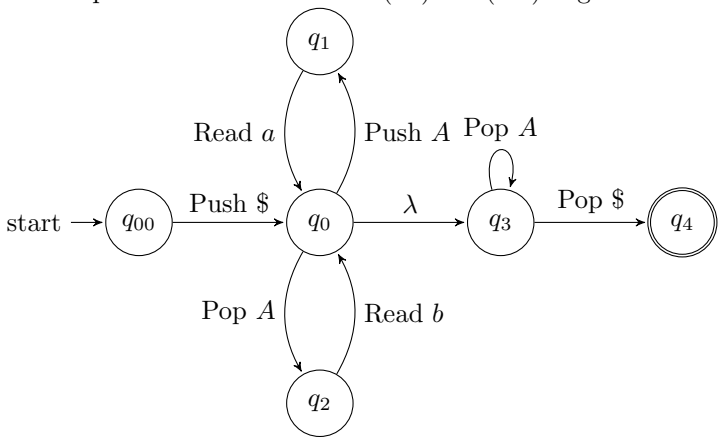
Theory of Computation Assignment no. 8

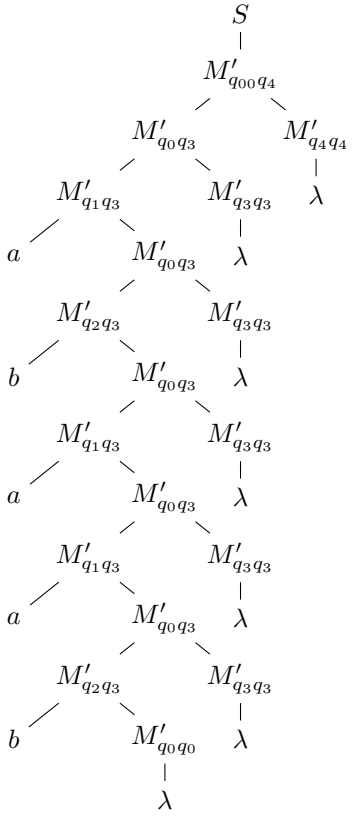
Goktug Saatcioglu

(1) a. The simple PDA M' such that $L(M) = L(M')$ is given below.

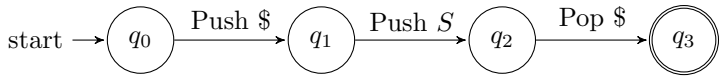


Where q_{00} is the intial state before the shielding symbol is pushed onto the stack, q_0 is q_0 from M, q_1 is the intermediary step in the upper loop of M, q_2 is the inermediary step in the lower loop of M, q_3 is the stack empyting step and q_4 is the accepting state once the stack is empty.

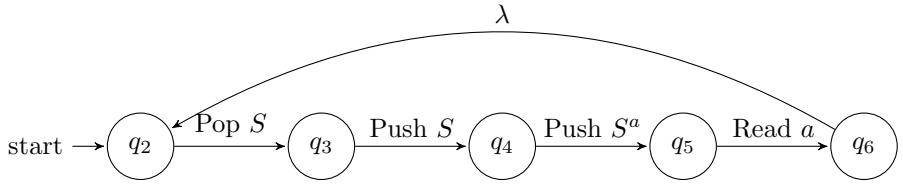
b. A derivation tree for the word $w = abaab$ is given below.



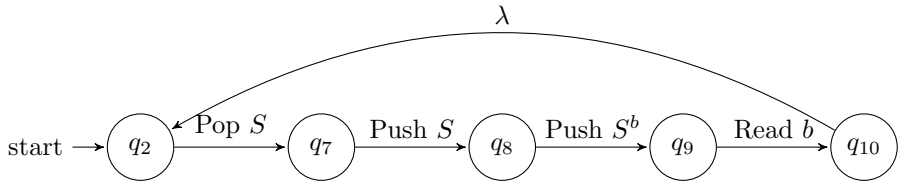
(2) The transformation of the CFG into a PDA is given below. We begin by defining the PDA with the main state and then define the transition in and out of main.



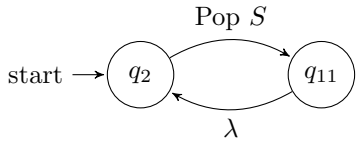
Here q_0 is the initial state, q_1 is the state with the shielding state, q_2 is main where we begin by pushing S and q_3 is the accepting state. Next, for each rule we show a set of transition out from main and back into main. We begin with the rule $S \to aS^aS$.



