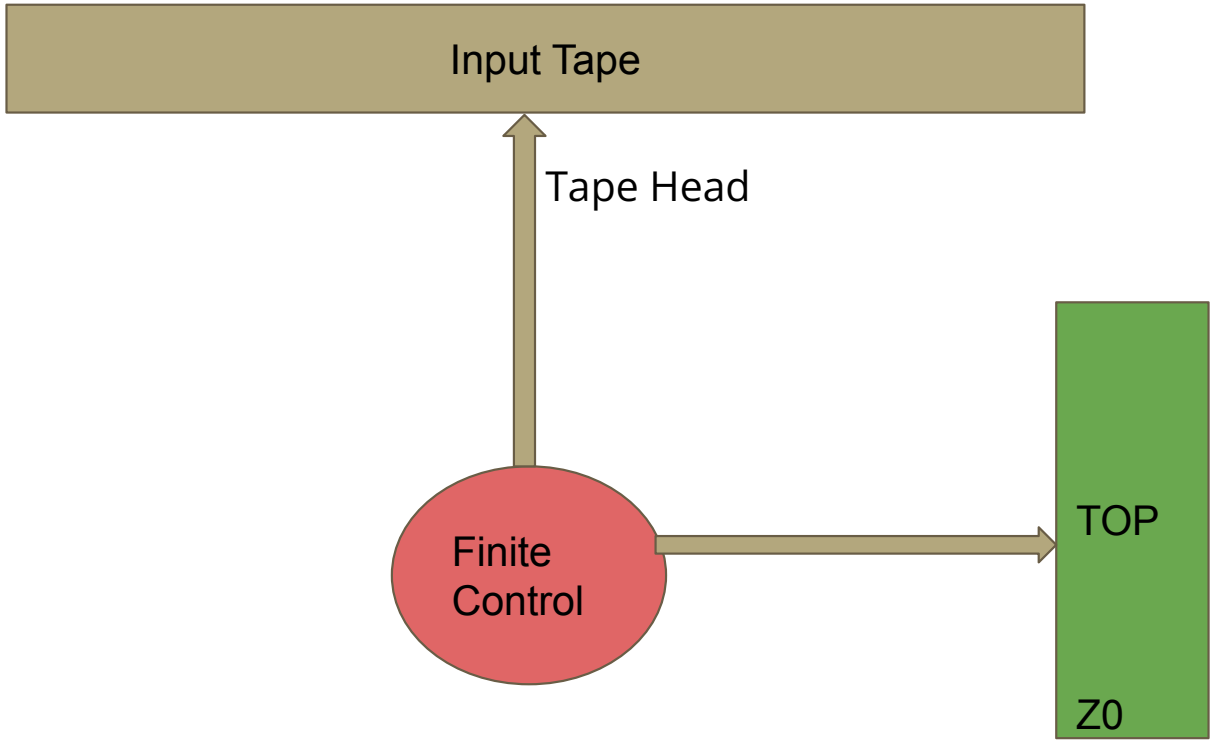
Pushdown Automata - PDA

It can be defined as a finite state automata with a stack or pushdown store.

This abstract model of computing contains

1. Input Tape - It contains input string which is to be read.
2. Tape Head - It is used to read input symbol under tape head.
3. Finite Control - It reads input symbol under tape head and tape symbol in the pushdown store and makes state transition and replaces stack top with some new string
4. Pushdown store - It is stack which finite control can access for read and write only from top position.

Pushdown Automata



Pushdown store

Non deterministic PDA

A pushdown automata M is a 7 tuple

M=(Q, Σ, Γ, δ, q_0, F, Z_0) where

Q - finite set of states

Σ - finite set of input alphabets

Γ - finite set of stack symbols

δ - state transition function

q_0- initial state of finite control

F - finite set of accept or final states

Z_0- initial input on stack

State Transition Function

δ - It is a function $Q \times \Sigma \times \Gamma \rightarrow 2^{Q} \times \Gamma^{*}$.

It maps current state p, input alphabet a and stack top Z to some next state p and replaces stack top with string γ.

