CS46 practice problems 2

These practice problems are an opportunity for discussion and trying many different solutions. They are not counted towards your grade, and you do not have to submit your solutions. The purpose of these problems is to get more comfortable with DFAs and with using the Automata Tutor site. I recommend trying to solve these problems on paper first, then trying with the online tool. Once you are ready to test your solutions, the site will give you feedback on how to improve your solution. For each practice problem, you are allowed 10 attempts to solve the problem.

For all of these problems, $\Sigma = \{a, b\}$.

0. Go to [www.automatatutor.com](http://www.automatatutor.com) and create a login (use your preferred first and last name, as we will use this tool for actual graded problems as well). On the left-side panel, go to “Courses” and enroll in this course with:

Course ID: 188SWARTH
Course Password: COOJ0QTH

Under “Courses” you should see “Swarthmore CS46-19s”. Clicking “Show” will take you to your active problemsets, which includes “Practice problems 2”, corresponding to the problems on this page.

1. Construct a DFA for the language $\{w \mid w$ contains the substring $ab\}$.

2. Construct a DFA for the language $\{w \mid w$ does not contain the substring $ab\}$.

3. Construct a DFA for the language $\{w \mid w$ contains the substring $baba\}$.

4. Construct a DFA for the language $\{w \mid w$ does not contain the substring $baba\}$.

5. Construct a DFA for the language $\{aa, abba\}$.

   You might consider breaking this problem into pieces:

   (a) Construct a DFA for the language $\{aa\}$.

   (b) Construct a DFA for the language $\{abba\}$.

   (c) Use the proof idea from theorem 1.25 (regular languages are closed under union) to construct a new DFA for the union language from your two simpler DFAs.

6. Construct a DFA for the language $\{w \mid w$ contains exactly two $a$s and at least two $b$s\}$.

   You might consider breaking this problem into pieces:

   (a) Construct a DFA for the language $L_1 = \{w \mid w$ contains exactly two $a$s\}$

   (b) Construct a DFA for the language $L_2 = \{w \mid w$ contains at least two $b$s\}$

   (c) We want to construct a DFA for $L_1 \cap L_2$, so we can use an idea like the footnote (page 46) on the proof of theorem 1.25 to construct the states and transitions for this new DFA.

7. Construct a DFA for the language $\{w \mid w$ begins with $a$ and ends with $b\}$.

8. Construct an NFA for the language $\{w \mid w$ begins with $a$ and ends with $b\}$. (Try to use nondeterminism so that it has fewer states than the previous DFA for the same language.)