CSE 490/590 Spring 2025 **Homework 1** **NOT GRADED**

Updated Content in Green and highlighted

[Question 1]

A program's run time is determined by the product of instructions per program, cycles per instruction, and clock frequency. Assume the following instruction mix for a MIPS-like instruction set and compute the overall CPI. **Show your work.**

Instruction Type	% of program	Cycles needed
Store and Load	40%	2
Branch	10%	4
Integer Add	30%	1
Shift	10%	1
Integer Multiply	10%	10

[Question 2]

Consider three different processors P1, P2, and P3 executing the same instruction set.

Processor	Clock Speed in GHz	CPI
P1	3.0	1.5
P2	2.5	1.0
P3	4.0	2.2

Which processor has the highest performance expressed in instructions per second? Remember, 1GHz = 10^9Hz. **Show your work.**

[Question 3]

a. Provide the assembly language instruction for the following R type instruction which is written in binary: [Use the MIPS Green Sheet]

```
0000 0010 0001 0000 1000 1000 0010 0000
```

b. Provide the binary of the following R type Instruction [Use the MIPS Green Sheet]

```
sub $v1,$v1,$v0
```

[Question 4]

For the following C statement, what is the corresponding MIPS assembly code? Assume that the variables `f`, `g`, `h`, and `i`, are given and are assigned to registers $s2, $s3, $s4, and $s5 respectively. Use a minimal number of MIPS assembly instructions.

```
f = (g + h) - (5 + i);
```

[Question 5]

Consider a byte-addressable memory system with the following contents:

Memory Location	Value
0x2000	0x01
0x2001	0x56
0x2002	0x70
0x2003	0x12
0x2004	0x23
0x2005	0x45
0x2006	0x67
0x2007	0x89

a. Assume `$s1` contains the value `0x2000`. After executing the instruction `lw $s0, 4($s1)` what will `$s0` contain? Use big-endian.

b. Assume `$s0` contains the value `0x12121212` and `$s1` contains the value `0x2006`. After executing the instruction `lb $s0, 1($s1)` what will `$s0` contain?

[Question 6]

Assume `$t1` contains the value `0x0000000A`. What will the value of `$t1 $t0` be after the following instruction is executed:

```
sll $t0, $t1, 5
```

[Question 7]

Given the following instruction,

```
beq $s0, $s1, L1
```

Replace it by using other instruction(s) that offers a much greater branching distance.

[Question 8]

Main routine `M1` calls a procedure `P1` with the instruction `jal P1`. The return address in the main routine when it returns from the procedure `P1` is labelled as `RM`. The stack pointer has an initial value of `0x0700C`.

Procedure `P1` will use save registers `$s0` and `$s1`, and hence need to save these on the stack. Procedure `P1` calls another procedure `P2`, with a return address (in `P1`) labeled `RP1`.

Note, `RM` (which is stored in `$ra`) needs to be saved on the stack and restored eventually to `$ra` to return to the Main routine (since there is a call to another procedure).

Procedure `P2` uses save register `$s4`, (and hence needs to be saved on the stack). Show the stack pointer value right after `$s4` is saved. Also, show the stack contents (updated in the entire sequence).