CS46 practice problems 3

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 NFAs and regular expressions. 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 Automata Tutor site will give you troubleshooting feedback. For each practice problem, you are allowed unlimited attempts. For all of these problems, the alphabet is $\Sigma = \{a, b\}$.

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 as and at least two bs$\}$.

   You might consider breaking this problem into pieces:

   (a) Construct a DFA for the language $L_1 = \{w \mid w$ contains exactly two as$\}$
   (b) Construct a DFA for the language $L_2 = \{w \mid w$ contains at least two bs$\}$.
   (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 $\{\varepsilon\}$.
8. Construct a DFA for the language $\{w \mid w$ does not contain exactly two as$\}$.
9. Construct a DFA for the language $\{w \mid 3 \leq |w| \leq 5\}$.
10. Constructa DFA for the language $\{w \mid a$ appears k times in w where $k + 1$ is divisible by 3$\}$.
11. Construct a DFA for the language $\{w \mid$ every b in w is immediately followed by two as$\}$.