Midterm Exam 1
CS 611: Theory of Computation

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.

Name	
NetID	

Problem	Maximum Points	Points Earned
1	30	
2	30	
Note	10	
Total	70	

Problem 1. **[30 points]**

Given language $L_1 = \{w \in \{a, b\}^* | w$ starts and ends with the same symbol.$\}$, design a DFA and a NFA and finally the regular expression for the language. For DFA and 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.

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

2. Prove the language $L_2 = \{\ a^i b^j c^k, i, j, k \geq 0,\ \text{and if } i = 1,\ \text{then } j = k\}$ is not regular. **[20 points]**