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# MIDTERM EXAM 1

## CS 611: THEORY OF COMPUTATION

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**Instructions:**

1. This is an open-note exam, you can bring a note written on a A4 paper with you, double sided is fine, and you will write down your name and NetID on the note and turned it in together with the exam.
2. You have 75 minutes to solve this exam, scan and submit your answers, you will scan a copy and put to Canvas if the exam is online.
3. Please clearly write down your answers, points deducted due to unreadable writing will be fully your responsibility.
4. Make your answer concise, e.g., when 4 states is enough for a NFA, then no need to draw 5 states.

<b>Name</b>	
<b>NetID</b>	

Problem	Maximum Points	Points Earned
Note	10	
1	20	
2	30	
3	30	
Total	90	

**Problem 1.**

**[20 points]**

Given language  $L_1 = \{w \in \{0,1\}^* \mid w \text{ does NOT end in double letter.}\}$ , design

(1) a DFA or a NFA

(2) the regular expression for the language.

For DFA or NFA, you can just draw the diagram. You can start with either one of the three and convert it to the other, or directly give the design.

**Problem 2.**

Recall we discussed language  $L_2 = \{w \in \{0,1\}^* | w \text{ has equal number of } 01 \text{ and } 10 \text{ as substrings.}\}$  is regular.  
**[30 points]**

1. Give the DFA that we drew on the class white board, you need to write the exact same DFA (same number of states, same transitions), the state names of your DFA can be different from our board one.
2. Convert that DFA into regular expression by following our method, which is converting the DFA to GNFA first, then remove the state of the GNFA one by one, draw the GNFA after you remove each state.

**Problem 3.**

1. Write down pumping lemma and the contrapositive of pumping lemma for regular language. [10 points]

2. Prove the language  $L = \{ www, w \in \{0, 1\}^* \}$  is not regular using pumping lemma. [20 points]