

⊕ Sub: Automata Theory & Compiler Design

Sub code: 21CS51

IAT3 Solution

① $S \rightarrow (L) | a$

$L \rightarrow L, S | S$

Step 1: Remove left recursion

$S \rightarrow (L) | a$

$L \rightarrow SL'$

$L' \rightarrow , SL' | \epsilon$

Step 2: Calculate FIRST & FOLLOW

$FIRST(S) = \{ (, a \}$

$FIRST(L) = FIRST(S) = \{ (, a \}$

$FIRST(L') = \{ , , \epsilon \}$

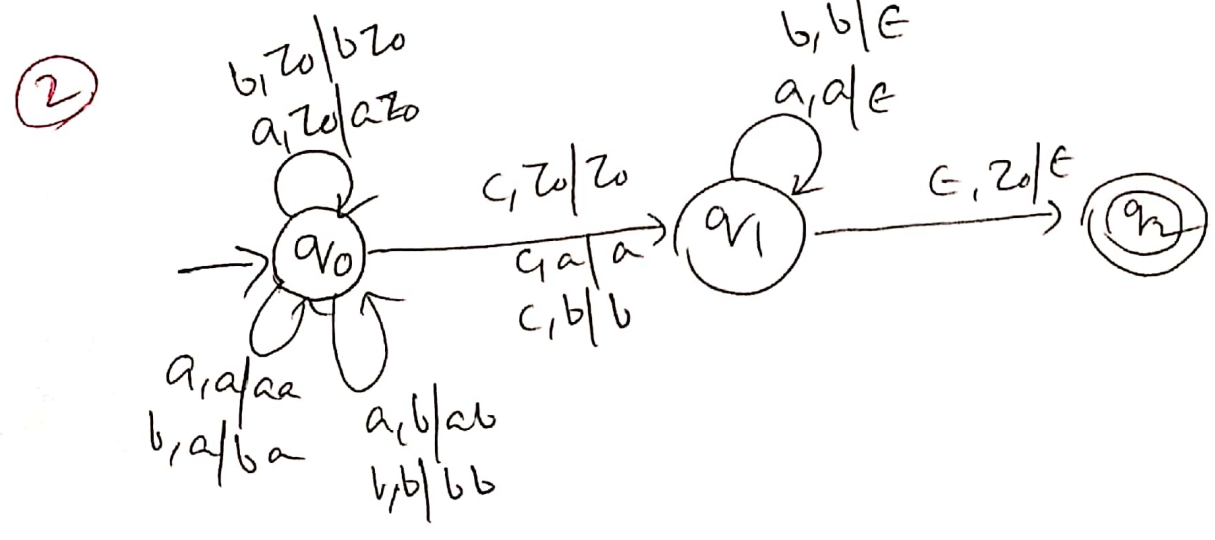
$FOLLOW(S) = \{ \$, , ,) \}$

$FOLLOW(L) = \{) \}$

$FOLLOW(L') = \{) \}$

	(	)	a	,	\$
S	$S \rightarrow (L)$		$S \rightarrow a$		
L	$L \rightarrow SL'$		$L \rightarrow SL'$		
L'		$L' \rightarrow \epsilon$		$L' \rightarrow , SL'$	

Stack	I/P	Action
\$ S	(a, a) \$	$S \rightarrow (L)$
\$) L (	(a, a) \$	Matched
\$) L	a, a) \$	$L \rightarrow SL'$
\$) L' S	a, a) \$	$S \rightarrow a$
\$) L' a	a, a) \$	Matched
\$) L'	, a) \$	$L' \rightarrow , SL'$
\$) L' S,	, a) \$	Matched
\$) L' S	a) \$	$S \rightarrow a$
\$) L' a	a) \$	Matched
\$) L'	) \$	$L' \rightarrow \epsilon$
\$ )	) \$	Matched
\$	\$	<u>Accepted</u>



It is DPDA

- $(q_0, bba-cabb, z_0) \vdash (q_0, bacabb, bz_0)$
- $\vdash (q_0, acabb, bbz_0) \vdash (q_0, cabb, abbz_0)$
- $\vdash (q_1, abb, abbz_0) \vdash (q_1, bb, bbz_0) \vdash (q_1, b, bz_0)$

$\vdash (q_1, \epsilon, z_0) \vdash (q_2, \epsilon, \epsilon)$ Accepted

③

PDA is defined by 7-tuples

$$M = (Q, \Sigma, \Gamma, \delta, q_0, z_0, F)$$

where $Q \rightarrow$ set of states

$\Sigma \rightarrow$ I/P alphabet set

$\Gamma \rightarrow$ stack symbols

$\delta \rightarrow$ transition function

$$\delta : (Q \times \Sigma \cup \epsilon) \rightarrow (Q \times \Gamma^*)$$

$q_0 \rightarrow$ start state

~~Q~~ $F \rightarrow$ Final state

$z_0 \rightarrow$ Initial stack symbol.

