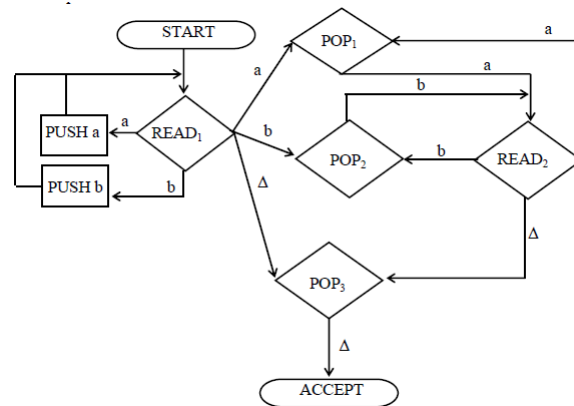


Nondeterministic PDA:

- No edge is labeled by string of terminals or nonterminals, like that can be observed in TGs. Also if there is no edge for any letter to be read from the TAPE, the machine crashes and the string is rejected.
- A string may trace more than one paths. If there exists at least one path traced by a string leading to ACCEPT state, then the string is supposed.



Pushdown Automaton (PDA) consists of the following:

1. An alphabet Σ of input letters.
2. An input TAPE with infinite many locations in one direction. Initially the input string is placed in it starting from first cell; the remaining part of the TAPE is empty.
3. An alphabet Γ of STACK characters.
4. A pushdown STACK which is initially empty, with infinite many locations in one direction. Initially the STACK contains blanks.
5. One START state with only one out-edge and no in-edge.
6. PUSH state(s) that introduces characters onto the top of the STACK.
7. POP state(s) that reads the top character of the STACK, (may contain more than one out-edges with same label).
8. READ state(s).

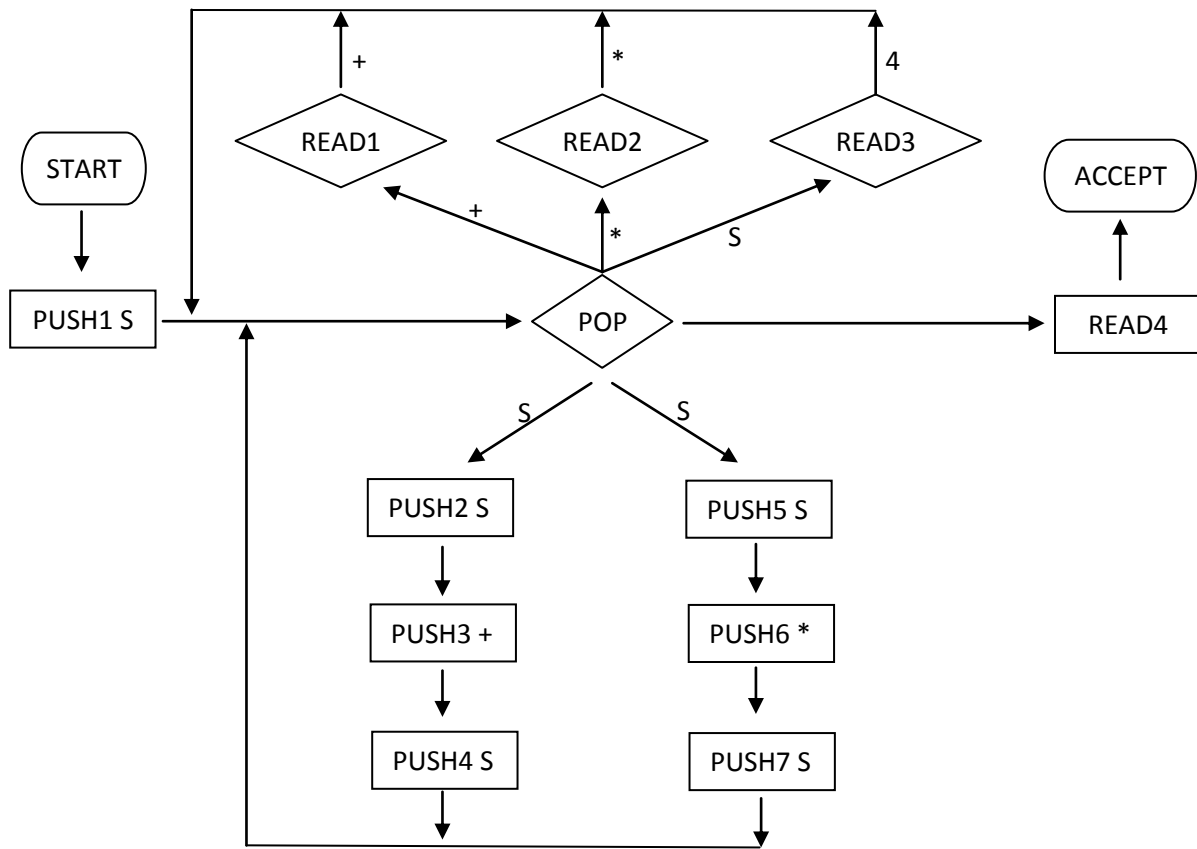
PDA and CFG:

