Solution to Problem 12

Task. For the grammar described in Homework 7, show how the word +110 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:

```
I
+  U
  1  U
   1  U
    1  D
     0
```

The lowest pair of occurrences of the same variable is the lowest pair of occurrences of the variable U:
Thus, the desired decomposition of this word into \( u, v, x, y, \) and \( z \) has the following form:

So, here \( u = +1, v = 1, x = 0, \) and \( y = z = \varepsilon \). If we copy of the part between the two lowest occurrences of \( U \) to the lower occurrence, we conclude that the word \( uvx_zyyz \) can be derived as follows: