

## Feedback — Week 4: PDA's and CFL Properties

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You submitted this homework on **Sun 18 Oct 2015 2:50 AM CEST**. You got a score of **6.00** out of **6.00**.

### Question 1

The language  $L = \{ss \mid s \text{ is a string of a's and b's}\}$  is not a context-free language. In order to prove that  $L$  is not context-free we need to show that for every integer  $n$ , there is some string  $z$  in  $L$ , of length at least  $n$ , such that no matter how we break  $z$  up as  $z = uvwxy$ , subject to the constraints  $|vwx| \leq n$  and  $|vx| > 0$ , there is some  $i \geq 0$  such that  $uv^iwx^iy$  is not in  $L$ .

Let us focus on a particular  $z = aabaaaba$  and  $n = 7$ . It turns out that this is the wrong choice of  $z$  for  $n = 7$ , since there are some ways to break  $z$  up for which we can find the desired  $i$ , and for others, we cannot. Identify from the list below the choice of  $u,v,w,x,y$  for which there is an  $i$  that makes  $uv^iwx^iy$  not be in  $L$ . We show the breakup of  $aabaaaba$  by placing four  $|$ 's among the a's and b's. The resulting five pieces (some of which may be empty), are the five strings. For instance,  $aa|b||aaaba|$  means  $u=aa$ ,  $v=b$ ,  $w=\epsilon$ ,  $x=aaaba$ , and  $y=\epsilon$ .

Your Answer	Score	Explanation
<input type="radio"/> aa ba a ab a		
<input type="radio"/> aab a aab a		
<input checked="" type="radio"/> a a baaab a	1.00	Correct. For instance, for $i = 0$ we get the string abaaab, which is not of the form $ss$ .
<input type="radio"/> aa ba aa ba		
Total	1.00 / 1.00	



1.00

Correct. For instance, for  $i = 0$  we get the string abaaab, which is not of the form  $ss$ .

### Question 2

Apply the CYK algorithm to the input ababaa and the grammar:

$S \rightarrow AB \mid BC$   
 $A \rightarrow BA \mid a$   
 $B \rightarrow CC \mid b$   
 $C \rightarrow AB \mid a$

Compute the table of entries  $X_{ij}$  = the set of nonterminals that derive positions  $i$  through  $j$ , inclusive, of the string ababaa. Then, identify a true assertion about one of the  $X_{ij}$ 's in the list below.

Your Answer	Score	Explanation
<input type="radio"/> $X_{34} = \{C\}$		
<input type="radio"/> $X_{23} = \{A\}$		
<input type="radio"/> $X_{23} = \{S\}$		
<input checked="" type="radio"/> $X_{36} = \{S, A\}$	✓ 1.00	
Total	1.00 / 1.00	

### Question 3

Consider the pushdown automaton with the following transition rules:

1.  $\delta(q, 0, Z_0) = \{(q, XZ_0)\}$
2.  $\delta(q, 0, X) = \{(q, XX)\}$
3.  $\delta(q, 1, X) = \{(q, X)\}$
4.  $\delta(q, \epsilon, X) = \{(p, \epsilon)\}$
5.  $\delta(p, \epsilon, X) = \{(p, \epsilon)\}$
6.  $\delta(p, 1, X) = \{(p, XX)\}$
7.  $\delta(p, 1, Z_0) = \{(p, \epsilon)\}$

The start state is  $q$ . For which of the following inputs can the PDA first enter state  $p$  with the input empty and the stack containing  $XXZ_0$  [i.e., the ID  $(p, \epsilon, XXZ_0)$ ]?

Your Answer	Score	Explanation
<input type="radio"/> 0101010		
<input checked="" type="radio"/> 0011011	✓ 1.00	
<input type="radio"/> 0011100		

☐ 011001101

Total1.00 / 1.00

Question 4

Consider the pushdown automaton with the following transition rules:

- 1.  $\delta(q,0,Z_0) = \{(q,XZ_0)\}$
- 2.  $\delta(q,0,X) = \{(q,XX)\}$
- 3.  $\delta(q,1,X) = \{(q,X)\}$
- 4.  $\delta(q,\epsilon,X) = \{(p,\epsilon)\}$
- 5.  $\delta(p,\epsilon,X) = \{(p,\epsilon)\}$
- 6.  $\delta(p,1,X) = \{(p,XX)\}$
- 7.  $\delta(p,1,Z_0) = \{(p,\epsilon)\}$

From the ID  $(p,1101,XXZ_0)$ , which of the following ID's can NOT be reached?

Your Answer	Score	Explanation
<input type="radio"/> $(p,01,XZ_0)$		
<input checked="" type="radio"/> $(p,\epsilon,XZ_0)$	1.00	Notice that in state $p$ it is not possible to consume a 0 from the input.
<input type="radio"/> $(p,101,XZ_0)$		
<input type="radio"/> $(p,01,XXXZ_0)$		
Total	1.00 / 1.00	

Question 5

Here are the transitions of a pushdown automaton. The start state is  $q_0$ , and  $f$  is the accepting state.

State-Symbol	a	b	$\epsilon$
$q_0-Z_0$	$(q_1,AAZ_0)$	$(q_2,BZ_0)$	$(f,\epsilon)$
$q_1-A$	$(q_1,AAA)$	$(q_1,\epsilon)$	-

$q_1-Z_0$	-	-	$(q_0,Z_0)$
$q_2-B$	$(q_3,\epsilon)$	$(q_2,BB)$	-
$q_2-Z_0$	-	-	$(q_0,Z_0)$
$q_3-B$	-	-	$(q_2,\epsilon)$
$q_3-Z_0$	-	-	$(q_1,AZ_0)$

Describe informally what this PDA does. Then, identify below the one input string that the PDA accepts.

Your Answer	Score	Explanation
<input type="radio"/> bbbaabbb		
<input type="radio"/> abbbabb		
<input checked="" type="radio"/> babbbba	✓ 1.00	
<input type="radio"/> bababbaa		
Total	1.00 / 1.00	

### Question 6

If we convert the context-free grammar G:

```
S → AS | A
A → 0A | 1B | 1
B → 0B | 0
```

to a pushdown automaton that accepts L(G) by empty stack, using the construction given in the slides. which of the following would be a rule of the PDA?

Your Answer	Score	Explanation
<input type="radio"/> $\delta(q,\epsilon,B) = \{ (q,0) \}$		
<input type="radio"/> $\delta(q,\epsilon,A) = \{ (q,1) \}$		
<input checked="" type="radio"/> $\delta(q,\epsilon,B) = \{ (q,0B), (q,0) \}$	✓ 1.00	
<input type="radio"/> $\delta(q,\epsilon,S) = \{ (q,AS) \}$		
Total	1.00 / 1.00	

