ICS 6B F23 Take Home Exam 9

Due: December 1st, 2023 at 11:59PM

- **Read** the instructions of each question carefully.
- **All problems will have a "What to show" section that will describe exactly what work is expected of you we solving the problem. Failure to meet the requirements of the "What to show" sections will result in a Not Yet. If you have questions about what to show please ask on Ed.**
- An answer where thought process is unclear will be given a grade of Not Yet
- Your submission should follow the template exactly. Any insertion, removal, or reordering of pages from the original template may result in readers not grading certain problems. In such an event you will receive "Not Yet" and no feedback on the problems in question.
- Place your answers in the boxed regions. Writing outside of the boxes will not be considered as part of your answers.
- This exam will cover the Outcomes from the M Learning Objective
- Please keep in mind of the academic honesty guidelines. This take-home exam is to be **completed individually, with no outside help**. You may use any resources from our class (ZyBooks and resources from Canvas), but you may not use any other online resources.
- You may choose to print the exam or use a digital editor for completing the exam. It is required that you use this PDF to complete your work. If you have no access to a printer or digital tools to fulfill the exam, feel free to reach out to the staffs regarding your concern.
- If you have any questions, please post a private Ed or attend available Office Hours. Note that we are not allowed to provide specific help to answering the exam questions.
- As a reminder there is **No Midterm** for this objective. In order to Fully Achieve these Outcomes you will need to get Satisfied on the THE or THE Redo as well as the Final.

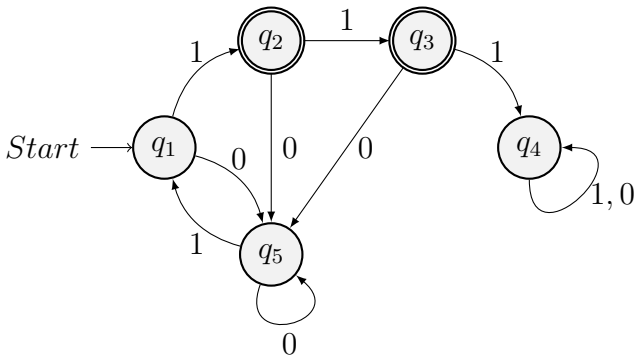
Name: _____ UCI NetID: _____

Problem 1 (M1)

What you need to show: When giving the definition of FSA, fill out all parts of the definition in the appropriate spaces. Some of the areas are filled out for you, just fill out the areas that are left blank. When giving the diagram, the states are provided (but uncircled). You must circle/double circle each state, draw and label edges, and label the start state. An explanation box is provided but it is not require to fill out. However what you write in the explanation box may assist with regrade requests if you make one.

Consider the two ways to represent a Finite State Automaton (FSA) using the definition or a diagram.

a) Given the following FSA diagram, provide its definition.



b) Given the definition of the following FSA draw the diagram that represent it.

$Q = \{q_0, q_1, q_2\}$, $I = \{a, b, c\}$, $A = \{q_1, q_2\}$, Starting state = q_0

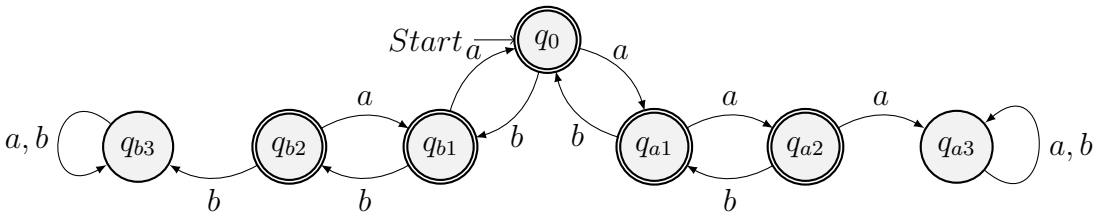
δ:

	q_0	q_1	q_2
a	q_1	q_2	q_0
b	q_2	q_0	q_1
c	q_0	q_1	q_2

Name: _____ UCI NetID: _____

Problem 2.1 (M2)

What you need to show: For the following FSA answer the following questions about it. No explanation is required.



a) Given the input string aababa, what state is the FSA in after 3 steps?

b) Trace the execution for (label each state the FSA is in after each step) for the FSA when given the input string babaa.

c) Will the FSA accept or reject the following input string, bbaabaaabb?

Problem 2.2 (M2)

What you need to show: Answer the following questions about the Turing Machine. When writing out the tape, make sure to include the location of the head. A sample of what is expected for the tape is included on the answer sheet. No explanation is required.

