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CS 321 HW - 5

Assignments:

1. (5 pts) Convert the grammar below to CNF.

G = {V,T,S,P}

where

V = { S, A, B, C, D} T = { 0, 1, 2 }

and P is given below.

$S \rightarrow A \mid ABD \mid 0BB$

$A \rightarrow 0 \mid BAA$

$B \rightarrow BB \mid 1 \mid 2 \mid \lambda$

$C \rightarrow CD \mid 0$

$D \rightarrow D1 \mid DD$

Answer:

We can delete $C \rightarrow CD \mid 0$, because it isn`t impact on $S \rightarrow A \mid ABD \mid 0BB$.

And we can delete D because it is infinite variable, also we should delete ABD variables.

In result $S \rightarrow A \mid 0BB$;

Remove λ from $B \rightarrow BB \mid 1 \mid 2 \mid \lambda$ and because B can be BB:

$S \rightarrow A \mid 0 \mid 0B$;

$A \rightarrow 0 \mid BAA$;

$B \rightarrow BB \mid 1 \mid 2$;

Also we can change 0B:

$0B \rightarrow T_0B$; $T_0 \rightarrow 0$;

S will be $S \rightarrow 0 \mid T_0B \mid A$ but $A \rightarrow 0 \mid BAA$;

Change AA to T_A and in general we are receiving $S \rightarrow 0 \mid T_0B \mid BT_A$;

Our grammar in CNF:

$G = \{V, T, S, P\}$, $V = \{S, T_0, B, T_A, A\}$, $T = \{ 0, 1, 2 \}$, $S = \{S\}$, $P = \begin{Bmatrix} S \rightarrow 0 \mid T_0B \mid BT_A \\ T_0 \rightarrow 0 \\ T_A \rightarrow AA \\ A \rightarrow BT_A \mid 0 \\ B \rightarrow BB \mid 1 \mid 2 \end{Bmatrix}$;

2. (5 pts) Consider the CNF grammar

G = (V,T,S,P) where V = {S, A, B, C, D },

T = { a, b, c }, S = S and P is given below.

S ⟶AB | AD | AC

A ⟶ AA | a

B ⟶ BB | AB | b

C ⟶ AC | DC | c

D ⟶ DD | b | c

Use the CYK algorithm to determine if the strings w1 = babbc and w2 = aaaabb are in the language L(G). Show the DP table. If the string is in L(G) construct the parse tree.

Answer:

DP – table for w1

i/j	1	2	3	4	5
1	b				
2		a			
3			b		
4				b	
5					c

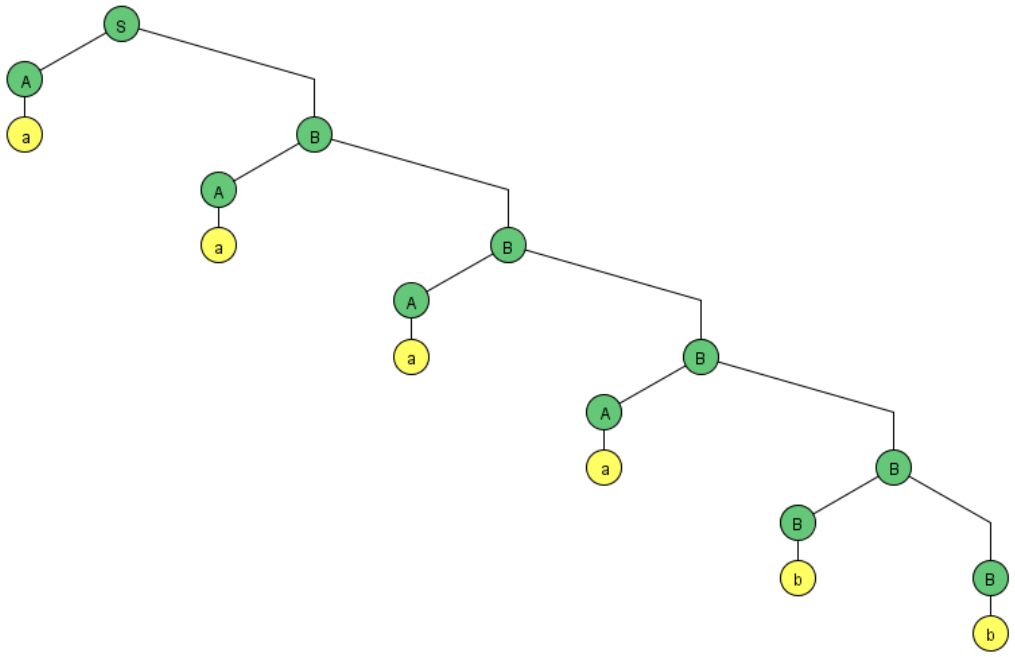
i/j	1	2	3	4	5
1	B,D	Ø	B	B	Ø
2		A	S,B	S,B	S
3			B,D	B,D	D,C
4				B,D	D,C
5					D,C

