

The University of Alabama in Huntsville  
Electrical & Computer Engineering Department  
CPE 431 01  
Test 1  
October 4, 2005

Name: \_\_\_\_\_

1. (1 point) A \_\_\_\_\_ is a computer inside another device used for running one predetermined application or collection of software.
2. (1 point) A \_\_\_\_\_ is an optical storage medium with a storage capacity of more than 4.7 GB. It was initially marketed for entertainment and later for computer users.
3. (1 point) A program that manages the resources of a computer for the benefit of the programs that run on that machine is a(n) \_\_\_\_\_.
4. (1 point) \_\_\_\_\_ is a nickname for a die or integrated circuit.
5. (1 point) To specify a register choice from a 512 register register file requires \_\_\_\_\_ bits.
6. (20 points) Using the following MIPS program, determine the instruction format for each instruction and the decimal values of each instruction field. Do not worry about whether this program does anything useful.

```
      addi    $v0, $zero
loop:  lw      $v1, 0($a0)
      sw      $v1, 0($a1)
      addi    $a0, $a0, 4
      beq     $v1, $zero, loop
```

8. (20 points) Given the bit pattern:

1010 1101 0001 0000 0000 0000 0000 0010<sub>2</sub>

what does it represent, assuming that it is

- a. a two's complement integer?
- b. an unsigned integer?
- c. a single precision floating-point number?
- d. a MIPS instruction?

9. (10 points) Show the IEEE 754 binary representation for the floating-point number  $20.5_{\text{ten}}$  in single and double precision.

10. (10 points) Pseudoinstructions are not part of the MIPS instruction set but often appear in MIPS programs. For each pseudoinstruction in the following table, produce a minimal sequence of actual MIPS instructions to accomplish the same thing. You may need to use \$at for some of the sequences. In the table, big refers to a specific number that requires 32 bits to represent and small to a number that can fit in 16 bits.

Pseudoinstruction	What it accomplishes
li \$t1, small	\$t1 = small
move \$t1, \$t2	\$t1 = \$t2
beq \$t2, big, L	if (\$t2 = big) go to L

11. (10 points) Consider two different implementations, P1 and P2 of the same instruction set. There are five classes of instructions (A, B, C, D, E) in the instruction set. P1 has a clock rate of 4 GHz. P2 has a clock rate of 6 GHz. The average number of cycles for each instruction class for P1 and P2 is as follows:

Class	CPI on P1	CPI on P2
A	1	2
B	2	2
C	3	2
D	4	4
E	3	4

Assume that peak performance is defined as the fastest rate that a computer can execute any instruction sequence. What are the peak performances of P1 and P2 expressed in instructions per second?

12. (10 points) Consider program P, which runs on a 1 GHz machine M in 10 seconds. An optimization is made to P, replacing all instances of multiplying a value by 16 (mult X, X, 4) with two instructions that set  $x$  to  $x + x$  four times (add X, X; add X, X; add X, X; add X, X). Call this new optimized program P'. The CPI of a multiply instruction is 10, and the CPI of an add is 1. After recompiling, the program now runs in 9 seconds on machine M. How many multiplies were replaced by the new compiler?
13. (15 points) One user has told you that three programs constitute the bulk of his workload, but he does not run them equally. The user wants to determine how these three computers compare when the workload consists of different mixes of these three programs.

Suppose the total execution time is equally divided among the three programs on computer C. Find which computer is fastest for this workload and by what factor.

Program	FLOPS	Computer A	Computer B	Computer C
1	$5 \times 10^9$	2 s	5 s	10 s
2	$20 \times 10^9$	20 s	20 s	20 s
3	$40 \times 10^9$	200 s	50 s	15 s