$\Gamma = \{0, 1, a, b, *\}, \Sigma = \{0, 1\}$

δ:

	q_{start}	q_1	q_2	q_3	q_4	q_5
0	(q_2, b, R)	$(q_2, 0, R)$	$(q_2, 0, R)$	$(q_{rej}, 0, L)$	$(q_5, 1, L)$	$(q_5, 0, L)$
1	(q_1, a, R)	$(q_1, 1, R)$	$(q_2, 1, R)$	$(q_3, 0, L)$	$(q_4, 0, L)$	$(q_5, 1, L)$
a	(q_{rej}, a, R)	(q_{rej}, a, R)	(q_{rej}, a, R)	$(q_{acc}, 1, L)$	$(q_{rej}, 0, L)$	$(q_{acc}, 1, L)$
b	(q_{rej}, b, R)	(q_{rej}, b, R)	(q_{rej}, b, R)	(q_{rej}, b, L)	$(q_{acc}, 1, L)$	$(q_{acc}, 0, L)$
$*$	$(q_{acc}, 1, R)$	$(q_3, 0, L)$	$(q_4, *, L)$	$(q_{rej}, *, L)$	$(q_{rej}, 0, L)$	$(q_{rej}, 0, L)$

a) What does the tape look like after 6 steps with the following input, 0101?

b) Given the input 010111, what would the tape look like after the Turing Machine finishes executing? Does the Turing Machine accept or reject this input?

Name: _____ UCI NetID: _____

Problem 3.1 (M3)

What you need to show: Draw a diagram of the FSA in a similar manner of Problem 1 part b. The states (uncircled) are provided for you. You must circle/double circle the states, draw and label the edges, and label the start state. A box for each state is provided below the diagram. Use these spaces to document the purpose of each state (*i.e.* what does it mean if the FSA is in that state).

Construct a FSA that accepts the Language of strings where the number of a's and the number of b's in the string have the same parity (ie the number of a's and number of b'a are both even or both odd).

Note that the input alphabet is $I = \{a, b, c\}$ and the set of states for the FSA is $Q = \{q_1, q_2, q_3, q_4\}$. The rest of the FSA is for you to design. On the answer sheet there is a spot to document the purpose of each state (be a good programmer and document you machine).

Name: _____ UCI NetID: _____

Problem 3.2 (M3)

What you need to show: Fill out any part of the definition of the machine that is not already filled out. If you are adding characters to the tape alphabet make sure to add a row for them in the table. If you are adding states make sure to add a column for them in the table. Below the table is a space to document the states you are designing. Make sure to document all states that you add to the machine (you may refer to the documented state below for examples of what is expected).

Design a Turing Machine that accepts the language of strings with more a's than b's. The Turing Machine is started for you. Note that you may add to Q or Γ, but you may not change Σ.

$$Q = \{q_{start}, q_{acc}, q_{rej}, q_{ra}, q_{rb}\},\ \Sigma = \{a, b\},\ \Gamma = \{a, b, x, \alpha, \beta, \gamma, *\}$$

Refer to the answer sheet for the transition function δ.

Documentation of states that are provided for you.

- q_{start}: The starting state of the Turing Machine. If we see an blank (so input is empty) we reject since $0 > 0$ is false. Otherwise we will begin by marking the first character, so we know have to get back to the front of the string.
- q_{ra}: Return to the front of the string after finding an a.
- q_{ba}: Return to the front of the string after finding a b.

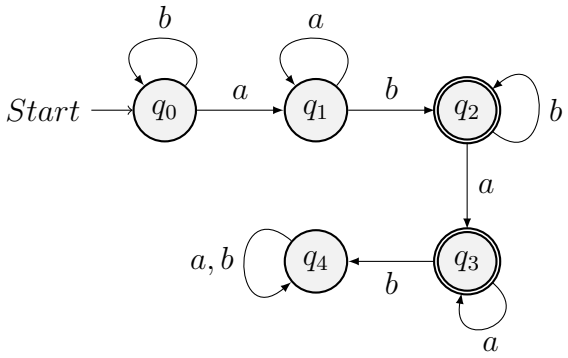
Fill out any part of the Turing Machine definition that is blank. You may want to use the q_{ra} and q_{rb} states as part of your solution, but it is not required. You will need to add some of your own states to Q, for each state you add fill out a column for it and document the state. You do not need to add more tape characters to the Turing Machine, but you may do so if you desire. If you do add more tape characters then you must fill out the row for them. If a column or row is unused (you didn't give it a state or tape character respectively) then you should leave it blank.

Name: _____ UCI NetID: _____

Problem 3.3 (M3)

What you need to show: In the description box provide a 1 to 2 sentence description of the language the FSA accepts. In the Explanation box explain your thought process of how you came to that conclusion. Was there something about the design of the FSA that give you a clue? Did you work out the meaning of each state? Did you try example strings to see if they get accepted or rejected?

Give a sentence or two description of the Language that the following FSA accepts.



Hint: try running the following strings aaaaa, bbbb, abababab, aaaabbbbb.