

CS230 - Digital Logic Design and Computer Architecture

Problem Set 3

Autumn 2023

Q1. Consider the following C++ program:

```
int t0 = 3;
if (t0 < 7)
    t1 = 7 + t0;
else
    t1 = t0 + t0;
```

Convert this into the MIPS program.

Q2. Suppose there is a system which has 32 bit instructions and 64 general purpose registers. Answer the following questions:

- (a) What is the number of bits required for the registers?
- (b) Is it possible to have various operations consisting of 30 three-address instructions, 40 two-address instructions and 60 one-address instructions?

Q3. Consider a 32-bit processor which supports 70 instructions. Each instruction is 32 bit long and has 4 fields namely opcode, two register identifiers and an immediate operand of unsigned integer type. Maximum value of the immediate operand that can be supported by the processor is 8191. How many registers the processor has?

Q4. Consider the following code segment:

```
int a, b, c, d, e, f, g, h, i, j, k, l, m, n, o;
a = b * c;
d = a - e;
f = d + g;
h = f * i;
```

1
2
3
4
5

- (a) If you are using temporary registers of MIPS ISA for the code segment, will there be any spill to the memory?
- (b) If you are allowed to change the number of temporary registers, then what is the minimum number of registers required so that there is no spill to the memory for the given code segment?

Q5. For the following sequence of MIPS instructions, identify the final value present in each register after the code has been executed.

```
li    $t0, 4
li    $t1, 7
li    $t2, 3
sub   $t3, $t1, $t2
beq   $t0, $t3, next
add   $s0, $zero, $t3
j     end
next:
      add   $s0, $t1, $t2
end:
```