

## Quiz 2: CS 331: FLAT

(10 Marks) CS1

### Question 1 (2 Marks)

Given the DFA below: States:  $\{q_0, q_1, q_2\}$

Initial state:  $q_0$

Final states:  $\{q_2\}$

Transitions:

$\delta(q_0, a) = q_1$

$\delta(q_1, b) = q_2$

$\delta(q_2, a) = q_2$

$\delta(q_2, b) = q_2$

Part A: Write the CFG production rules for this DFA using the standard conversion algorithm.

Part B: What language does this CFG generate?

### Question 2 (1 Mark)

Given the production rules obtained from DFA conversion:

$S \rightarrow aA \mid bS$

$A \rightarrow bB \mid aA$

$B \rightarrow \epsilon$

What type of strings does this grammar accept?

### Question 3 (2 Marks)

Consider the language  $L = \{a^n b^n c^n \mid n \geq 1\}$ .

Part A (1 mark): Using the pumping lemma for context-free languages, explain why this language is NOT context-free. (Choose the correct reasoning)

- A) The pumping length constraint  $|vxy| \leq p$  cannot be satisfied
- B) The substring  $vx$  can contain at most two types of symbols, making pumping impossible
- C) The language is regular, so pumping lemma doesn't apply
- D) The grammar has left recursion

Part B (1 mark): What is the pumping length condition in the pumping lemma for CFLs?

### Question 4 (2 marks)

Given the grammar:

$S \rightarrow aB \mid ab$

$A \rightarrow AB \mid a$

$B \rightarrow ABb \mid b$

Check if this grammar is ambiguous for the string "ab". Show your work by constructing derivation(s)

### Question 5: (1 + 2 = 3 marks)

Part A: What is left recursion? How to remove it? Part B: Eliminate indirect left recursion from the following grammar:

$S \rightarrow Aa \mid b$

$A \rightarrow Sc \mid d$