

The University of Alabama in Huntsville
Electrical & Computer Engineering Department
CPE 431 01
Test I
October 2, 2001

Name: _____

1. (10 points) Use the following code fragment:

```
loop: lw    $1, 0($2)
      addi  $1, $1, 4
      sw    $1, 0($2)
      add   $2, $2, $4
      bne   $2, $3, loop
```

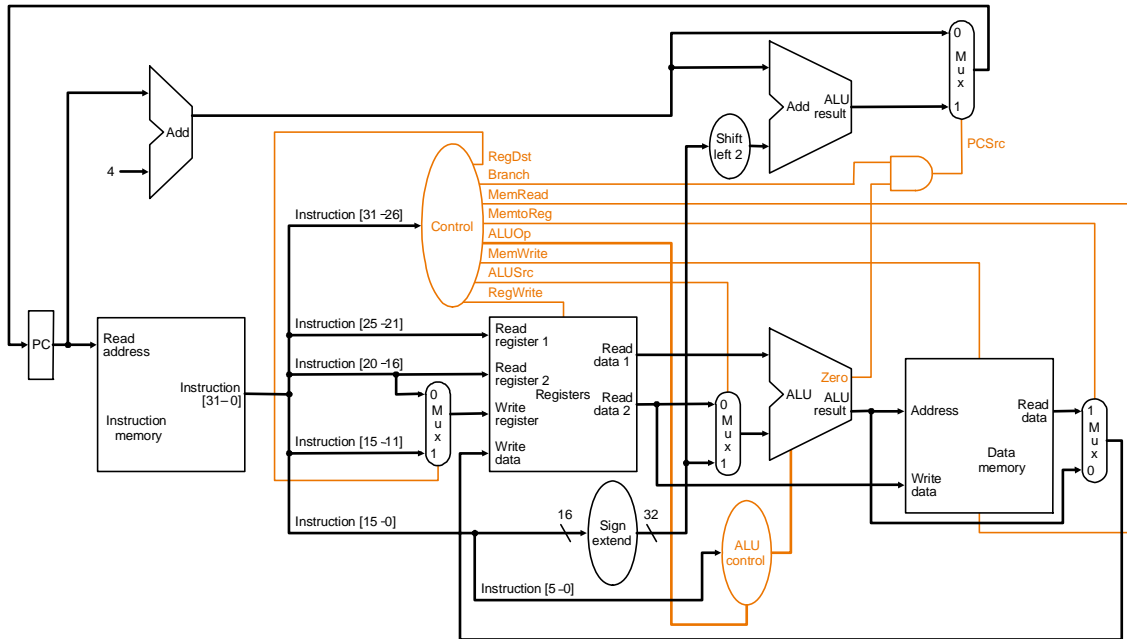
Assume that the initial value of \$2 is \$3 – 196 and that this code fragment is run on a machine with a 250-MHz clock that requires the following number of cycles for each instruction:

Instruction	Cycles
addi	1
add, bne	2
lw, sw	3

In the worst case, how many seconds will it take to execute this code?

2. (1 point) A _____ is a program that translates a symbolic version of an instruction into the binary version.
3. (1 point) A _____ is a rectangular component that results from dicing a wafer.

4. (10 points) Add the instruction `lui` (load upper immediate) to the single-cycle datapath shown in the figure below. Add any necessary datapaths and control signals and show the necessary additions to the table of control signals given.



Instruction	RegDst	ALUSrc	Memto Reg	Re Write	Mem Read	Mem Write	Branch	ALUOp1	ALUOp0
R-format	1	0	0	1	0	0	0	1	0
lw	0	1	1	1	1	0	0	0	0
sw	d	1	d	0	0	1	0	0	0
beq	d	0	d	0	0	0	1	0	1
lui									

d-don't care

5. (1 point) A _____ is an individual command to a computer.
6. (1 point) The _____ is the percentage of good dies from a total number of dies on a wafer.
7. (1 point) An _____ is a component of the processor that performs arithmetic operations.

8. (15 points) Consider two different implementations, M1 and M2, of the same instruction set. There are four classes of instructions (A, B, C, and D) in the instruction set. M1 has a clock rate of 400 MHz, and M2 has a clock rate of 200 MHz. The average number of cycles for each instruction class on M1 and M2 is given in the following table:

Class	CPI on M1	CPI on M2	C1 usage	C2 usage	Third-party usage	Fourth-party usage
A	3	2	20%	30%	30%	15%
B	5	3	25%	25%	30%	45%
C	7	4	30%	25%	30%	35%
D	8	5	25%	20%	10%	5%

The table also contains a summary of how four different compilers use the instruction set. C1 is a compiler produced by the makers of M1, C2 is a compiler produced by the maker of M2, and the other compilers are competing third- and fourth-party products. Assume that each compiler uses the same number of instructions for a given program but that the instruction mix is as described in the table.

