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](http://www.automatatutor.com) 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 troubleshooting feedback.

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

0. Go to [www.automatatutor.com](http://www.automatatutor.com) and create a login. On the left-side panel, go to “Courses” and enroll in this course with:
   
   - Course ID: 119SWARTH
   - Course Password: ZDNEIXB5

   Under “Courses” you should see “Swarthmore CS46-17s”. Clicking “Show” will take you to your active problemsets, which includes “Practice problems 1”, which corresponds to the problems on this page.

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

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

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

4. Construct a DFA for the language \{w \mid w \text{ 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 \text{ contains exactly two } a \text{ s and at least two } b \text{ s}\}.
   
   You might consider breaking this problem into pieces:
   
   (a) Construct a DFA for the language \{w \mid w \text{ contains exactly two } a \text{ s}\}
   
   (b) Construct a DFA for the language \{w \mid w \text{ contains at least two } b \text{ 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.

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1. If you are stumped or looking for guidance, many of these problems are in the selected solutions at the end of chapter 1 – see Sipser 1.5a, 1.5b, and 1.4b.

2. Despite off-by-one considerations