Mathematically δ(p,a,Z) contains (q,γ)

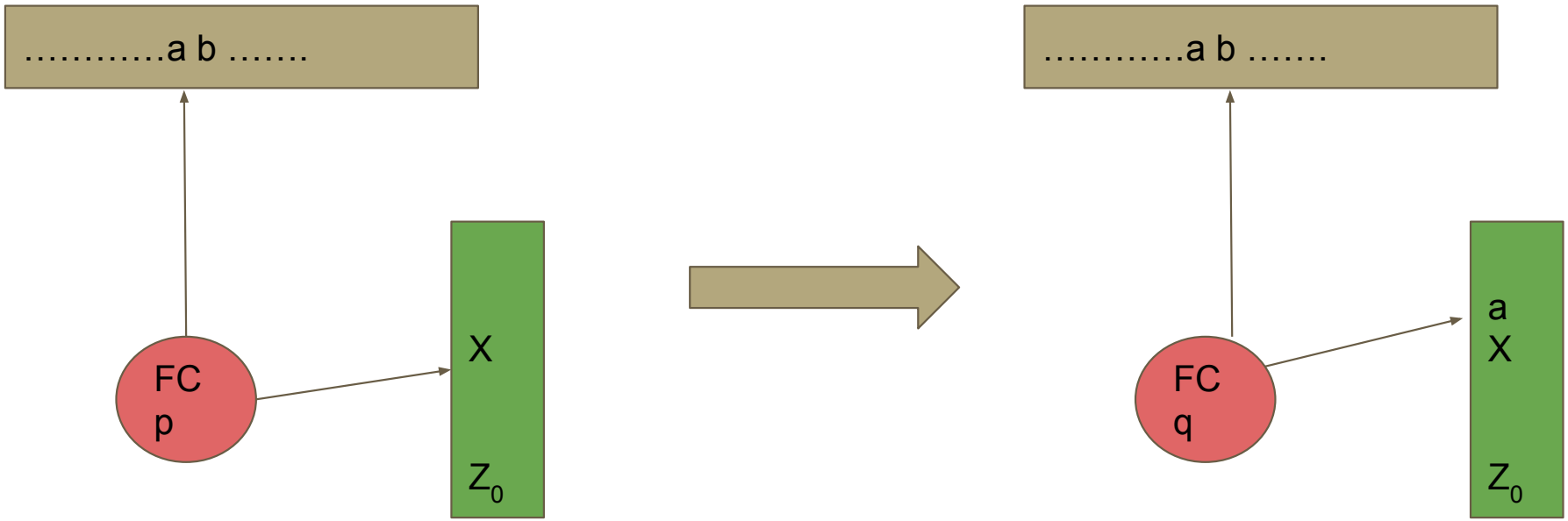
Stack operation can be

1. PUSH (insert onto stack) when γ is not equal to ε (empty string).
2. POP (delete from stack) when γ is equal to ε (empty string).
3. NOOP (no change in stack) when γ is equal to Z

Note - PDA is an ε - NFA with a pushdown store.