Which compiler produces the best performance on M1?

9. (5 points) For the following C code, write an equivalent assembly language program in the accumulator style (assume all variables are initially in memory):

$a = b - c;$

10. (15 points) When designing memory systems, it becomes useful to know the frequency of memory reads versus writes and also accesses for instructions versus data. Using the following average instruction-mix information, find

- (1) (5 points) the percentage of all memory accesses for instructions
- (2) (5 points) the percentage of data accesses that are writes
- (3) (5 points) the percentage of all memory accesses that are reads.

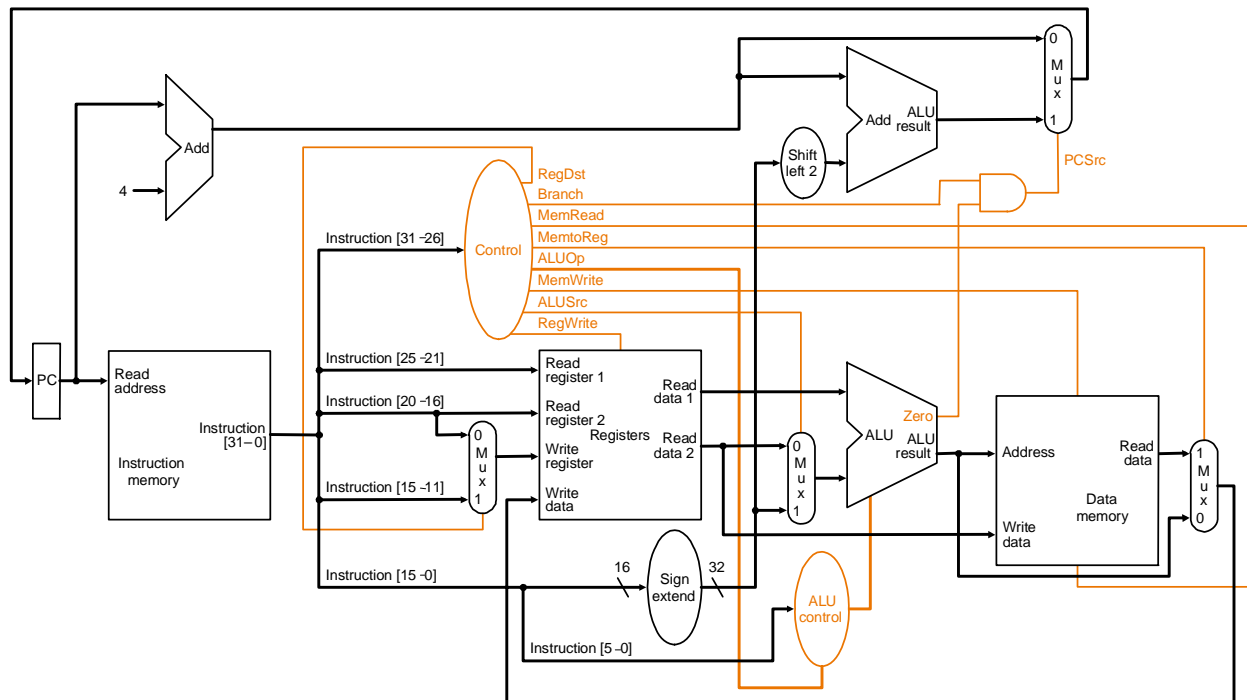
Instruction	Percentage
lw	29
sw	15
add	18
sub	3
lui	7
beq, bne	6
jump	3
and, or	16
mult	3

11. (5 points) What number does the two's complement binary number represent:

1111 1110 0000 1100₂?

12. (20 points) a. (5 points) Describe the effect that a single stuck-at-0 fault (i.e., regardless of what it should be, the signal is always 0) would have on the multiplexors in the single-cycle datapath shown. b. (15 points) Which instructions, if any would still work? Consider each of the following faults separately: RegDst = 0, ALUSrc = 0, MemtoReg = 0, Zero = 0.

	RegDst = 0	ALUSrc = 0	MemtoReg = 0	RegWrite = 0
R-type				
lw				
sw				
beq				



12. (15 points) The table below shows the number of floating-point operations executed in two different programs and the runtime for those programs on three different machines:

Program	Floating-point operations	Execution time in seconds		
		Computer A	Computer B	Computer C
1	10,000,000	1	10	20
2	100,000,000	1000	100	20

One user has told you that the two programs above constitute the bulk of his workload, but he does not run them equally. The user wants to determine how the three machines compare when the workload consists of different mixes of these programs. Suppose the total number of FLOPS executed in the workload is equally divided among the two programs. Find which machine is fastest for this workload and by how much.