Name: _____

Question 1	
Question 2	
Question 3	
Question 4	
Question 5	
Question 6	
Question 7	
Question 8	
Total	

Exam 1

CMP 416/685: Computability Theory
Lehman College– CUNY, 11 March 2004

Directions:

- **Write each answer on a separate piece of paper.**
- **Undergraduates: Do any 5 of the problems.**
- **Graduates: Do 5 of the problems, at least 2 problems must be chosen from Part II.**
- **If you complete more than 5 questions, the highest scores will be used to calculate your grade.**

Part I: Undergraduate Questions

1. Define the following terms:
   (a) finite state automaton (give formal definition of either DFA or NFA)
   (b) regular language
   (c) Given a finite set Σ, define Σ^*
   (d) Given a string s, define $|s|$
   (e) Given finite sets Σ_1, Σ_2, define $\Sigma_1 \circ \Sigma_2$

2. Give the state diagrams of deterministic finite state automata (DFAs) recognizing the following languages:
   (a) $A = \{w \mid w \text{ begins with a 1 and ends with a 0}\}$
   (b) $B = \{w \mid \text{every odd position of } w \text{ is a 1}\}$
   (c) $A \circ B$

3. Give state diagrams for nondeterministic finite state automata (NFAs) recognizing the following languages:
   (a) $C = \{w \mid w \text{ ends with a 00}\}$
   (b) $D = C^*$
   (c) $E = 0^*1010^*$

4. For each of the following, justify your answer:
   (a) What is the difference between an DFA and an NFA?
   (b) Is every DFA also an NFA?
   (c) Is every NFA also an DFA?
   (d) Is every language that is recognizable by an DFA, also recognizable by an NFA?
   (e) Is every language that is recognizable by an NFA, also recognizable by an DFA?

5. Use the pumping lemma to show that the following language is not regular:
   $$F = \{w \mid 0^n 1^{2n} n \geq 0\}$$