Compiler Theory CS447b: Quiz 5. **UWO, January 28, 2004.**

Student ID number:

Guidelines. The quiz is closed book and all notes are forbidden. The duration of the quiz is 30 minutes. Each of the 4 exercices will marked be over 5 points. All answers should be written in the *answer boxes*. No justifications for the answers are needed **unless** explicitly required. You are expected to do this exam on your own without assistance from anyone else in the class. If possible, please avoid pencils and use pens with dark ink. Thank you.

Exercise 1. We consider the alphabet $\Sigma = \{(,)\}$ consisting of the opening parenthesis and the closing parenthesis. For each of the following grammars, if its generated language is regular ,then give a finite automaton recognizing this language, otherwise justify briefly why it is not regular.

$$G_1 : \begin{cases} S \longmapsto A \\ A \longmapsto (\, B \\ A \longmapsto (\, A \\ B \longmapsto)\, B \\ B \longmapsto) \end{cases} \qquad G_2 : \begin{cases} S \longmapsto E \\ E \longmapsto (\, E\,)\, E \\ E \longmapsto \varepsilon \end{cases}$$

Answer 1

Exercise 2. We consider the alphabet $\Sigma = \{a, b\}$ and the grammar G below. Let L be the language generated by G over Σ.

$$G \begin{cases} S & \longmapsto & AB \\ A & \longmapsto & aAA \\ A & \longmapsto & \varepsilon \\ B & \longmapsto & bBB \\ B & \longmapsto & \varepsilon \end{cases}$$

Give a grammar G' generating $L \setminus \{\varepsilon\}$ and with **no** ε-productions, that is **no** rules of the form $X \longmapsto \varepsilon$, where ε denotes the empty word. Is G' left-recursive?

Answer 2

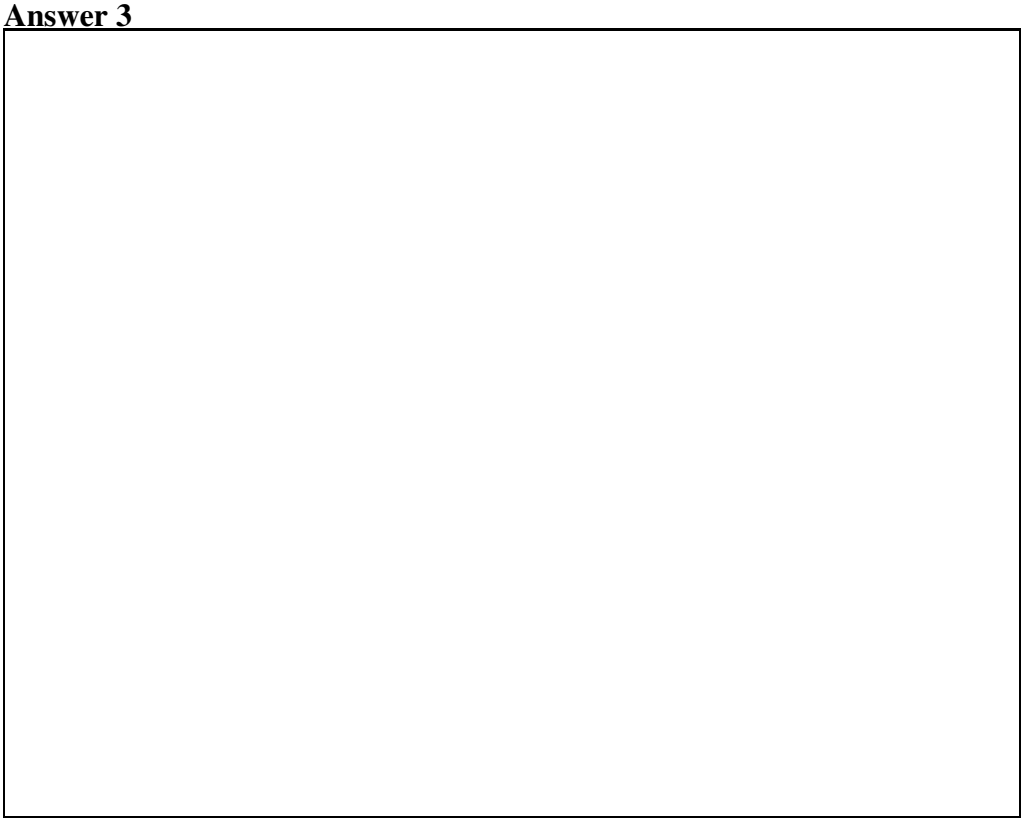
Exercise 3. Let Σ be the alphabet consisting of the opening parenthesis, the closing parenthesis, the comma and the lower-case letter a. That is $\Sigma = \{(,), \mathbf{,}, \mathbf{a}\}$. Let G be the grammar over Σ, with non-terminals S, L, E, start symbol S and the six productions below

$$\begin{array}{lcl} S & \longmapsto & \mathbf{a} \\ S & \longmapsto & L \\ L & \longmapsto & \mathbf{()} \\ L & \longmapsto & \mathbf{(}E\mathbf{)} \\ E & \longmapsto & S \\ E & \longmapsto & E\,\mathbf{,}\,S \end{array}$$

Let $\mathcal{L}$ be the language over Σ generated by G. For each of the words below, if it belongs to $\mathcal{L}$, then give a derivation from S to this word.

$$\begin{array}{llllll} w_1 & = & \textbf{(a, a)} & w_2 & = & \textbf{(a, (a, a))} \\ w_3 & = & \textbf{(a), (a, a)} & w_4 & = & \textbf{((a, a, a), (a))} \end{array}$$

Answer 3



Exercise 4. We consider the same grammar as in the previous exercise. Is the grammar G left recursive? If yes, construct a grammar G' which is not left recursive and which generates L.

Answer 4

Work space 1