For the first string w1 = babbc is not language, because corner of table equal Ø

DP – table for w2

i/j	1	2	3	4	5	6
1	a					
2		a				
3			a			
4				a		
5					b	
6						b

i/j	1	2	3	4	5	6
1	A	A	A	A	S,B	S,B
2		A	A	A	S,B	S,B
3			A	A	S,B	S,B
4				A	S,B	S,B
5					B,D	B,D
6						B,D

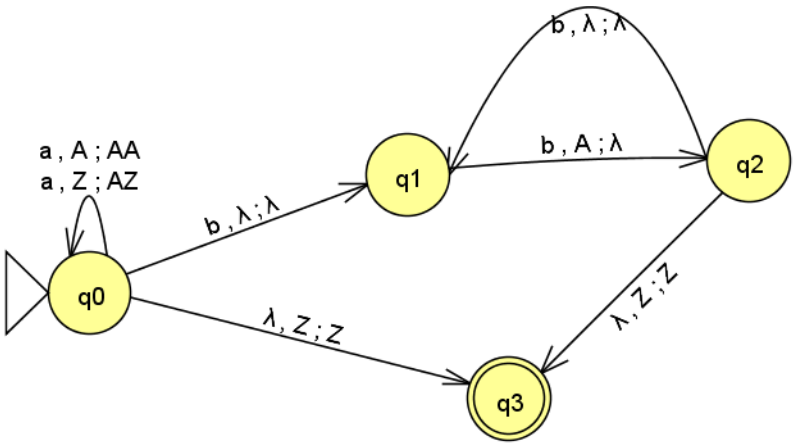


3. (15 pts) Construct NPDA's that accept the following languages on Σ = {a, b, c}. Give both a verbal explanation on how your NPDA works and the formal definition including the transition function and/or

transition graph. You must use JFLAP. Submit the transition graph in the HW pdf and the JFLAP code file for each problem.

a) $L = \{ a^n b^{2n} : n \geq 0 \}$

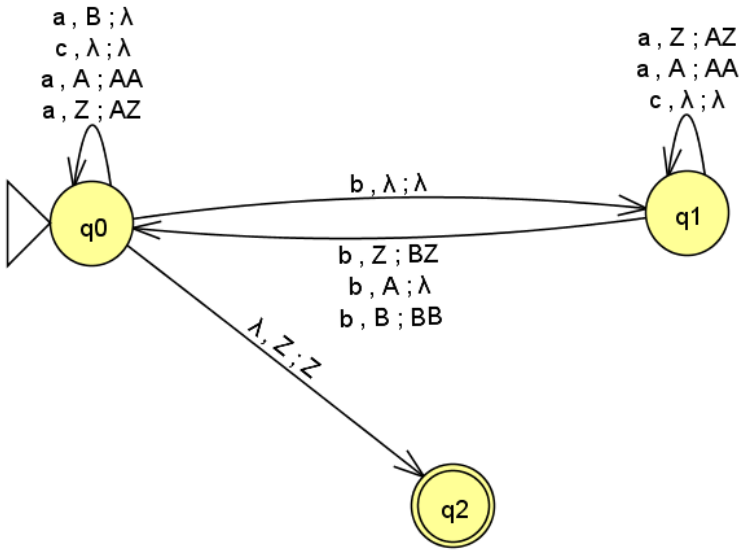
Answer:



1. For each a push A in stack; state reading a`s ;
2. Move to a state for seeing even b`s for each is pop A off stack ;
3. If consume the input and stack contains only Z we will reach to the final state.

b) $L = \{ w : n_a(w) = 2n_b(w) \}$

Answer:



1. For each a push A in stack; state reading a`s ; For each c doing noting;
2. Move to a state for seeing even b`s we need to check the top of stack. If top of stack is A string we will pop A off stack; Else if top of stack contain B or Z; we need to add B in a stack;
3. If consume the input and stack contains only Z we will reach to the final state.

c) L = { wcw^R : w ∈{a,b}* }

Answer:

1. For each a push A in stack; For each b push B in stack; state reading a`s and  b`s
2. For each c move to state q1; Move to a state for seeing even a`s  for each is pop A off stack ; Also seeing even b`s for each is pop B off stack; State q1 keep check a`s and b`s strings.
3. If consume the input and stack contains only Z we will reach to the final state.