Feedback — Week 3: Context Free Language

Help Center

You submitted this homework on **Sun 11 Oct 2015 6:53 PM CEST**. You got a score of **6.00** out of **6.00**.

Question 1

Let G be the grammar:

```
S → SS | (S) | ε
```

L(G) is the language BP of all strings of balanced parentheses, that is, those strings that could appear in a well-formed arithmetic expression. We want to prove that L(G) = BP, which requires two inductive proofs:

1. If w is in L(G), then w is in BP.
2. If w is in BP, then w is in L(G).

We shall here prove only the first. You will see below a sequence of steps in the proof, each with a reason left out. These reasons belong to one of three classes:

A)
Use of the inductive hypothesis.
B)
Reasoning about properties of grammars, e.g., that every derivation has at least one step.
C)
Reasoning about properties of strings, e.g., that every string is longer than any of its proper substrings.

The proof is an induction on the number of steps in the derivation of w. You should decide on the reason for each step in the proof below, and then identify from the available choices a correct pair consisting of a step and a kind of reason (A, B, or C).

Basis: One step.
(1)
The only 1-step derivation of a terminal string is S => ε because _________
(2)
ε is in BP because _________
Induction: An n-step derivation for some n>1.
(3)
The derivation $S =>^{n} w$ is either of the form
(a) $S => SS =>^{n-1} w$ or of the form
(b) $S => (S) =>^{n-1} w$

because _________
Case (a):
(4)
w = xy, for some strings x and y such that S =>^{p} x and S =>^{q} y, where p<n and q<n because _________
(5)
x is in BP because _________
(6)
y is in BP because _________
(7)
w is in BP because _________
Case (b):
(8)
w = (z) for some string z such that S =>$^{n-1}$ z because _________
(9)
z is in BP because _________
(10)
w is in BP because _________

Your Answer		Score	Explanation
(5) for reason C			
(2) for reason A			
(5) for reason B			
(5) for reason A	✔	1.00	
Total		1.00 / 1.00	

Question 2

Which of the following grammars derives a subset of the language:

{x | x contains a and c in proportion 4:3 and there are no two consecutive c's}?

Your Answer		Score	Explanation
S → ε S → SaScSaScSaSaSaS			
S → ε S → aScaScSaScSaS	✔	1.00	
S → ε S → aacacac S → SaScSaScSaScSa			
S → ε S → aScScaSaScSaS			

Total	1.00 / 1.00

Question 3

Here are eight simple grammars, each of which generates an infinite language of strings. These strings tend to look like alternating *a*'s and *b*'s, although there are some exceptions, and not all grammars generate all such strings.

G1: S → abS | ab

G2: S → SS | ab

G3: S → aB; B → bS | a

G4: S → aB; B → bS | b

G5: S → aB; B → bS | ab

G6: S → aB | b; B → bS

G7: S → aB | a; B → bS

G8: S → aB | ab; B → bS

The initial symbol is S in all cases. Determine the language of each of these grammars. Then, find, in the list below, the pair of grammars that define the same language.

Your Answer		Score	Explanation
G2 and G5			
G4 and G6			
G4 and G7			
G1 and G2	✔	1.00	
Total		1.00 / 1.00	

Question 4

For the grammar:

```
S → AB | CD
A → BC | a
B → AC | C
```

```
C → AB | CD
D → AC | d
```

1. Find the generating symbols. Recall, a grammar symbol is *generating* if there is a deriviation of at least one terminal string, starting with that symbol.
2. Eliminate all *useless productions* --- those that contain at least one symbol that is not a generating symbol.
3. In the resulting grammar, eliminate all symbols that are not *reachable* --- they appear in no string derived from S.

In the list below, you will find several statements about which symbols are generating, which are reachable, and which productions are useless. Select the one that is FALSE.

Your Answer		Score	Explanation
◉ A → *a* is useless.	✔	1.00	
○ *d* is generating.			
○ S is not generating.			
○ C → CD is useless.			
Total		1.00 / 1.00	

Question 5

Here is a context-free grammar:

```
S → AB | CD
A → BG | 0
B → AD | ε
C → CD | 1
D → BB | E
E → AF | B1
F → EG | 0C
G → AG | BD
```

Find all the nullable symbols (those that derive ε in one or more steps). Then, identify the true statement from the list below.

Your Answer	Score	Explanation
○ C is nullable.		

G is not nullable.		
E is not nullable.	✔	1.00
B is not nullable.		
Total		1.00 / 1.00

Question 6

Here is a context-free grammar:

```
S → AB | CD
A → BG | 0
B → AD | ε
C → CD | 1
D → BB | E
E → AF | B1
F → EG | 0C
G → AG | BD
```

Find all the nullable symbols, and then use the construction given in the slides to modify the grammar's productions so there are no ε-productions. The language of the grammar should change only in that ε will no longer be in the language. Which of the following productions is in the modified grammar?

Your Answer		Score	Explanation
G → AG | BD | A | G | B | D | ε			
C → CD | C			
G → AG | BD | A | G | B | D	✔	1.00	
A → BG | 0 | G | ε			
Total		1.00 / 1.00	