CS 154
Formal Languages and Computability

Department of Computer Engineering
San José State University
Spring 2-016
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MIDTERM EXAMINATION #1

100 points total

This examination is open book, open notes, open laptop, and open Internet. You have **1 hour and 15 minutes** to complete it. **No form of cheating will be tolerated**, including using e-mail, instant messaging, tweeting, or any other means to communicate or share answers with another person during the examination.

This is a buffet-style exam. Look over the questions and choose which ones you want to answer. There may be more questions than you can answer during the exam time.

Put all your written answers into a Word or text document. Your screen shots can be in separate files, in which case you should name the files to clearly indicate which questions they answer. Or, you can insert the screen shots into your Word document.

Submit all your files (no need to zip) into Canvas:
CS 154/Assignments/Midterm Exam #1

1. Suppose language L_G = {*Guten, Tag, Katzen, Gesundheit*}
   and language L_F = {*Bonjour, Au, Revoir, Amour*}.

   a. [5 points] Give an example member of $L_G\ L_F$

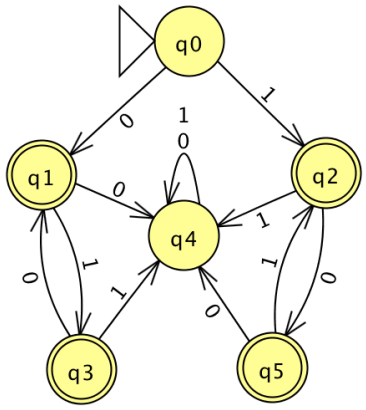
   b. [5 points] Give an example member of $L_F\ L_G$

   c. [5 points] Give three different example members of L_F^* - L_F

   d. [5 points] Give three different example members of $L_F \cup L_G$

   e. [5 points] Give three different example members of $(L_F \cup L_G)^*$

2. Consider the following DFA:



   a. [5 points] Describe in English what strings the DFA accepts.

   b. [10 points] Use JFLAP to test your answer with at least four sample strings that are accepted and at least two sample strings that are rejected. Use Input | Multiple Run and create a screen shot showing your test results.

3. Let $\Sigma = \{a, b\}$.

   a. [10 points] Use JFLAP to construct a DFA that accepts all strings in Σ^* that contain a double letter. Use Input | Multiple Run to test your DFA with some sample strings. Create a screen shot showing your test results.

   b. [5 points] Write a regular expression that accepts the same strings.

4. Consider this matrix that represents a simple maze:

S	1	2	3
4		5	
6		7	
8		9	*F*

Starting from cell *S*, you can move horizontally or vertically but not diagonally from one numbered cell to an adjacent cell in order to reach the goal of cell *F*.

a. [10 points] Create an NFA using JFLAP as follows: Represent each numbered cell by a state. Draw edges between the states to represent the allowable paths. Label each edge with the symbol *a*. Create a screen shot.

b. [5 points] How can you use input strings for your NFA to determine the length of the shortest path from *S* to *F*?

c. [5 points] What happens to input strings that are longer than the length of the shortest path?

d. [5 points] Use JFLAP and your NFA to demonstrate your answers to the previous two questions 4.b and 4.c. Create a screen shot.

e. [5 points] Use JFLAP to automatically convert your NFA to a minimal DFA. Test your DFA with the same input strings that you used for the NFA. Create a screen shot.

f. [5 points] Explain the difference in performance between the NFA and the DFA.

5. [10 points] Construct a grammar that generates the language $L = \{a^n b^n c^i : n > 0, i \geq 0\}$. Test your grammar using JFLAP with sample strings, some that are accepted and others that are rejected. Use Input | Multiple Run and create a screen shot showing your test results.