CSE 378 Midterm Exam

Snyder/Wolman 5 November 1997

Answer all questions. Write in the space provided. Show all work, since the process of arriving at the answer is always more important than the answer itself. COMMENT YOUR CODE, PLEASE!

1. [1] "MUX" is the abbreviated term for _____.

2. [2] What is the binary representation of the hexadecimal number: 2bad4dad

3. [2] Show the normalized form of the binary floating point number: 10001010111.00101

4. [4] What are the facts?
   (a) What is the double precision floating point bias?

   (b) What is the single precision floating point representation for zero?

   (c) Explain whether or not it is POSSIBLE to represent one million exactly as a single precision floating point value.

5. [6] MIPS has a rotate instruction that circularly shifts the contents of a register to the right, i.e. bits that shift out of the LSB appear in the MSB. Write an instruction sequence that doesn't use the rotate instruction, but rotates register $4 right 4 positions. (For extra credit don't use any assembler pseudo-instructions.)

6. [2] What decimal number does the twos complement number

1111111111110101

correspond to?

7. [4] Tracy writes the instructions

```
add $t0, $zero, $zero
add $s0, $zero, $zero
```

and after calling a procedure executes the instruction

```
slt $t1, $t0, $s0
```

What is contained in $t1 after executing this instruction and why?

8. [4] The op-code for lw is 35. Give (a) the symbolic form of the instruction to load the next to top item from the stack into register $4

(b) Give the binary equivalent given $sp is register 29.

9. [12] An architect needs an 5-bit ALU with four operations:

```
result = A and B
result = A or B
result = A shifted right 1 bit, 0 fill
result = A or (not B)
```

as well as a test for all result bits equal to zero. Show the block diagram and data paths for this ALU.

10. [6] A computer has a 10 MHz clock.

(a) How long in nanoseconds is the clock period?

(b) While performing a simple computation, the computer executes 4000 1 cycle instructions, 1000 2 cycle instructions 1000 3 cycle instructions. What is the CPI for this program?

(c) What is the CPU time for this program?

11. [7] (a) What does PC-relative addressing mean in the MIPS ISA?

(b) Give an example of a PC-relative instruction.

(c) Why is -1 rarely found in the offset field of PC-relative instructions?

12. [10] Suppose Pat is implementing a procedure called "factorial" with the following code:

```
     .globl     factorial
     .ent       factorial
factorial:
     subui      $sp, $sp, 32
     .frame     $sp, 32, $ra
     .mask      0x80040000, -8
```

(a) How large is the portion of the stack allocated for "locals and temporary values"?

(b) Which registers are saved at the start of this procedure? (You don't have to specify the symbolic names of the registers, only the numeric names.)

(c) Write the sw instructions that would immediately follow the .mask directive that perform the register save operations.

(d) How many bytes is the argument build area for this procedure?

13. [15] Assist Pat by writing the factorial computation in MIPS assembly language. Assume an integer n is supplied in a0, put the result in v0, and ignore overflow. (It is NOT necessary to combine this solution with problem #12; only computing factorial is required.)