Gradiance Online Accelerated Learning

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Based on Sections 5.1 and 5.4 of HMU. Note: there are many other questions on these topics; this homework is a recommended set.

1. Programming languages are often described using an extended form of context-free grammar, where square brackets are used to denote an optional construct. For example, A → B[C]D says that an *A* can be replaced by a *B* and a *D*, with an optional *C* between them. This notation does not allow us to describe anything but context-free languages, since an extended production can always be replaced by several conventional productions.

Suppose a grammar has the extended productions:

```
A → B[CDE]FGH | BCD[EFG]H
```

Convert this pair of extended productions to conventional productions. Identify, from the list below, the conventional productions that are equivalent to the extended productions above.

a) $A \rightarrow BA_1H$
$A_1 \rightarrow CDE \mid EFG \mid \varepsilon$

b) `A → BCDEFGH | BFGH | BCDH | BH`

c) `A → BCDEFGH | BFGH | BCDH`

d) `A → BCDEFGH | BH`

Answer submitted: **c)**

You have answered the question correctly.

2. Here is a context-free grammar G:

```
S → AB
A → 0A1 | 2
B → 1B | 3A
```

Which of the following strings is in L(G)?

a) 21113021

b) 000021130011

c) 0021113002111

d) 00211100211

Answer submitted: **d)**

Your answer is incorrect.

Every string generated by S has a 3. The reason is that the first derivation step must be S => AB. B has no production consisting of only terminals, so using B => 1B will not get rid of the B; only B => 3A can do that. Thus, there must be a 3 in every terminal string. See Sections 5.1.3 (p. 175) and 5.1.5 (p. 179) for definitions of derivations and languages.

3. The grammar G:

S → SS | a | b

is ambiguous. That means at least some of the strings in its language have more than one leftmost derivation. However, it may be that some strings in the language have only one derivation. Identify from the list below a string that has exactly TWO leftmost derivations in G.

a) abab
b) aaaa
c) aa
d) aba

Answer submitted: **c)**

Your answer is incorrect.

The only leftmost derivation is $S \Rightarrow_{lm} SS \Rightarrow_{lm} aS \Rightarrow_{lm} aa$. Ambiguous grammars are discussed in Section 5.4 (p. 205). In particular, the relationship between ambiguous grammars and leftmost derivations is covered in Section 5.4.3 (p. 211).

4. Consider the languge L={a}. Which grammar defines L?

a) G_1:S → AB|C, A → b, C → ε
b) G_1:S → ac|a, A → c|b|ε
c) G_1:S → AB|C|a, A → b, C → a
d) G_1:S → AB|a|b, A → b

Answer submitted: **c)**

You have answered the question correctly.

5. Consider the grammars:

G_1: S → SaS | aa | a
G_2: S → SS | ε
G_3: S → SS | a
G_4: S → SS | aa
G_5: S → Sa | a
G_6: S → aSa | aa | a
G_7: S → SAS | ε

Describe the language of each of these grammars. Then, identify from the list below a pair of grammars that define the same language.

a) G_3, G_7
b) G_5, G_6
c) G_1, G_2
d) G_5, G_7

Answer submitted: **b)**

You have answered the question correctly.