 12 by 3. [4]

Instruction	Opcode	Function Code
add	0	32
sub	0	34
lw	35	-
sw	43	-
and	0	36
or	0	37
nor	0	39
andi	12	-
ori	13	-
sll	0	0
srl	0	2
beq	4	-
bne	5	-
slt	0	42
j	2	-
jr	0	8
jal	3	-
addi	8	-

Table 1: MIPS Machine Codes

Name	Register Number
\$zero	0
\$at	1
\$v0-\$v1	2-3
\$a0-\$a3	4-7
\$t0-\$t7	8-15
\$s0-\$s7	16-23
\$t8-\$t9	24-25
\$k0-\$k1	26-27
\$gp	28
\$sp	29
\$fp	30
\$ra	31

Table 2: MIPS Registers