Grammar

: $S \rightarrow S+S \mid S*S \mid 4$

Expression/String

: $4 + 4 * 4$



Expression/String: $4 + 4 * 4$

State	Stack	Tape
START	Empty	$4 + 4 * 4$
PUSH1 S	S	$4 + 4 * 4$
POP (S)	Empty	$4 + 4 * 4$
PUSH2 S	S	$4 + 4 * 4$
PUSH3 +	+S	$4 + 4 * 4$
PUSH4 S	S+S	$4 + 4 * 4$
POP (S)	+S	$4 + 4 * 4$
READ3	+S	<u>4</u> + 4 * 4
POP (+)	S	4 + 4 * 4
READ1	S	4 <u>+</u> 4 * 4
POP (S)	Empty	4 + 4 * 4
PUSH5 S	S	4 + 4 * 4
PUSH6 *	*S	4 + 4 * 4
PUSH7 S	S*S	4 + 4 * 4
POP (S)	*S	4 + 4 * 4
READ3	*S	4 + <u>4</u> * 4

POP (*)	S	4 + 4 * 4
READ2	S	4 + 4 * 4
POP (S)	Empty	4 + 4 * 4
READ3	Empty	4 + 4 * 4
POP	Empty	4 + 4 * 4
READ4	Empty	4 + 4 * 4
ACCEPT		

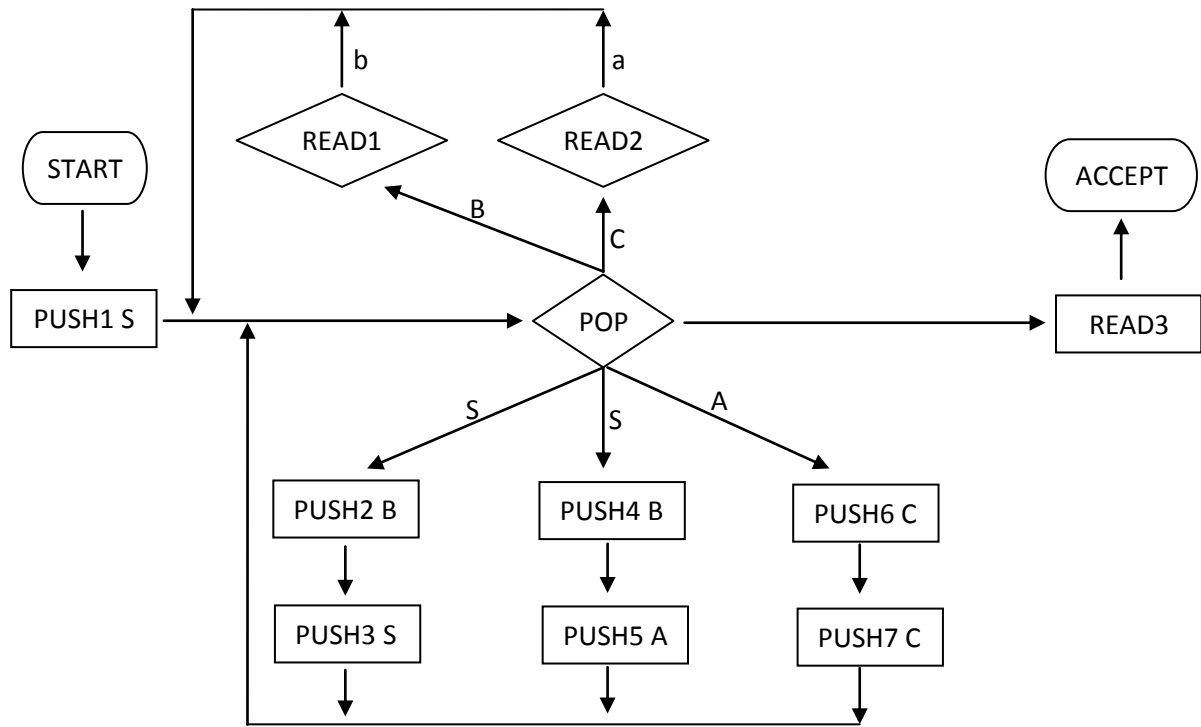
EXAMPLE:

- Grammar:

 1. $S \rightarrow SB \mid AB$
 2. $A \rightarrow CC$
 3. $B \rightarrow b$
 4. $C \rightarrow a$
- This grammar is CNF

Allowed Productions:

 - $NT \rightarrow NT_1NT_2$
 - $NT \rightarrow T$



- $S \rightarrow SB$
 $S \rightarrow AB$
- PUSH B

PUSH B
- PUSH S

PUSH A
- POP: SB

POP: AB

- Task: Run the string aab on this PDA
- Task: Convert to CNF $S \rightarrow S+S \mid S*S \mid 4$

EXAMPLE:

Grammar:

Step 1: Convert to CNF

Correct:

 $S \rightarrow XY$ $X \rightarrow a$ $Y \rightarrow b$

Introduce new productions:

 $A \rightarrow a$ $B \rightarrow b$

Result:

 $X \rightarrow aX$ becomes $X \rightarrow AX$ $X \rightarrow bX$ becomes $X \rightarrow BX$ $Y \rightarrow Ya$ becomes $Y \rightarrow YA$ $Y \rightarrow Yb$ becomes $Y \rightarrow YB$

Final grammar:

1. $S \rightarrow XY$
2. $X \rightarrow AX$
3. $X \rightarrow BX$
4. $Y \rightarrow YA$
5. $Y \rightarrow YB$
6. $X \rightarrow a$
7. $Y \rightarrow b$
8. $A \rightarrow a$
9. $B \rightarrow b$

Original grammar:

1. $S \rightarrow XY$
2. $X \rightarrow aX \mid bX \mid a$
3. $Y \rightarrow Ya \mid Yb \mid b$

Re-writing grammar:

1. $S \rightarrow XY$
2. $X \rightarrow aX$
3. $X \rightarrow bX$
4. $X \rightarrow a$
5. $Y \rightarrow Ya$
6. $Y \rightarrow Yb$
7. $Y \rightarrow b$

