Prework 7.2b: More Languages in P

Write your preliminary solutions to each problem and submit a PDF on Canvas. The names in brackets indicate the subset responsible for presenting the problem.

1. [Ky, Andrew, Joshua] Consider the following context-free grammar.

$$S \to AB$$
$$A \to AA \mid 1$$
$$B \to BA \mid 0$$

   a. Complete the table produced by the algorithm in the proof of Theorem 7.16 on the input $w = 11011$. Does the algorithm accept (i.e., is 11011 generated by this grammar)?
   b. Repeat part (a) for the string 01101.

2. [Meghan, Ben, Micah] Recall that $ALL_{\text{DFA}} = \{\langle M \rangle \mid M \text{ is a DFA and } L(M) = \Sigma^*\}$. Show that $ALL_{\text{DFA}} \in \text{P}$ by describing a polynomial-time decider. (Hint: Use the polynomial-time decider for *PATH* as a subroutine).

3. [Todd, Levi, Allie] Recall that $EQ_{\text{DFA}} = \{\langle P, Q \rangle \mid P, Q \text{ are DFA's and } L(P) = L(Q)\}$. Show that $EQ_{\text{DFA}} \in \text{P}$. (Hint: show that every step of the algorithm described in the proof of Theorem 4.5 is polynomial time, including the algorithm from the proof of Theorem 4.4.)

4. [Curtis, David, Grace, Connor] A *triangle* in an undirected graph is a set of 3 vertices that all share edges with each other. Let $TRIANGLE = \{\langle G \rangle \mid G \text{ is a graph that contains a triangle}\}$. Show that $TRIANGLE \in \text{P}$ by describing an algorithm for it and showing that it is polynomial time.

BEGIN YOUR SOLUTIONS BELOW THIS LINE