MCS-284 Intraterm Exam 1

Serial #:

This exam is closed-book and mostly closed-notes. You may, however, use a single 8 1/2 by 11 sheet of paper with *hand-written* notes for reference. (Both sides of the sheet are OK.)

Please write your name only on this page. Do not turn the page until instructed, in order that everyone may have the same time. Then, be sure to look at all problems before deciding which one to do first. Some problems are easier than others, so plan your time accordingly. **You have 50 minutes to work. Choose only four of the five problems. If you do any work on all five, mark one "do not grade." Only four will be graded.**

Write the answer to each problem on the page on which that problem appears. You may also request additional paper, which should be labeled with your test number and the problem number.

Printed name: _____

Problem	Page	Possible	Score
1	2	25	
2	3	25	
3	4	25	
4	5	25	
5	6	25	
Total		100	

1. [**25 Points**] You are considering a change in the design of a computer. The software that runs on the computer is fixed, and will not be changed; of the instructions executed by this software, 10% are floating point instructions. The computer can execute floating point instructions in 5 cycles each and other instructions in 1 cycle each. A proposed revision to the computer's design would allow the clock rate to be increased from its current 2.8 GHz. However, the floating point instructions will now take 8 cycles. (The other instructions will be unchanged, still taking 1 cycle.)

   (a) What is the average CPI of the old computer?

   (b) What is the average CPI of the proposed new computer running the same workload?

   (c) How fast will the new clock rate need to be for the change to be beneficial for this workload?

2. [**25 Points**] Consider the following procedure named `foo`:

```
foo:
    ori $v0, $a0, 3
    beq $v0, $zero, done
    j bar
bar:
    ori $v0, $v0, 5
done:
    jr $ra
```

(a) Write as simple a replacement for the procedure as you can that computes the same function. (That is, for any argument value, the replacement needs to return the same answer as the original does.) Your replacement version needs to start with the label `foo`, but other than that, it does not need to have the same labels as the version above.

(b) Suppose in the original version of `foo` (shown above), the instruction `j bar` were changed to `jal bar`. Explain in detail how this modified version of `foo` would behave.

3. [**25 Points**] Consider the following 8-bit numerals:

$$\begin{aligned} A &= 01010101 \\ B &= 11010101 \\ C &= 00111000 \\ D &= 11101010 \end{aligned}$$

(a) Fill the letters A, B, C, and D into the appropriate blanks to make this statement true, provided that the numerals are interpreted using the twos-complement notation for signed integers:

$$\_\_\_\_ > \_\_\_\_ > \_\_\_\_ > \_\_\_\_$$

(b) Fill the letters A, B, C, and D into the appropriate blanks to make this statement true, provided that the numerals are interpreted as unsigned integers:

$$\_\_\_\_ > \_\_\_\_ > \_\_\_\_ > \_\_\_\_$$

(c) Which two of the numerals represent even integers? (This doesn't depend on twos-complement versus unsigned.)

(d) Which two of the numerals, if added using twos-complement arithmetic, would result in an overflow?

(e) Taking C as an unsigned integer, what is its value in decimal?

4. [**25 Points**] The following table lists four 32-bit floating point numerals; they are broken into meaningful groups of bits. For each numeral, put a T or F in each column, indicating whether the column's heading represents a true statement about the number.

x	$x < 0$	$x < 1$	$x < -10$	$x > -2$
1 01111111 10000000000000000000000				
1 10010000 01000000000000000000000				
0 10000101 01010000010001000000010				
0 00000011 00000000000000000000000				

5. [**25 Points**] Consider the following truth table:

inputs			outputs	
A	B	C	D	E
0	0	0	1	0
0	0	1	0	0
0	1	0	1	1
0	1	1	1	1
1	0	0	1	0
1	0	1	0	1
1	1	0	1	1
1	1	1	1	1

(a) Use input don't cares to rewrite the truth table using only four rows. Of the original eight rows, four will be compressed together into a single row using input don't cares. Two other rows from the original table will be compressed together into a single row. That leaves two more rows from the original eight which will be retained unchanged.

(b) Add dots to the following PLA diagram so that it will implement the functions from the table. Do not add any lines.