

Pop Quiz #13 (CYK parsing)

Due Mar 25 at 11:59pm

Points 11

Questions 8

Available after Mar 25 at 1:30pm

Time Limit None

Allowed Attempts 2

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Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	3 minutes	10 out of 11

⚠️ Correct answers will be available on Mar 26 at 12am.

Score for this attempt: **10** out of 11

Submitted Mar 25 at 2:50pm

This attempt took 3 minutes.

Question 1

1 / 1 pts

Consider the following languages over $\Sigma = \{a, b\}$ with the notations below

- $n_a(w)$: number of a's in string w
- $n_b(w)$: number of b's in string w
- $L1 = \{w: n_a(w) = n_b(w)\}$
- $L2 = \{w: n_a(w) \geq n_b(w)\}$
- $L3 = \{w: n_a(w) \leq n_b(w)\}$
- $L4 = \{w: n_a(w) > n_b(w)\}$
- $L5 = \{w: n_a(w) < n_b(w)\}$
- $L6 = \{w: n_a(w) \neq n_b(w)\}$

L1 and L6 are complement to each other

Correct



$L_6 = L_4 + L_5$

Correct

 **$(L_2 + L_3)$ is a regular language**

Correct

 **L_3 and L_4 are complement to each other**

Correct

**Question 2****1 / 1 pts**

(Cont.)

Give the grammar for L_1 . Assume the start symbol is A .

- $L_1 = \{w: n_a(w) = n_b(w)\}$

☒ $A \rightarrow AA \mid aAb \mid bAa \mid \epsilon$
☐ $A \rightarrow AA \mid aAb \mid bAa \mid a \mid b \mid \epsilon$
☐ $A \rightarrow aAb \mid bAa \mid \epsilon$
☐ None is a correct answer
Question 3**2 / 2 pts**

(Cont.)

Based on the grammar for L_A , give the grammars for the other languages L_2, \dots, L_6 .

Assume that A,B,C,D,E,F are the start symbols of the grammars for each of the languages. In particular, A is the start symbol of the grammar for L_A .

Judge if the given grammar is correct or not

The grammar for L2: $B \rightarrow BB \mid A \mid a$

Correct



The grammar for L3: $C \rightarrow CC \mid A \mid b$

Correct



The grammar for L4: $D \rightarrow BaB$

Correct



The grammar for L5: $E \rightarrow CbC$

Correct



The grammar for L6: $F \rightarrow D \mid E$

Correct



Question 4

2 / 2 pts

Indicate the correctness of the given grammar for the following languages over $\Sigma = \{a, b\}$.

Assume that A,B,C,D,E,F are the start symbols of the grammars for each of the languages.

- $L1 = \{a^n b^n : n \geq 0\}$

- $L2 = \{a^m b^n : m, n \geq 0, m \geq n\}$

- $L3 = \{a^m b^n : m, n \geq 0, m \leq n\}$
- $L4 = \{a^m b^n : m, n \geq 0, m > n\}$
- $L5 = \{a^m b^n : m, n \geq 0, m < n\}$
- $L6 = \{a^m b^n : m, n \geq 0, m \neq n\}$

Grammar for L1: $A \rightarrow aAb \mid e$

correct



Grammar for L2: $B \rightarrow aBb \mid X, X \rightarrow aX \mid e$

correct



Grammar for L3: $C \rightarrow aCb \mid Y, Y \rightarrow bY \mid e$

correct



Grammar for L4: $B \rightarrow aBb \mid X, X \rightarrow aX \mid a$

correct



Grammar for L5: $C \rightarrow aCb \mid Y, Y \rightarrow bY \mid b$

correct



Grammar for L6: $F \rightarrow B \mid C$

incorrect



Question 5

1 / 1 pts

Consider the following languages over $\Sigma = \{a, b\}$ with notations:

- $n_a(w)$: number of a's in string w
- $n_b(w)$: number of b's in string w

- $A = \{a^n b^n : n \geq 0\}$
- $A' = \Sigma^* - A$ = The complement of A
- $B = \{a^m b^n : m, n \geq 0, m \neq n\}$
- $C = \{w : w \text{ contains } ba\}$
- $D = \{w : n_a(w) \neq n_b(w)\}$

Choose the correct statements about A' .

- ☒ $A' = B + C$
- ☐ $A' = B$
- ☐ $A' = B + D$
- ☐ None is a correct answer

Question 6

1 / 1 pts

To convert a context-free grammar G (which doesn't produce λ) to CNF, we must remove

- ☒ Nullable variables (except the start symbol)
- ☒ Unit productions
- ☐ Useless variables
- ☐ None is a correct answer

Partial

Question 7

1 / 2 pts

CYK Parser

Consider the table that uses the CYK parsing algorithm to determine if string $w=aabbb$ is in $L(G)$ for the grammar G listed on the top of the table.

- Complete the table by giving the values for the unknowns X, Y , and Z .
 - Fill in the names of variable S, A or B
 - If the answer has multiple variables,
 - fill in the answers in the format of X, X, X, \dots, X in the **string** order.
 - $X =$
 - $Y =$
 - $Z =$
 - (y/n) The string $w=aabbb$ is in $L(G)$ if and only if Z in the table contains the start symbol S .
 - Answer = (fill in either y or n)

Grammar G : $S \rightarrow AB$, $A \rightarrow BB a$, $B \rightarrow AB b$					
Use CYK to determine if $w=aabbb$ in $L(G)$					
$ w =1$	a	a	b	b	b
$F(w)$	{A}	{A}	{B}	{B}	{B}
$ w =2$	aa	ab	bb	bb	
$F(w)$	{ }	{S,B}	{A}	{A}	
$ w =3$	aab	abb	bbb		
$F(w)$	{S,B}	{A}	{S,B}		
$ w =4$	aabb	abbb			
$F(w)$	{X}	{Y}			

$ w =5$	aabbb				
$F(w)$	$\{Z\}$				
$F(w)$ = set of variables that produce w					

Answer 1:

A

Answer 2:

BS

Answer 3:

BS

Answer 4:

y

Question 8

1 / 1 pts

(cont.) CYK Parser

Give the time complexity of the CYK parser. Assume that N is the length of the string.

☐ $O(N)$

☐ $O(N^2)$

☒ $O(N^3)$

☐ $O(N \log N)$

Quiz Score: **10** out of 11