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U19CS076

Tutorial 8

Q1] Design a PDA for following grammer and find language

$S \rightarrow 0A$

$A \rightarrow 0AB / 1$

$B \rightarrow 1$

And trace the string 00001111.

Ans Given

$G = (V, T, R, S)$

$= \{\{S, A, B\}, \{0, 1\}, R, S\}$

So

PDA $P = \{\{q_0\}, T, V \cup T, \delta, q_0, S\}$

$= \{\{q_0\}, \{0, 1\}, \{S, A, B, 0, 1\}, \delta, q_0, S\}$

And $\delta(q_0, \epsilon, S) = \{(q_0, 0A)\}$

$\delta(q_0, \epsilon, A) = \{(q_0, 0AB), (q_0, 1)\}$

$\delta(q_0, \epsilon, B) = \{(q_0, 1)\}$

$\delta(q, 0, 0) = \{(q_0, \epsilon)\}$

$\delta(q_0, 1, 1) = \{(q_0, \epsilon)\}$

String tracing

$(q_0, 00001111, S) \vdash (q_0, 00001111, 0A)$

$\vdash (q_0, 0001111, A)$

$\vdash (q_0, 00001111, 0AB)$

$\vdash (q_0, 001111, AB)$

$\vdash (q_0, 001111, 0ABB)$

$\vdash (q_0, 01111, ABB)$

$\vdash (q_0, 01111, 0ABBB)$

$\vdash (q_0, 1111, ABBB)$

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$\vdash (q_0, 1111, 1BBB)$
$\vdash (q_0, 111, BBB)$
$\vdash (q_0, 111, 1BB)$
$\vdash (q_0, 11, BB)$
$\vdash (q_0, 11, 1B)$
$\vdash (q_0, 1, B)$
$\vdash (q_0, 111)$
$\vdash (q_0, \epsilon, \epsilon)$

Empty stack
is in the PDA P.

Q2] Design a PDA for following grammer and find the language

$S \rightarrow aSa$
$S \rightarrow bSb$
$S \rightarrow c$

And trace the string abbcbba.

Sol Given $G = \{\{S\}, \{a, b, c\}, R, S\}$

So

PDA $P = \{\{q\}, \{a, b, c\}, \{S, a, b, c\}, \delta, q, s\}$

And

$\delta(q, \epsilon, S) = \{(q, aSa), (q, bSb), (q, c)\}$
$\delta(q, a, a) = \{(q, \epsilon)\}$
$\delta(q, b, b) = \{(q, \epsilon)\}$
$\delta(q, c, c) = \{(q, \epsilon)\}$

String tracing

$(q, abbcbba, S) \vdash (q, abbcbba, aSa)$
$\vdash (q, bbcbba, Sa)$
$\vdash (q, bbcbba, bSba)$

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$\vdash (q, bcbba, bSbba)$
$\vdash (q, cbba, SbbA)$
$\vdash (q, cbba, cbbA)$
$\vdash (q, c, \epsilon)$

Empty stack

Here, given string is in PDA P.

Q.3] Construct the PDA and find language corresponding to given grammar

$S \rightarrow aABB / aAA$
$A \rightarrow aBB / a$
$B \rightarrow bBB / A$

Given $G = \{\{S, A, B\}, \{a, b\}, R, S\}$

So

PDA $P = \{\{q\}, \{a, b\}, \{S, A, B, a, b\}, \delta, q, S\}$

$\delta(q, \epsilon, S) = \{(q, aABB), (q, aAA)\}$
$\delta(q, \epsilon, A) = \{(q, aBB), (q, a)\}$
$\delta(q, \epsilon, B) = \{(q, bBB), (q, A)\}$
$\delta(q, a, a) = \{(q, \epsilon)\}$
$\delta(q, b, b) = \{(q, \epsilon)\}$

Q.4] Consider a pushdown automata $P = (\{q, q_1, q_2, q_3\}, \{0, 1\}, \{X, Y, Z\}, \delta, q_0, Z, \{q_3\})$ has the following ~~states~~ defining δ:

(1) $\delta(q_0, \epsilon, Z) = \{(q_1, XZ)\}$
(2) $\delta(q_1, 0, X) = \{(q_1, YZ)\}$
(3) $\delta(q_1, 0, Y) = \{(q_1, YY)\}$
(4) $\delta(q_1, 1, Y) = \{(q_2, \epsilon)\}$
(5) $\delta(q_2, 1, Y) = \{(q_2, \epsilon)\}$

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(7) $\delta(q_2, \epsilon, X) = \{(q_2, \epsilon)\}$
(8) $\delta(q_1, \epsilon, Z) = \{(q_3, Z)\}$
(9) $\delta(q_2, \epsilon, Z) = \{(q_3, Z)\}$

(I) Given an execution trace showing that string 0110 is in L(P) or not.
(II) Given the contents of stack after P has read $0^3 1^5 0^3$ term its input.
(III) Informally describe L(P).

Ans → (I)

$(q_0, 0110, Z) \vdash (q_1, 0110, XZ)$
$\vdash (q_1, 110, YXZ)$
$\vdash (q_2, 10, YXZ)$
$\vdash (q_2, 0, YXZ)$
$\vdash (q_2, \epsilon, XZ)$
$\vdash (q_2, \epsilon, Z)$
$\vdash (q_3, \epsilon, Z)$

accepts because final state reached.

(II)

state	Unread	stack
q_0	000111111000	Z
q_1	0 0011111000	XZ
q_1	00111111000	YXZ
q_1	0111111000	YYXZ
q_1	111111000	YYYXZ

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	q_2	111000	YYYXZ
$\vdash^*$	q_2	000	YYYXZ
	q_2	00	YYXZ
$\vdash^*$	q_2	$\in$	XZ
	q_2	$\in$	Z
	q_3	$\in$	Z

Here, content of stack will be Z after reading $0^3 1^5 0^3$

(iii) We can describe the pushdown automata on LCP informally as the device which is combination of a finite-state control which reads inputs one symbol at a time and a infinite sized stack.

The pushdown automaton is allowed to observe the symbol at the top of stack and to base its transition on its current state, the input symbol and the symbol at top of stack.

Alternatively, it may take a spontaneous transition, using ϵ as its input instead of an input symbol that it uses. In one transition the pushdown automata consumes from the input symbol that it uses in transition.

If ϵ is used for input then no input symbol is consumed.

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By transition, one state goes to next state, which may / may not be the same as old state.