University of California, Santa Barbara

CMPSC 138 FALL 2017

Homework III: Due Tuesday, October 24, 4:00 pm. in CS 138 HW box in Room 2108 in HAROLD FRANK HALL.

You can also turn in your homework in class, at the end of Lecture on Tuesday.

Instructions:

- Your solution must be stapled. Put your name and email address on the first page.
- Write your solutions clearly, with appropriate mathematical rigor and care. Justify all steps of your solution. Partially incorrect solutions can still be worth several points, but unjustified answers will result in zero points for the corresponding question.
- You are not allowed to copy or transcribe answers to homework assignments from others or other sources.
- You are not allowed to post solutions of your homework on the Piazza Q&A. Moreover, if you use facts from the online discussion, you should provide your own justification in your solution.
- You are allowed to discuss homework assignments with others, but you must write your answers independently. You should always be able to argue and explain your answers when asked for clarifications.
- Please note that there are no late homeworks allowed.

Homework III problems:

1. Do Problem 14, Section 2.3 of the text.
2. Do Problem 18, Section 2.3 of the text.
3. Do Problem 8, Section 3.1 of the text.
4. Do Problem 20, Section 3.1 of the text.
5. Do Problem 2, Section 3.2 of the text.
6. Construct the transition diagram of a DFA $M$ that accepts the language denoted by the regular expression $a^*ba^*ba$ over $\Sigma = \{a, b\}$.

7. Let $L$ be the language denoted by the regular expression $a^*b$.
   
   (a) Find a right-linear grammar for $L$.
   (b) Find a left-linear grammar for $L$.

8. For each one of the NFA below, construct a DFA accepting the complement of the language accepted. The start state is $q_1$.

   (a)

   (b)

   (c)

9. Convert the NFA $N = (\{q_0, q_1, q_2\}, \{a, b\}, \delta, q_0, \{q_1\})$ where $\delta$ is given by

   \[
   \begin{array}{|c|c|c|c|}
   \hline
   \delta & a & b & \lambda \\
   \hline
   q_0 & \{q_1\} & \phi & \{q_1\} \\
   q_1 & \{q_0, q_2\} & \{q_1, q_2\} & \phi \\
   q_2 & \{q_2\} & \{q_1\} & \phi \\
   \hline
   \end{array}
   \]

   into an equivalent DFA.

10. Consider the grammar $G = (\{S, A\}, \{a, b\}, S, P)$ where $P$ is the set of productions

   \[
   \begin{align*}
   S & \rightarrow aA \\
   A & \rightarrow abS \mid b
   \end{align*}
   \]

   (a) Construct a DFA that accepts $L = \mathcal{L}(G)$.
   (b) Construct a regular expression denoting $L$.
   (c) Construct a left-linear grammar for $L$. 