The University of Alabama in Huntsville
Electrical & Computer Engineering Department
CPE 431 01
Test 1
September 16, 2010

Name: _____

1. (1 point) State one of the design principles: _____.
2. (1 point) A form of representation of an instruction composed of fields of binary numbers is an _____
3. (1 point) The program that instigates a procedure and provides the necessary parameter values is the _____ .
4. (1 point) The register that is reserved to point to the static area is called the _____.
5. (1 point) A systems program that places an object program in main memory so that it is ready to execute is a _____.
6. (9 points) At the point where this function is called, registers `$a0`, `$a1`, `$a2`, and `$a3` have values 1, 100, 1000, and 30, respectively. What is the value returned by this function?

```
F:    sub   $s0, $a0, $a3
      sll   $v0, $s0, 0x1
      add   $v0, $a2, $v0
      sub   $v0, $v0, $a1
      jr    $ra
```

7. (6 points) What are the binary representations of the opcode, rs, rt, rd, shamt, and funct fields in this instruction?

```
slt $t0, $s1, $a0
```

8. (5 points) Show the IEEE 754 binary representation for the floating-point number 253.125_{10} in single precision.

9. (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 divided among the three programs so that the number of FLOPS (Floating-point operations) is equally divided between the three programs. Find which computer is fastest for this workload and by what factor.

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

10. (10 points) The following problems deal with translating from C to MIPS. Assume that the variables `f`, `g`, `h`, `i`, and `j` are assigned to registers `$s0`, `$s1`, `$s2`, `$s3`, and `$s4`, respectively. Assume that the base address of the arrays `A` and `B` are in registers `$s6` and `$s7`, respectively.

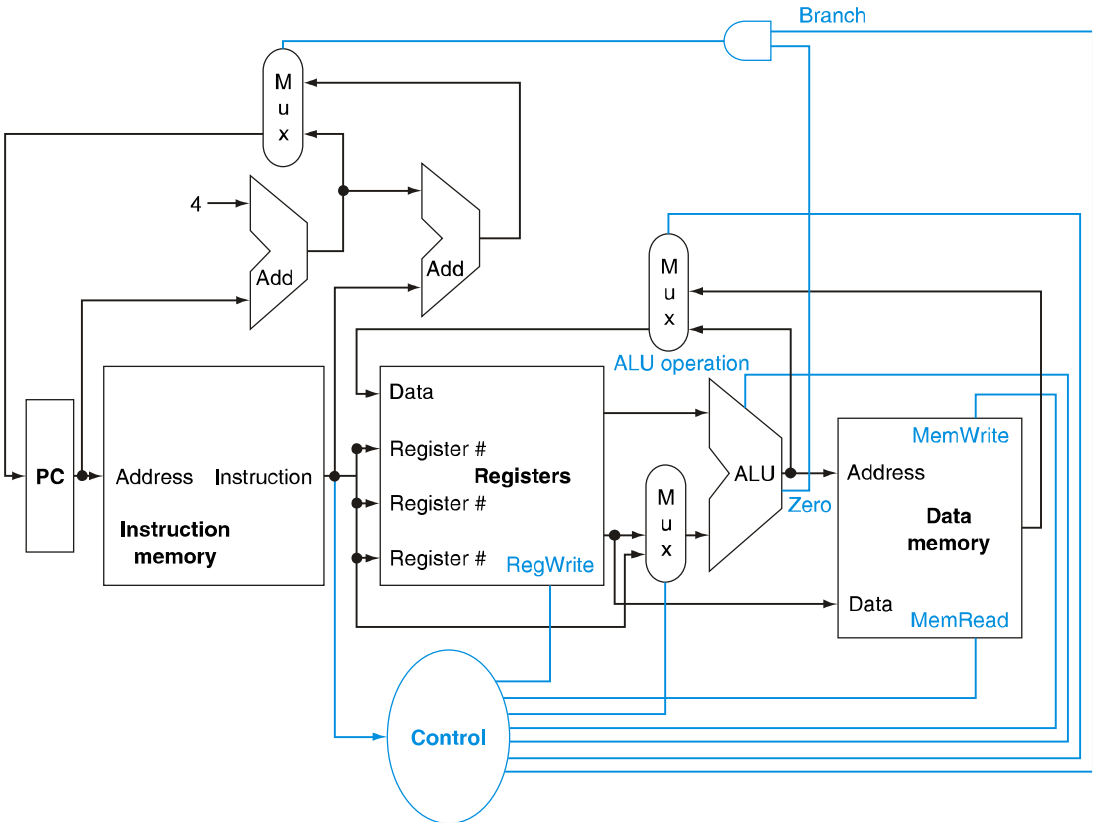
    f = g – A[B[4]]

11. (10 points) What decimal number does the bit pattern represent if it is a two's-complement integer? An unsigned integer?

    1010 1110 0011 0101

12. (20 points) When processor designers consider a possible improvement to the processor datapath, the decision usually depends on the cost/performance tradeoff. Consider the datapath shown, where I-Mem, Add, Mux, ALU, Regs, D-Mem, and Control blocks have latencies of 400 ps, 100 ps, 30 ps, 120 ps, 200 ps, 350 ps, and 100 ps, respectively, and costs of 1000, 30, 10, 100, 200, 2000, and 500, respectively. One possible improvement is to make the registers larger, this modification will add 100 ps to the latency for Regs, add 200 to the cost of Regs and result in 5% fewer instructions because fewer loads and stores are needed to save and restore register values.

a. (10 points) What is the clock cycle time with and without this improvement?
b. (10 points) Compare the cost/performance ratio with and without this improvement?



13. (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 defines 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?

14. (10 points) The following table shows the instruction type breakdown of a given application.

Floating-point Instructions	Integer Instructions	Load/Store Instructions	Branch Instructions	CPI (FP)	CPI (INT)	CPI (L/S)	CPI (Branch)
560×10^6	2000×10^6	1280×10^6	2560×10^6	1	1	4	2

Assume that the processor has a 2 GHz clock rate. What must the CPI of the L/S instructions be if we want the program to run two times faster if that is the only improvement made?