

Exam 1

Instructions: Show your work and explain every step. No explanation or insufficient explanation may result in a partial credit or no credit (depending on the situation). Do each question on a separate sheet of paper. Organize your solutions and cross out any unwanted work. The exam is closed book and closed notes. The Internet, computers, cell. phones, electronic devices, books, etc, are not allowed. No material printed or electronic can be used including graded homework, etc. Also, let me stress that cell. phones are not allowed to use at all. No communications with anyone are allowed during the test. **Time:** 50 minutes.

- (1) (22 points) Construct a STD for a PDA that recognizes the language $\{a^i b^j \mid i, j \geq 0, 3i > 4j\}$. The only transitions I'm allowing you to use are of the form

$$\begin{aligned} a, \epsilon &\longrightarrow a, \\ \epsilon, \epsilon &\longrightarrow a, \\ \epsilon, \epsilon &\longrightarrow \epsilon, \\ b, a &\longrightarrow \epsilon, \\ \epsilon, a &\longrightarrow \epsilon. \end{aligned}$$

- (2) (22 points) Minimize (i.e. find an equivalent DFA with the least possible number of states) the following DFA $M = (Q, \Sigma, \delta, q_0, F)$ using the algorithm we covered in class (if you use any other method, you'll get no credit), where $Q = \{q_0, q_1, q_2, q_3, q_4\}$, $F = \{q_1, q_4\}$, $\Sigma = \{a, b\}$, and δ is given by

δ	a	b
q_0	q_0	q_1
q_1	q_2	q_1
q_2	q_3	q_4
q_3	q_4	q_1
q_4	q_4	q_0

- (3) (22 points) Transform the following NFA $N = (Q, \{0, 1\}, \delta, q_0, F)$ to a DFA (it suffices to give the STD of the DFA) using the algorithm we covered in class (if you use any other method, you'll get no credit), where $Q = \{q_0, q_1, \dots, q_5\}$, $F = \{q_0\}$, and δ is as follows:

δ	0	1	ϵ
q_0	q_1	q_3	-
q_1	q_2	-	-
q_2	q_0	-	-
q_3	-	q_4	q_5
q_4	-	q_5	-
q_5	-	q_0	-

- (4) (16 points)
- (a) Give the formal (mathematical definition) of NFA.
 - (b) What does a configuration of (q, x, γ) mean in PDA?
- (5) (18 points) Determine if the following are true or false:
- (a) DFA is as powerful as NFA.
 - (b) DPDA is as powerful as NPDA.
 - (c) If L_1 and L_2 are regular languages, then so is L_1L_2 .
 - (d) If L is a regular language, then so is L^R .
 - (e) The language of the FA that accepts no strings is $\{\epsilon\}$.
 - (f) Every regular language is contest free.
 - (g) $\{a^n b^n \mid n \geq 0\}$ is regular.
 - (h) $\{a^n b^n c^n \mid n \geq 0\}$ is contest free.
 - (i) The stack alphabet Γ and the input alphabet Σ in the PDA must be the same.