Problem

Give a context-free grammar that generates the language

$$A = \{\mathtt{a}^i\mathtt{b}^j\mathtt{c}^k \mid i = j \text{ or } j = k \text{ where } i, j, k \geq 0\}.$$

Is your grammar ambiguous? Why or why not?

Step-by-step solution

Step 1 of 1

The language given in the problem is as follows:

$A = \left\{a^i b^j c^k \mid \text{i=j } or \text{ j} = k \text{ for i} \geq 0, \text{j} \geq 0,\ k \geq 0\right\}$

The language *A* can be split into two languages which are defined as follows:

$A_1 = \left\{a^i b^j c^k \mid i, j, k \geq 0, i = j\right\}$

and

$A_2 = \left\{a^i b^j c^k \mid i, j, k \geq 0, j = k\right\}$

Using the language *A1* and *A2* the user can construct a CFG for A_1 and A_2.

The grammar for language *A* is the union of grammar of two languages which is defined as follows:

$S \to S_1 \mid S_2$

In the language A_1 the values of i and j are equal so there must be equal number of a's and b's in the language A_1.

CGF for the language A_1 is as follows:

$S_1 \to S_1 c \mid E \mid \in$
$E \to aEb \mid \in$

Similarly, in the language A_2 the values of j and k are equal so there must be equal number of b's and c's in the language A_2.

CGF for the language A_2 is as follows:

$S_2 \to aS_2 \mid F \mid \in$
$F \to bFc \mid \in$

Since for generating a string $w = a^n b^n c^n$ using the language *A*, either S_1 or S_2 can be used.

Therefore, the context free grammar for the language *A* is ambiguous.

Comment