BRAC UNIVERSITY
CSE331 : Automata and Computability
Summer 2025

Duration: 30 minutes **Quiz 3** **Total: 20 marks**

Name: **ID:** 0.5 Points

Section: 0.5 Points

Pumping Lemma

Use the pumping lemma to prove that the following language is not regular: (8 points)

L(M) → {w ∈ {0,1}* | w contains more numbers of 0s than 1s}.

Solution:

$w = 1^p0^{p+1}$

For i = 2,

$xy^2z = 1^a1^{2b}1^{p-a-b}0^{p+1}$

=> b < 1

CFG

L_1 → {w ∈ {0, 1}* | w contains equal numbers of 0s and 1s}

$R_1 = 0\Sigma^*1 \mid 1\Sigma^*0$

$L_2 = L_1 \cap L(R_1)$

A. Write a CFG for L_1. (3 Marks)

Answer:

S → 0S1 | 1S0 | SS | ε

B. Convert R_1 into an equivalent CFG. (3 Marks)
Answer:
$S \rightarrow A \mid B$
$A \rightarrow 0X1$
$B \rightarrow 1X0$
$X \rightarrow 0X \mid 1X \mid \varepsilon$

C. Write all four-letter strings in L_2. [Note: $L(R_1)$ denotes the language generated by the regular expression R_1] (2 Marks)
Answer: 0011, 0101, 1010, 1100.

D. Write a CFG for L_2. (3 Marks)
Answer:
$S \rightarrow 0A1 \mid 1A0$
$A \rightarrow 0A1 \mid 1A0 \mid AA \mid \varepsilon$

Bonus

Use the pumping lemma to prove that the following language is not regular: (2 points)

$L(M) \rightarrow \{w_1w_2 \mid w_1$ is a substring of w_2 and $|w_1| \neq |w_2|\}$, where $\Sigma = \{0, 1\}$.

Solution: