Final Exam

CS 310
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1 Draw a DFA that accepts the same language as the following NFA. Apply the algorithm in Theorem 4.1 literally, without simplifying the answer.

2 Draw an NFA-Λ that accepts the same language as the regular expression

$$(\mathtt{a} + \mathtt{b}^*)(\mathtt{b} + \mathtt{a}^*).$$

Apply the algorithm in Theorem 4.4 literally, without simplifying the answer.

3 Draw a minimum-state DFA that accepts the same language as the following DFA. Apply Algorithm 5.1 literally.

4 Let $\Sigma = \{\mathtt{0}, \mathtt{1}, \mathtt{2}, \ldots, \mathtt{9}, \mathtt{+}, \mathtt{-}, \mathtt{*}, \mathtt{/}, \mathtt{(}, \mathtt{)}\}$, and

$$L = \{\, x \in \Sigma^* \mid x \text{ is a well-formed arithmetic expression} \,\}.$$

For example, `3*(5+4)` $\in L$ and `(5+/4` $\notin L$. Use the pumping lemma (Theorem 5.2a) to show that L is not regular.

5 Consider the following CFG G:

$$S \rightarrow AB \mid C$$
$$A \rightarrow \texttt{a} \mid \texttt{a}A\texttt{a}$$
$$B \rightarrow \Lambda \mid \texttt{b}B$$
$$C \rightarrow \texttt{a} \mid C\texttt{bb}$$

a) Show that G is ambiguous.

b) Give an unambiguous CFG that generates the same language as G.

6 Give a CFG that generates the language $L = \{\, \texttt{0}^{2i}\texttt{1}^{2j}\texttt{0}^{2i} \mid i, j \geq 0 \,\}$.

7 Consider the PDA $M = (Q, \Sigma, \Gamma, q_0, Z_0, A, \delta)$, where $A = \{q_1\}$ and

$$\delta\colon Q \times (\Sigma \cup \{\Lambda\}) \times \Gamma \rightarrow (\text{finite subsets of } Q \times \Gamma^*)$$

is defined by the following transition table:

Current State	*Current Input Symbol*	*Top Stack Symbol*	*Move(s)*
q_0	(	Z_0	$(q_0, \texttt{(}Z_0)$
q_0	(	(	$(q_0, \texttt{((})$
q_0	)	(	(q_0, Λ)
q_0	Λ	Z_0	(q_1, Λ)

a) What are the elements of Q? of Σ? of Γ?

b) Describe the language accepted by M.