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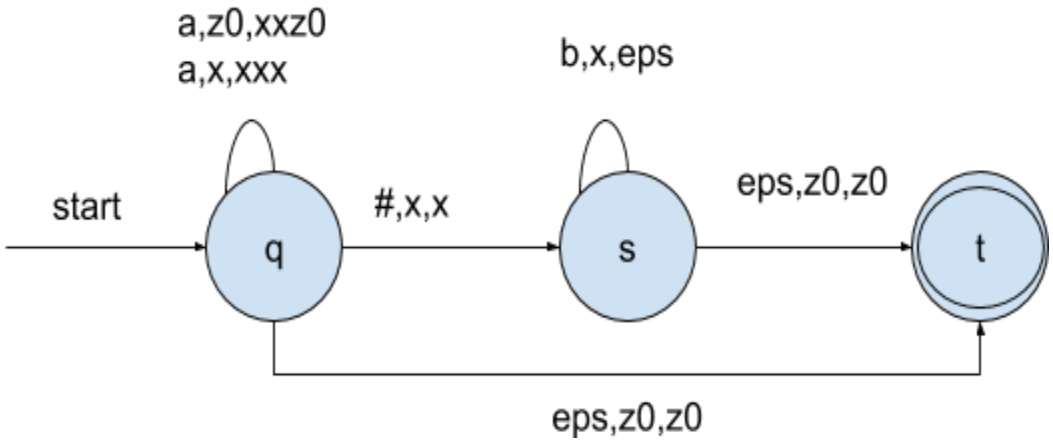
PDA

TASK 1

{ a^n # b^2n | n ≥ 0 }

Solution

a)



1) Upon input “a” two x’s are inserted in the stack on top of z0
2) If the input is empty and we just have z0 in the stack we go from state q to state t which is the final state because we assume that our n can be 0.

3) Upon second input “a” when x is the top most element in the stack another double x’s are added so now we have 4 x’s in the stack
4) Upon input “#” when the top most element is x the top most x is replaced with an x to preserve the number of x’s in the stack and we go to state “s”
5) At every input “b” when the top most element in the stack is “x” we pop the top most “x”
6) When we have no more inputs and we have only z0 in the stack we go to state “t” which is the accepting/final state

b)

1) $\delta(q,a,z0) = \{(q,xxz0)\}$ - input first a
2) $\delta(q,a,x) = \{(q,xxx)\}$ - input second a
3) $\delta(q,\varepsilon,z0) = \{(t,z0)\}$ - empty string
4) $\delta(q,\#,x) = \{(s,x)\}$ - input #
5) $\delta(s,b,x) = \{(s,\varepsilon)\}$ - input b we pop an x
6) $\delta(s,\varepsilon,z0) = \{(t,z0)\}$ - final state/accepting state

c) Valid Strings

- **aa#bbbb**

  [q,aa#bbbb,z0] |- [q,a#bbbb,xxz0] |- [q,#bbbb,xxxxz0] |- [s,bbbb,xxxxz0] |- [s,bbb,xxxz0] |- [s,bb,xxz0] |- [s,b,xz0] |- [s,ε,z0] |- [t,ε,z0] => accepted

- **“ “ (empty string)**

  [q,ε,z0] |- [t,ε,z0] => accepted

d) Invalid Strings

- **aabbbb (missing the “#”)**

  [q,aabbbb,z0] |- [q,abbbb,xxz0] |- [q,bbbb,xxxxz0] => stuck we can’t go to the next state and the input is not empty and the stack is also not empty

- **aaa#bbbb (wrong number of a’s)**

  [q,aaa#bbbb,z0] |- [q,aa#bbbb,xxz0] |- [q,a#bbbb,xxxxxxz0] |- [q,#bbbb,xxxxxxz0] |- [s,bbbb,xxxxxxz0] |- [s,bbb,xxxxxz0] |- [s,bb,xxxxz0] |- [s,b,xxxz0] |- [s,ε,xxz0] => stuck. Input is empty but the stack still has two x’s in it and not empty so it's not accepted.

- **a#bbb (wrong number of b’s)**

  [q,a#bbb,z0] |- [q,#bbb,xxz0] |- [s,bbb,xxz0] |- [q,bb,xz0] |- [q,b,z0] => stuck. Input is not empty neither is the stack so we can't reach the final state.