CS 200 - Final Exam
Fall 2000

Name _________________________

This test is open book and open note. You may use any resources you wish EXCEPT a laptop computer. Calculators are fine, but no laptops as this would confer an unfair advantage. You also must NOT share resources with other students during the test. You have the entire exam period. Look over the test before beginning and answer the problems you feel most comfortable with first. Point values are listed by each problem. The total is 100 points.

question 1, (15 points)

Give the binary machine language encodings for the following instructions or indicate the instruction is impossible and give the reason why. Be sure to designate fields in your encodings (e.g. REG, MOD etc...).

MOV AX,[SI+16]

PUSH AH

RET(far)

MOV [CX+3],AX

MOV BX,3556h
Question 2, 30 points

Using two edge triggered flip-flops of your choice, and any combinational logic you need, construct the state machine shown. Show all steps in your design, including: K-maps, Boolean algebra reductions etc.. Your flip-flop states should conform to the states given in the diagram. You may use the back side of the page to complete your answer.
Problem 3, 25 points

The **Fibonacci numbers** are the sequence

\[0, 1, 2, 3, 5, 8, \ldots\]

The sequence begins with 0, 1 and the next number in the sequence is the sum of the previous two. Write a short, complete x86 assembly language program which generates the first 40 numbers in the Fibonacci sequence and places the results in an array of 16-bit quantities called FIB. Your program need not output anything. Your program may use MASM, NASM or GAS syntax. You program should be "complete" in the sense that it could be typed in "as is" and assembled into an executable with the specified assembler and executed to produce the desired results. You may use the backside of the page to complete your answer.
Problem 4, 15 points

Given a memory with 26-bit address and 16-bit word size.

(a) How many bytes can be stored in this memory?

(b) If this memory were constructed from 1K × 8-bit RAMs, how many memory chips would be required?

(c) How many bits would be used for chip select?
Problem 5, 15 points

Draw the state diagram for a synchronous sequential circuit with one input $x$ and one output $y$. The input $x$ is a serial message and the system reads $x$ one bit at a time. The output $y$ is 1 whenever the binary pattern 101 is encountered, otherwise it should be 0. Only the first of two overlapping 101 sequences should be recognized.
Extra Credit Problem

Work on this problem only after you have completed the rest of the test. Write an assembly code sequence which will add two unsigned 16-bit integers pointed to by NUM_A and NUM_B and place the results in NUM_C. YOU MAY USE ONLY LOGICAL INSTRUCTIONS FOR THE ADDITION (e.g. AND, OR, NOT, XOR). You may use algebraic instructions (e.g. INC and ADD/SUB) for loops etc., but you cannot use them directly to produce the sum.