NAME _____

STUDENT NUMBER _____

COMP ENG 3DR4 Midterm Test
Feb 25, 2009

INSTRUCTIONS:

- This is a closed-book, closed-note exam.
- Total time allowed is 120 minutes.
- There are 5 questions. Budget your time accordingly
- Write your name and student number on every page.
- Total mark available is 30.
- No wireless devices of any kind (e.g., cell phone, PDA, wireless internet access of any kind) are allowed.

Question	Mark
1	
2	
3	
4	
5	
Total	

1. (6 points) Consider two different implementations, M1 and M2, of the same instruction set. There are three classes of instructions (A, B, and C) in the instruction set. M1 has a clock rate of 80 MHz and M2 has a clock rate of 100 MHz. The average number of cycles for each instruction class and their frequencies (for a typical program) are as follows:

Instruction Class	Machine M1 – Cycles/Instruction Class	Machine M2 – Cycles/Instruction Class	Frequency
A	1	2	60%
B	2	3	30%
C	4	4	10%

(a) Calculate the average CPI for each machine, M1, and M2.
(b) Calculate the average MIPS (Mega Instructions Per Second) ratings for each machine, M1 and M2.
(c) Which machine has a smaller MIPS rating? Which individual instruction class CPI do you need to change, and by how much, to have this machine have the same or better performance as the machine with the higher MIPS rating (you can only change the CPI for one of the instruction classes on the slower machine)?

2. (6 points) Consider 32-bit constant 10101101000100000000000000000010
a) Write the MIPS code that stores the 32-bit constant into register $t1 (do not use pseudo instructions)
b) If the current value of the PC is 0x00000000, how many branch instructions do you need to get to the above address?
c) If the current value of the PC is 0x00400600 how many branch instructions do you need to get to the above address?

3. (6 points) Convert the C function below to MIPS assembly language.

```
unsigned int sum(unsigned int n)
{
if (n == 0) return 0;
else return n + sum(n-1);
}
```

4. (6 points) Write a procedure, rev, in MIPS assembly language that reads a null-terminated string of ASCII characters and writes them in reverse order (e.g., “abc” is converted to “cba”). Assume that the address of start of the string is in register $a0 and the address of start of reverse string is in $a1. Do NOT use pseudo instructions.

5. (6 points) Find the shortest sequence of MIPS instructions to perform 64-bit integer addition. Assume that one 64-bit, two’s complement integer is in registers $t4 and $t5 and another is in registers $t6 and $t7. The result is to be placed in registers $t2 and $t3. In this example, the most significant word of the 64-bit integer is found in the even-numbered registers, and the least significant word is found in the odd-numbered registers. (Hint: It can be done in four instructions.)