
Second Midterm (30 pts)

This is an open book and open notes exam. You are allowed to consult Sudkamp text during the exam.

1 CFG Normal Forms (5 + 7)

Express the following context-free grammar in Chomsky Normal Form and in Griebach Normal Form after “cleaning” it up. Write the intermediate steps clearly.

$$\begin{aligned} S &\rightarrow SA \mid ABa \mid C \\ A &\rightarrow aA \mid a \\ B &\rightarrow AbA \mid b \\ D &\rightarrow Da \mid Ca \end{aligned}$$

(Nonterminals are S, A, B, C, and D. Terminals are ‘a’, ‘b’. S is the start symbol.)

2 RE and DFA Construction (5 + 8)

Construct (i) a regular expression and (ii) a DFA for the language of strings over the alphabet $\{0, 1, 2\}$ in which every 1 is immediately followed by at least one 0 or exactly one 2.

3 NFA Construction (5 pts)

Construct an NFA- λ for the language of binary numerals (bit strings) that are divisible by 3. That is, $0 \in \mathcal{L}$, $00110 \in \mathcal{L}$, $\lambda \in \mathcal{L}$, $1001 \in \mathcal{L}$, $1011 \notin \mathcal{L}$, $10110 \notin \mathcal{L}$, etc.