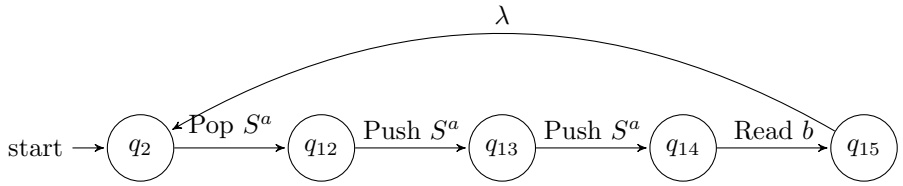
Here q_2 is main and the rest of the states is the derivation rule processed in reverse. Similarly, we write the transitions for the rule $S \to bS^bS$.

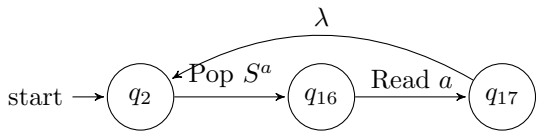


Again q_2 is main and we reverse process the derivation rules. Next, we write the derivation for the rule $S \to \lambda$ with q_2 as main.

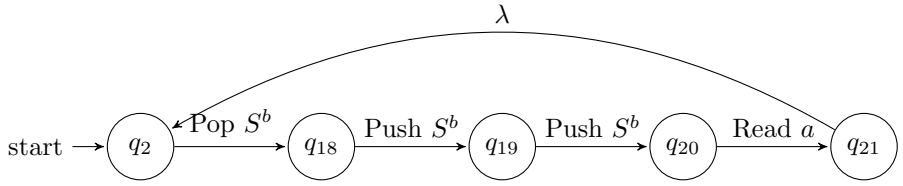


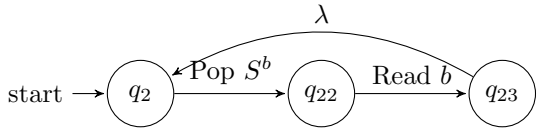
We then get two more derivations for the rule $S^a \to a \mid a^S aS^a$ with q_2 as main.





Finally, we get two more derivations for the rule $S^b \to b \mid a^S bS^b$ with q_2 as main.





Thus, we have transformed the CFG into a PDA that accepts thesame language.

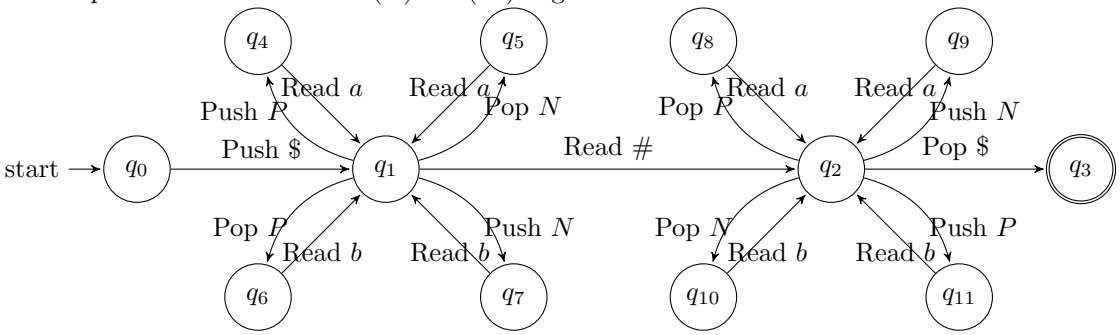
(3) (a) $L(P) = \{u\#v \mid u, v \in \{a,b\}^* \text{ and } \#_a(u) - \#_b(u) = \#_a(v) - \#_b(v)\}$

(b) A data-configuration sequence of an accepting computation path in P for the word $w = abb\#abb$ is given below.

$$\to (\lambda, q_0, \lambda) \to (\lambda, q_1, \$) \to (a, q_1, P\$) \to (ab, q_1, \$) \to (abb, q_1, N\$) \to (abb\#, q_2, N\$) \dots$$
$$\cdots \to (abb\#a, q_2, NN\$) \to (abb\#ab, q_2, N\$) \to (abb\#abb, q_2, \$) \to (abb\#abb, q_3, \lambda)$$

Here q_i is the i-th state from the left.

(c) The simple PDA P' such that $L(P) = L(P')$ is given below.



Here q_0, q_1, q_2 and q_3 are the states given by the PDA P and the remaining states are the intermediary steps in the loops of P where for example the left-top loop of q_1 which goes to q_4 is the left-top loop of q_1 in PDA P.

(d) A derivation tree for the word $w = abb\#abb$ is given below.