YOUR NAME PLEASE:

Computer Science 201a
PRACTICE Midterm
October 10, 2001

Open book and open notes. Show ALL work you want graded on the test itself, including the backs of pages as necessary.

For problems that do not ask you to justify the answer, an answer alone is sufficient. However, if the answer is wrong and no derivation or supporting reasoning is given, there will be no partial credit.

GOOD LUCK!

problem	points	actual
1	15	
2	15	
3	12	
4	10	
5	10	
6	10	
total	72	

1.(a) (10 points) Write a Scheme procedure (change item1 item2 ls) that changes every top-level occurrence of item1 in ls to item2.

Examples:

```
(change 3 4 '(4 5 3 4 4 3 0)) => (4 5 4 4 4 4 0)
(change 'a 'b '(a l a s (a n d))) => (b l b s (a n d))
(change '(0) 'x '(1 (0) 1 (1) (0))) => (1 x 1 (1) x)
```

1.(b) (5 points) Does your procedure generate a recursive or an iterative process? Justify your answer.

2. Consider the boolean function f presented by the following truth table:

x	y	z	f
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

(a) (10 points) Draw a logical circuit for computing f. (Don't forget to label inputs and outputs.)

(b) (5 points) Is the function f a complete basis for all the boolean functions? Justify your answer.

(c) (No credit: do only if it appeals to you.) Are f and NOT a complete basis for all the boolean functions? Justify your answer.

3. (12 points) Using the indicated representation, express the following quantities in 16 bits:

example:

-13 (in sign/magnitude):

1 0 0 0 0 0 0 0 0 0 0 0 1 1 0 1

(a) 47 (in unsigned binary):

(b) 64.5 (in ICS 16-bit floating point):

(c) - 0.125 (in ICS 16-bit floating point):

(d) -100.1 (in sign/magnitude)

(e) JUMPEQ 3 (in ICS-201a machine language):

(f) !! (in ASCII):

4. (10 points) Explain briefly the name, size and function of each of the following registers in the toy machine ICS-201a: acc, pc, mar, mdr, ir.

5. (10 points) Write a Scheme procedure (check-do pred proc ls) that takes a predicate pred, a procedure proc, and a list ls, and makes a list of proc applied to every element of ls for which pred is true, omitting elements for which pred is false.

Examples:

```
(check-do odd? (lambda (x) (* 3 x)) '(2 3 5 8)) => (9 15)
(check-do (lambda (x) (> x 10)) - '(17 5 83 2)) => (-17 -83)
(check-do zero? (lambda (x) (- x 1)) '(2 3 4 5)) => ()
```

6. (10 points) Write an assembly language program for the ICS-201a machine that reads in numbers until it encounters a zero, and then outputs the largest number among those read in. (You may assume that the numbers before the zero are positive; please use symbolic opcodes and addresses.)

Example:

```
input = 14
input = 4
input = 23
input = 17
input = 0
output = 23
```