

STALGCM Problem Set #1

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- Release date: January 30, 2025
- Due date: February 8, 2025, 11:59 PM
- Total points: 50 points

REMINDER: READ BEFORE YOU START ANSWERING

1. This is an open notes problem set. You may refer to any material online for reference.
 2. This problem set is worth 50 points.
 3. This problem set may be done in groups of three, pairs or solo.
 4. Clearly label each answer with the test and item number.
 5. Clearly indicate the final answer for each item (you may box the final answer to indicate it when applicable).
 6. For questions that require you to explain, you may use Filipino and/or English.
 7. When asked to design a machine, you may choose to provide either the mathematical definition or the state diagram. Providing more than one will NOT merit extra points and the first representation written will be the only one checked. Regardless of representation, failure to indicate the start state will automatically result in a score of ZERO for that item.
 8. For problems with deterministic machines, providing a nondeterministic machine will yield 0 points. For problems with state limits, providing a machine that exceeds the state limit will also yield 0 points.
 9. Cheating in any form is punishable with a grade of 0.0 for the course and a disciplinary offense.
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Provide the following information: Group name, members, section, group number and Colonist ID.

Example:

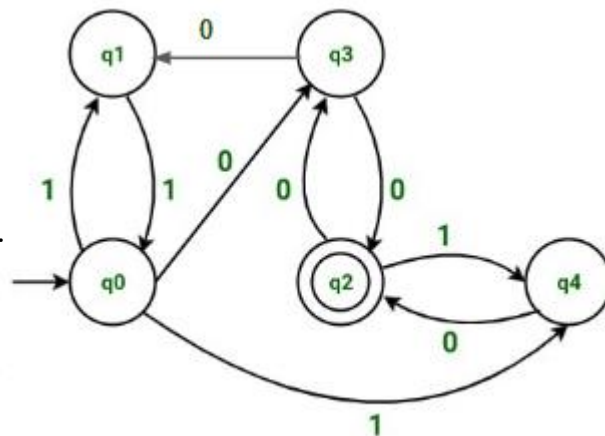
Members	Section	Group number	Colonist ID
John Doe	S12	#21	Muriel9090
Jane Doe	S13	#23	Crunch2104
No Wear	S13	#23	Point5678
Bot (in the screenshot)	N/A	N/A	Fai0000

Group name: Kikiang-kiang

Additional reminders: Intra-section groups must use groups 1 to 20 while inter-section groups must use groups 21 to 30. Inter-section groups do not need to have the same group number across sections. Compile your answers in a pdf file. For inter-section groups, each subgroup per section must upload a copy of the answers.

1. (15 points + 1 point bonus) Model the turn-based mechanics and key events of the board game Catan using an FSA. This will involve identifying states, transitions, and inputs based on the rules of the game. Play at least one full game of the online version (<https://colonist.io/>) with this set-up: 4 players, 10 points to win, 7 discard limit, friendly robber disabled. Add bots to fill the 4-player requirement.
 - a. (1 point bonus) Provide a screenshot of the final game result.
 - b. (3 points) A full game can be expressed using which type, DFA, NFA, or NFA with epsilon transitions? Explain your answer using a maximum of two sentences.
 - c. (3 points) If a full game will be expressed using an FSA, what does each state represent? Answer using a maximum of two sentences.
 - i. Example: Each state represents the number of resource cards you have
 - d. (3 points) What are the start and final state(s) (i.e., what do they represent)? Explain your answer using a maximum of two sentences.
 - i. Example: The start state represents 2 or 3 cards at the start while the final state represents seven cards because you cannot have eight cards or more.
 - e. (3 points) What are the elements of your alphabet (your input symbols)? Provide a sample transition.
 - f. (3 points) How would you classify the act of placing the robber, is it a state or an input? Explain your answer using a maximum of two sentences.
2. (5 points) Create an NFA (w/ ϵ -moves) for the RegEx: $[ef]^*ef^+$
3. (5 points) A DFA Juan dela Cruz created accepts word sequences conforming to the structure of proficiency-driven code-switching. Specifically, it accepts sequences where all English (e) words are preceded by at least two Filipino (f) words. The input includes at least one English (e) word and at least one Filipino (f) word. What is the RegEx for the language accepted by this DFA?
4. (5 points) Design a DFA that accepts word sequences conforming to the structure of intra-sentential code-switching. Specifically, the acceptor should accept sequences where the number of English words is divisible by 2 and the number of Filipino words is odd. Note that 0 is considered divisible by 2. State limit: $|Q| \leq 5$.
5. (10 points) Minimize the transition table below. Show your solution and draw the resulting DFA. $q_0 = Q_0$. $F = \{Q_1, Q_2, Q_3, Q_4\}$.

	e	f
$\rightarrow Q_0$	Q1	Q0
Q1	Q2	Q0
Q2	Q3	Q0
Q3	Q4	Q0
Q4	Q4	Q0



6. (10 points) Convert this NFA to DFA.