

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:

$$\delta(q_0, a) = q_1 \quad \delta(q_1, b) = q_2 \quad \delta(q_2, a) = q_2 \quad \delta(q_2, b) = q_2$$

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:

$$S \rightarrow aA \mid bS \quad A \rightarrow bB \mid aA \quad B \rightarrow \epsilon$$

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: $S \rightarrow aB \mid ab \quad A \rightarrow AB \mid a \quad B \rightarrow ABb \mid b$

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:

$$S \rightarrow Aa \mid b$$

$$A \rightarrow Sc \mid d$$