Here δ is defined as

① $\delta(q_0, a, z_0) = (q_0, az_0)$

② $\delta(q_0, b, z_0) = (q_0, bz_0)$

③ $\delta(q_0, a, a) = (q_0, aa)$

④ $\delta(q_0, b, a) = (q_0, ba)$

⑤ $\delta(q_0, a, b) = (q_0, ab)$

$$\textcircled{6} \quad \delta(q_0, b, b) = (q_0, bb)$$

$$\textcircled{7} \quad \delta(q_0, c, z_0) = (q_1, z_0)$$

$$\textcircled{8} \quad \delta(q_0, c, a) = (q_1, a)$$

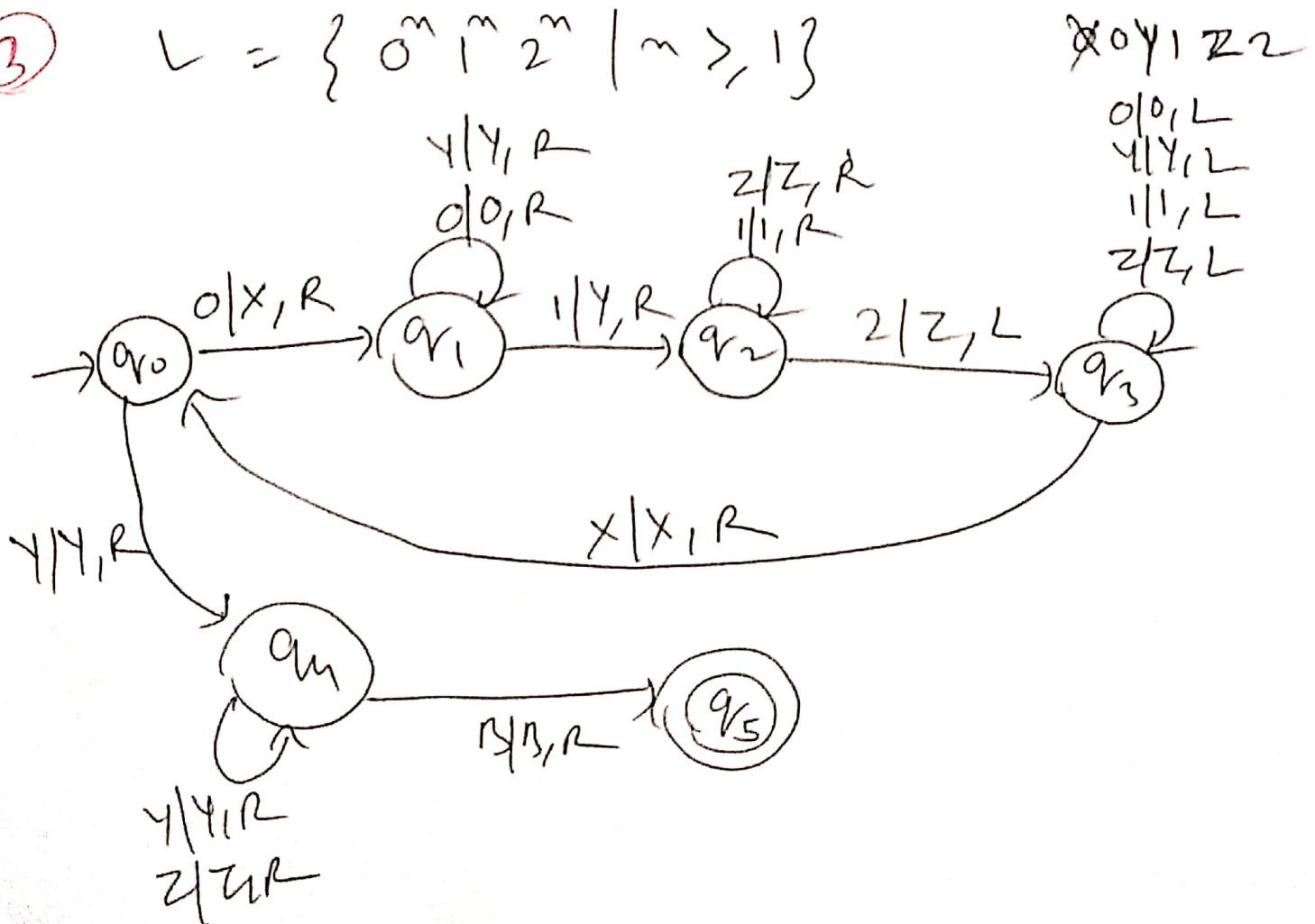
$$\textcircled{9} \quad \delta(q_0, c, b) = (q_1, b)$$

