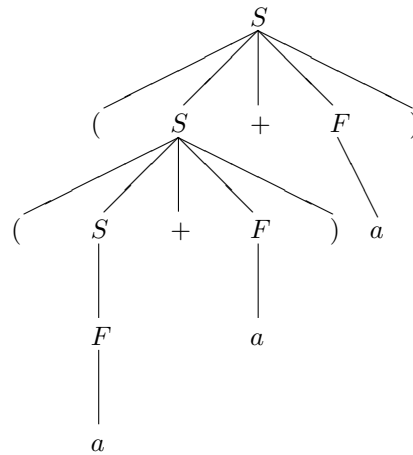


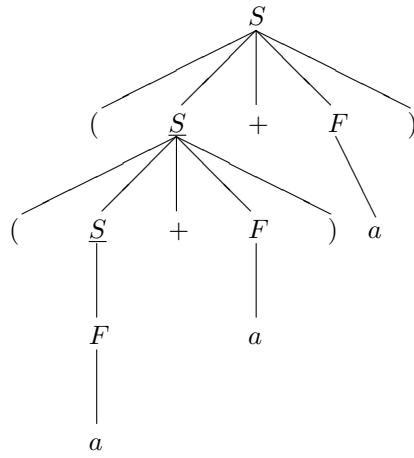
Solution to Problem 14

Task. For the $LL(1)$ grammar that we studied in class, with rules $S \rightarrow F$, $S \rightarrow (S + F)$, and $F \rightarrow a$, show how the word $((a + a) + a)$ can be represented as $uvxyz$ in accordance with the pumping lemma for context-free grammars. Show that the corresponding word $uvvxyyz$ will be generated by this grammar.

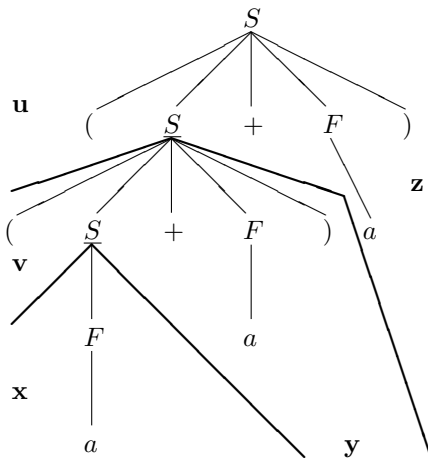
Solution. The derivation of this string takes the following form:



In this derivation, we have two occurrences of the variable F , but they are not on the same branch. The lowest pair of occurrences of the same variable is the lowest pair of occurrences of the variable S :



Thus, the desired decomposition of this word into u , v , x , y , and z has the following form:



So, here $u = v = ($, $x = a$, $y = +a$, and $z = +a$). If we copy of the part between the two lowest occurrences of S to the lower occurrence, we conclude that the word $uvvxyz$ can be derived as follows:

