CS350 Automata and Formal Languages Spring 2023

Johnstone HW2: deterministic finite automata (due 1.20.23)

In this homework, you will specify the language accepted by a DFA and build a DFA from a language.
In all homeworks/exams, conciseness, elegance, and clarity count.
Every part of your answer should be digital (typed in rather than handwritten) using Markdown, except for the state diagrams. The state diagrams are hand-drawn, but please draw them precisely so there is no ambiguity about start state, final state, and so on. If there is a difference/ambiguity between your drawing of the machine and the file encoding for the machine, we will use the file encoding (since it is digital).

Exercises beyond this homework: I suggest looking over every exercise in the textbook, trying several of them, and verifying for the others that you know how to approach the problem. This is excellent preparation for the exams. Doing a couple of them before attacking this homework (which can be done collaboratively) is good preparation. We will solve some of the Sipser exercises in Friday's recitations. Once you get to the problems in this homework, please work them completely alone.

Reading Sipser 1.1

Please insert the following statement at the top or bottom of your homework, and sign it digitally (type your name, acknowledging understanding).

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I declare that I have completed this assignment entirely on my own.
I have read the UAB Academic Integrity Code and understand that any breach
of this code may result in severe penalties, including failure of the class.

Student signature:
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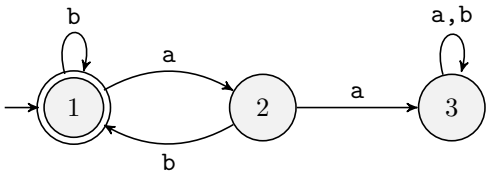
1. Consider the following deterministic finite automaton.



   (a) Give the language accepted by this DFA.
   (Emulate the way we express languages as sets below. Use a formal universe-constraint style.)

   (b) Define the 5 components of the DFA quintet $(Q, \Sigma, \delta, q_0, F)$ for this machine.
   Q, Σ, and F should be sets. Specify the transition function by enumerating its behaviour on all inputs (e.g., $\delta(\text{foo}, \text{bar}) = \text{qux}$).

   (c) Encode this machine in our file format.
   (See lecture 4 on Wednesday and a Wednesday example in even_parity_dfa.pdf.
   So delay answering this question to Wednesday.)

2. Build a deterministic finite automaton that accepts the language
   $\{w \in \{a, b\}^* : w \text{ ends with } ab\}$.

   (a) Draw the state diagram. Use states numbered 1 through n, with the start state 1.

   (b) Encode the machine in our file format.

3. Build a deterministic finite automaton that accepts the language
   $\{w \in \{a, b\}^* : w \text{ has length at least 4 and its third symbol is b}\}$.

   (a) Draw the state diagram. Use states numbered 1 through n, with the start state 1.

   (b) Encode the machine in our file format.

4. (bonus: a challenging problem for the brave few)

   Build a deterministic finite automaton (DFA) that accepts the language
   $\{w \in \{0, 1\}^* : w \text{ begins with 1 and, when interpreted as a binary number, is a multiple of 5}\}$

   In this question, you will only draw a state diagram. Label your states intelligently to suggest their semantics, and lay it out intelligently to make it a planar graph (no edges crossing). Since I am not asking for a file format answer in this question, please be particularly clear with your diagram.