

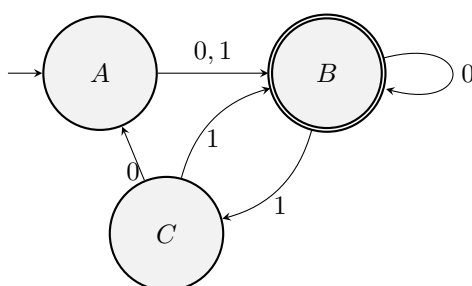


## COS 210 Worksheet 8

- This worksheet consists of **5 questions** for a total of **13 marks**.
- Show your working for all calculations and reasoning.

### Question 1 ..... (4 marks)

Apply the construction given in the proof of Theorem 3.3.1 to convert the following DFA  $M$  to a context-free grammar  $G$  which accepts the same language  $L(M)$ . Give the 4-tuple for  $G$ .



### Question 2 ..... (2 marks)

Consider the ruleset for a context-free grammar, where  $V = \{S, A, B\}$ ,  $\Sigma = \{0, 1\}$ , and  $S$  is the start variable. Perform Step 2 of converting the ruleset to be in Chomsky Normal Form: eliminate all  $\epsilon$ -rules. Show all steps.

$S \rightarrow A$   
 $A \rightarrow 0A \mid 1B \mid B$   
 $B \rightarrow 0B \mid 1A \mid \epsilon$

### Question 3 ..... (3 marks)

Consider the ruleset for a context-free grammar, where  $V = \{S, A, B\}$ ,  $\Sigma = \{0, 1\}$ , and  $S$  is the start variable. Perform Step 3 of converting the ruleset to be in Chomsky Normal Form, that is, eliminate all unit-rules. Show all steps.

$S \rightarrow A \mid \epsilon$   
 $A \rightarrow 0A \mid 1A \mid B$   
 $B \rightarrow 0 \mid 1 \mid B$

### Question 4 ..... (2 marks)

Consider the ruleset for a context-free grammar, where  $V = \{S, A, B\}$ ,  $\Sigma = \{0, 1\}$ , and  $S$  is the start variable. Perform Step 4 of converting the ruleset to be in Chomsky Normal Form, that is, eliminate all rules having more than two symbols on the right hand side. Show all steps.

$S \rightarrow A$   
 $A \rightarrow BAB \mid 0A \mid 1B$   
 $B \rightarrow BABA \mid 1A \mid 0B$

### Question 5 ..... (2 marks)

Consider the ruleset for a context-free grammar, where  $V = \{S, A, B\}$ ,  $\Sigma = \{0, 1\}$ , and  $S$  is the start variable.

Perform Step 5 of converting the ruleset to be in Chomsky Normal Form, that is, eliminate all rules, whose right hand side contains exactly two symbols, which are not variables. Show all steps.

$S \rightarrow AB \mid \epsilon$   
 $A \rightarrow 0A \mid 1B$   
 $B \rightarrow 00 \mid 11$