Computer Science 181, Homework 5

Michael Wu
UID: 404751542

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Problem 1

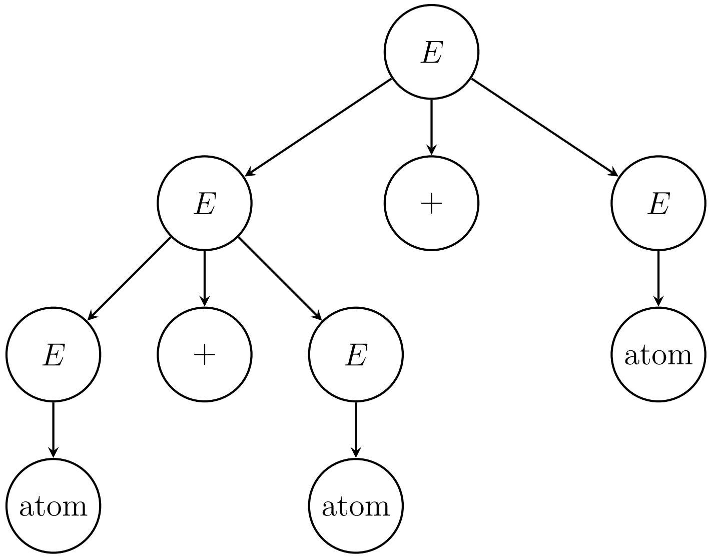
Assume for contradiction that $\bar{L}$ is a finite state language. Then by the closure properties of finite state languages, its complement L is a finite state language. Then by the pumping lemma there exists some p such that whenever a string $s \in L$ is longer than p, it can be split into three strings $s = xyz$ such that $|y| \geq 1$, $|xy| \leq p$, and $xy^n z \in L$ for any integer $n \geq 0$. Consider the string $s \in L$, where $s = ww$ and $|w| > p$. Let w be a string beginning with a followed entirely by b's. Because $|xy| \leq p$, the leftmost w must contain x and y. If y consists of only b's then $xy^n z \notin L$ for $n = 2$, since this would mean that $xy^2 z$ has the form $ab^{k_1}ab^{k_2}$, where $k_1 > k_2$. Strings of this format are not in L. If y contains an a, then it can only contain a single a. So $xy^2 z$ will have three a's, since there are two in xyz and one in y. Then $xy^2 z \notin L$, since L must contain an even number of both a's and b's. This is a contradiction, since the pumping lemma says that $xy^n z \in L$ for all $n \geq 0$. Thus our assumption that $\bar{L}$ is a finite state language cannot be correct, and $\bar{L}$ is a non finite state language.

Problem 2

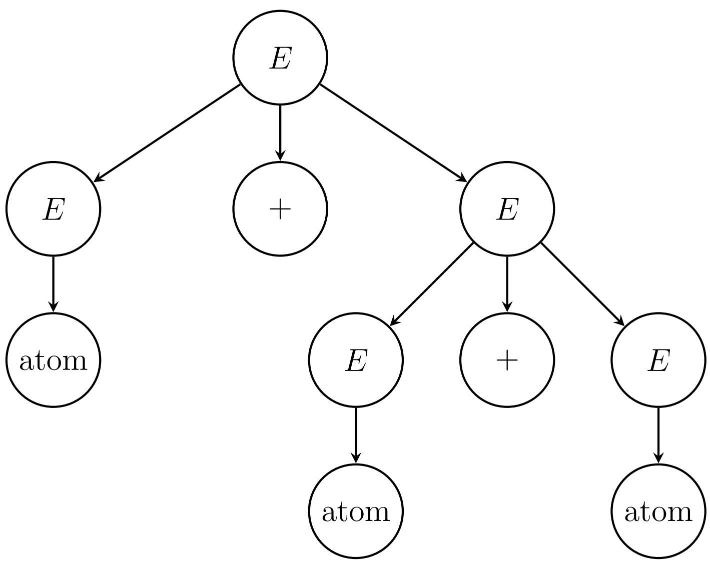
Yes it is ambiguous. The string

`atom+atom+atom`

can be parsed as either



or it can be parsed as



Problem 3

$$
\begin{aligned}
L_{ists} &= (V, \Sigma, R, S) \\
V &= \{A, B\} \\
R &= \{A \rightarrow \text{atom} \mid (B), \\
&\quad\; B \rightarrow A \mid BB \mid \epsilon\} \\
S &= A
\end{aligned}
$$