Let G_1 be the following grammar that we introduced in Example 2.45. Use the *DK*-test to show that G_1 is not a DCFG.

$$R \rightarrow S \mid T$$
$$S \rightarrow aSb \mid ab$$
$$T \rightarrow aTbb \mid abb$$

Step-by-step solution

Step 1 of 3

DK-**test is a procedure which is exactly used to determine whether a CFG is deterministic or not**. DK-test comes into picture because the definition of DCFG's does not give any accurate way to determine whether a CFG is deterministic. The procedure of DK-test can be explained as follow.

Starting with a CFG G, construct the associated DFA DK. Now, determine whether G is deterministic by testing $DK's$ accept states. The DK-test stipulates that every accept state contains:

1. **Exactly one completed rule, and**

2. **No dotted rule in which terminal symbol immediately follows the dot (that is, no dotted rule of the form** $B \rightarrow u.av \; for \; a \in \sum$).

Comment

Step 2 of 3

Now**, consider the grammar** G_1 which is given below:

$R \rightarrow S \mid T$
$S \rightarrow aSb \mid ab$
$T \rightarrow aTbb \mid abb$

• **The language of grammar** is $B \cup C$ where $B = \{a^m b^m \mid m \geq 1\} \; and \; C = \{a^m b^{2m} \mid m \geq 1\}$. In the leftmost reduction of string $aaabbb \in L(G_1)$. It is underlined the handle at each step:

$aa\underline{abb}bb \rightarrow aa\underline{Sb}b \rightarrow a\underline{Sb} \rightarrow S \rightarrow R$

• **Equivalently**, this is leftmost reduction of the string $aaabbbbbb$:

$aa\underline{abb}bbbb \rightarrow aa\underline{Tbbbb} \rightarrow a\underline{Tbb} \rightarrow T \rightarrow R$.

• In the both of the cases which is given above, the leftmost reduction as shown happens to be **the only reduction possible**. In other grammars, where many reduction may occur.

• Here, it is notice that the handles of $aaabbb$ and $aaabbbbbb$ **are unequal**, even though the initial part of these strings agree.

Comment

Step 3 of 3

Therefore, from the above discussion **it violates the condition of** DK-**test (as** DK-**test say that every accept state must consist of exactly one completed rule**), because **so many completed rules present here**. **Thus,** it can be said that "**The grammar** G_1 **is not a DCFG".**

Comment