Quiz 6 Solutions

(1) Suppose you use the procedure described in class to convert the following NFA $M$ into a right-liner grammar $G = (V, \Sigma, R, S)$ for the same language. How many rules will $G$ have? (I’m only asking for the number of rules; no need to list them. Remember to include in your count both rules of the form $A \to aB$ and any of the form $A \to \varepsilon$, where $A$ and $B$ are variables and $a$ is a terminal.)

\[ S \to a \quad b \quad Q \]

4 rules

(2) Write the rules for a CFG $G = (V, \Sigma, R, S)$ for the language $L = \{a^n \# a^n : n \geq 0\}$. Two rules suffice, so please don’t use more. The alphabet is $\Sigma = \{a, \#\}$.

$S \to a \quad S \quad a \mid \#$

(3) Define what it means for a CFG $G = (V, \Sigma, R, S)$ to be ambiguous. Make your English grammatical and precise, and don’t use any form of the word “ambiguous” in your definition.

A grammar $G$ is ambiguous if there is some $w \in L(G)$ where $w$ has two different parse trees (equivalently, two or more leftmost derivations).

(4) Below is the Turing Machine $M$ described in class that accepts $L = \{a^n b^n : n \geq 1\}$.

Suppose you run $M$ on $a^{10} b^{10}$. When it accepts, the tape will have on it how many $a$’s, $b$’s, $A$’s, and $B$’s?

\begin{align*}
a: & \quad 0 \\
b: & \quad 0 \\
A: & \quad 10 \\
B: & \quad 10
\end{align*}
(5) Darken the box if the statement is true.

True  Every regular language is context free.

True  An unrestricted grammar could have a rule $Ad \rightarrow cB$ (with $A, B$ variables, $c, d$ terminals)