

# COMPSCI 3331 - Fall 2022 - Quiz 6

(1.5 marks) 1. Consider the CNF grammar on the left below and the partially filled CYK table **for the word**  $w = abaabcd$  in the center. Fill in the entries of the table **on the right** that are indicated by the circled numbers ①, ② and ③ in the CYK table on the middle. Note that entries that have been calculated to be empty in the table are indicated by  $-$ . You are only responsible for giving the entries for the numbered cells. Do not fill in any other cells.

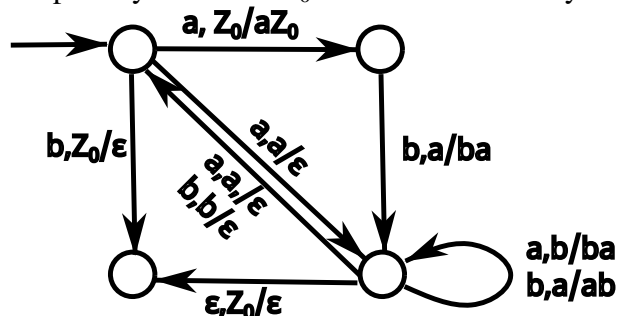
$S \rightarrow XA \mid BB \mid ZX \mid d$   
 $X \rightarrow AX \mid BY \mid d$   
 $Y \rightarrow YS \mid b$   
 $Z \rightarrow AB \mid a$   
 $A \rightarrow DB \mid YC \mid a$   
 $B \rightarrow SY \mid b$   
 $C \rightarrow ZB \mid c$   
 $D \rightarrow AC \mid YD \mid AA \mid c$

A,Z	C,Z					
	B,Y	-	D	③		
		A,Z	D	D,A		
			A,Z	C,Z		
				B,Y	②	
					C,D	
						①

The entries of the table are:

①	S,X
②	A,D
③	A,D

(1.5 marks) 2. Consider the PDA below, which accepts by empty stack. For each of the words in the table, put a checkmark in the box if it is accepted by the PDA, and put an X in the box if it is not accepted by the PDA.  $Z_0$  is the initial stack symbol.



$ababaaba$	X
$abaabaaa$	✓
$ababb$	X

*Solution:* Number the states in the PDA as  $q_0, q_1, q_2, q_3$  starting from the start state, in clockwise order.

The path for the first word is

$$\begin{aligned}
 (q_0, ababaaba, Z_0) &\vdash (q_1, babaaba, aZ_0) \\
 &\vdash (q_2, abaaba, baZ_0) \\
 &\vdash (q_2, baaba, baaZ_0) \\
 &\vdash (q_0, aaba, aaZ_0) \\
 &\vdash (q_2, aba, aZ_0) \\
 &\vdash (q_0, ba, Z_0) \\
 &\vdash (q_3, a, \varepsilon)
 \end{aligned}$$

At this point, there is no transition on  $a$  from state  $q_3$  and the computation fails.

The path for the second word is

$$\begin{aligned}
 (q_0, abaabaaa, Z_0) &\vdash (q_1, baabaaa, aZ_0) \\
 &\vdash (q_2, aabaaa, baZ_0) \\
 &\vdash (q_2, abaaa, baaZ_0) \\
 &\vdash (q_2, baaa, baaaZ_0) \\
 &\vdash (q_0, aaa, aaaZ_0) \\
 &\vdash (q_2, aa, aaZ_0) \\
 &\vdash (q_0, a, aZ_0) \\
 &\vdash (q_2, \varepsilon, Z_0) \\
 &\vdash (q_3, \varepsilon, \varepsilon)
 \end{aligned}$$

As the stack is empty, the computation is accepting.

Finally, the path for the third word is

$$\begin{aligned}
 (q_0, ababb, Z_0) &\vdash (q_1, babb, aZ_0) \\
 &\vdash (q_2, abb, baZ_0) \\
 &\vdash (q_2, bb, baaZ_0) \\
 &\vdash (q_0, b, aaZ_0)
 \end{aligned}$$

At this point, there is no transition in state  $q_0$  on letter  $b$  and stack top  $a$ .