$$\textcircled{10} \quad \delta(q_1, a, a) = (q_1, \epsilon)$$

$$\textcircled{11} \quad \delta(q_1, b, b) = (q_1, \epsilon)$$

$$\textcircled{12} \quad \delta(q_1, \epsilon, z_0) = (q_2, \epsilon)$$

$$\textcircled{3} \quad L = \{ 0^m 1^m 2^m \mid m \geq 1 \}$$



ID for 001122

(5)

$q_0 001122 \vdash X q_1 01122 \vdash X0 q_1 1122 \vdash$
 $\vdash X0Y q_2 122 \vdash X0Y1 q_2 22 \vdash X0Y q_3 122 \vdash$
 $\vdash X0 q_3 Y122 \vdash X q_3 0Y122 \vdash q_3 X0Y122 \vdash$
 $\vdash X q_0 0Y122 \vdash XX q_1 Y122 \vdash XX Y q_1 122 \vdash$
 $\vdash XX Y Y q_2 22 \vdash XX Y Y Z q_2 2 \vdash$
 $\vdash XX Y Y q_3 Z2 \vdash XX Y q_3 Y Z Z \vdash$
 $\vdash XX q_3 Y Z Z \vdash X q_3 X Y Y Z Z \vdash$
 $\vdash XX q_0 Y Y Z Z \vdash XX Y q_m Y Z Z \vdash$
 $\vdash XX Y Y q_m Z Z \vdash XX Y Y Z q_m Z \vdash$
 $\vdash XX Y Y Z Z q_m \vdash XX Y Y Z Z \vdash q_5 \text{ Accepted}$

④ Actions of shift reduce parser

① Shift ② Reduce ③ Accept

④ Error

RMD

$E \Rightarrow T$
 $\Rightarrow T * F$
 $\Rightarrow T * id$
 $\Rightarrow F * v_d$
 $\Rightarrow (E) * v_d$

$\Rightarrow (E - T) * id$
 $\Rightarrow (E - F) * id$
 $\Rightarrow (E - id) * id$
 $\Rightarrow (T - id) * id$
 $\Rightarrow (F - id) * v_d$
 $\Rightarrow (id - id) * v_d$

Stack	I/P	Actions
\$	(rd-id)*rd\$	shift
\$(	rd-id)*rd\$	shift
\$(rd	-rd)*rd\$	Reduce $F \rightarrow id$
\$(F	-rd)*rd\$	Reduce $T \rightarrow F$
\$(T	-rd)*rd\$	Reduce $E \rightarrow T$
\$(E	-rd)*rd\$	shift
\$(E-	rd)*rd\$	shift
\$(E-)	rd)*rd\$	Reduce $F \rightarrow rd$
\$(E-id	)*rd\$	Reduce $T \rightarrow F$
\$(E-F	)*rd\$	Reduce $E \rightarrow E-T$
\$(E-T	)*rd\$	shift
\$(E	)*rd\$	Reduce $F \rightarrow (E)$
\$(E)	)*rd\$	Reduce $T \rightarrow F$
\$F	)*rd\$	shift
\$T	*rd\$	shift
\$T*	rd\$	shift
\$T*	\$	Reduce $F \rightarrow id$
\$T*rd	\$	Reduce $T \rightarrow T*F$
\$T*F	\$	Reduce $E \rightarrow T$
\$T	\$	Accept
\$E	\$	