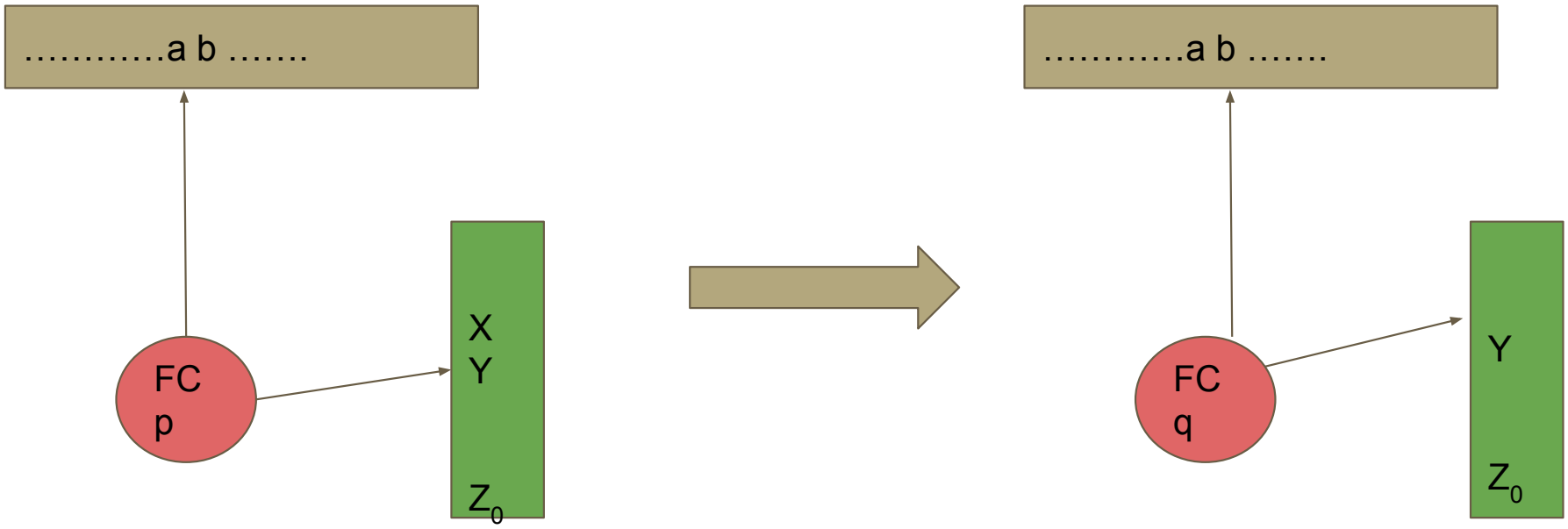
State Transition Example

Suppose δ(p,a,X) contains (q,aX) - It means PUSH operation on Pushdown store



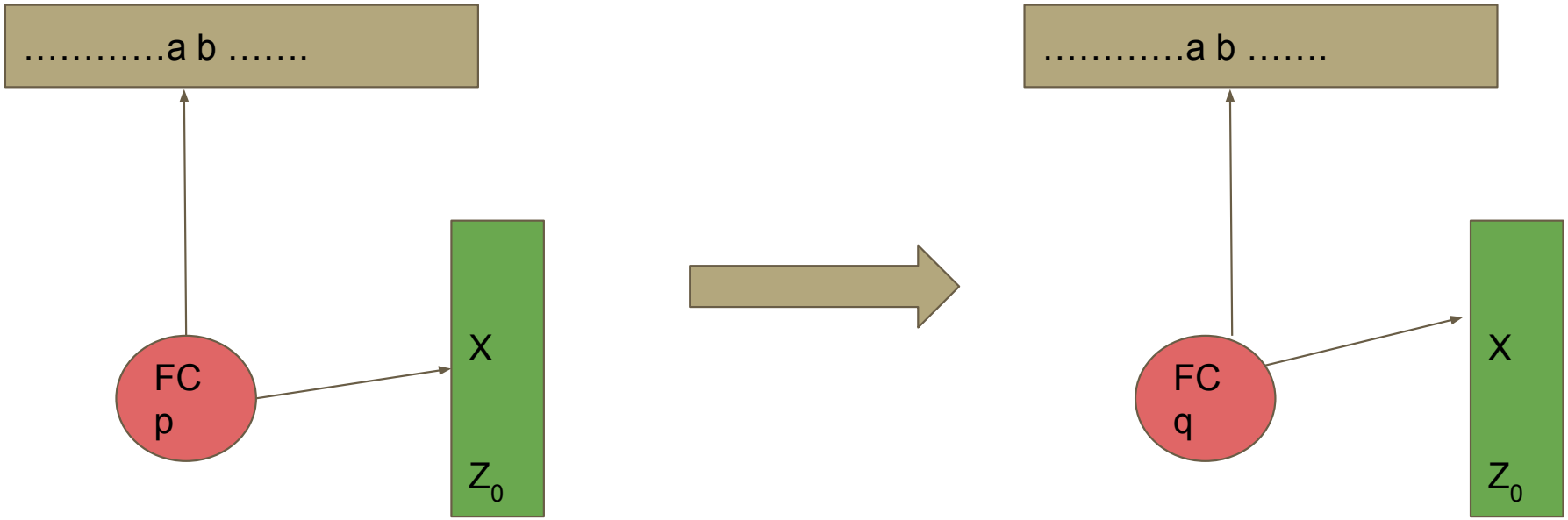
State Transition Example

Suppose δ(p,a,X) contains (q,ε) - It means POP from pushdown store.



State Transition Example

Suppose δ(p,a,X) contains (q,X) - It means NOOP on pushdown store. (No operation /no change in stack - neither push nor pop on pushdown store)

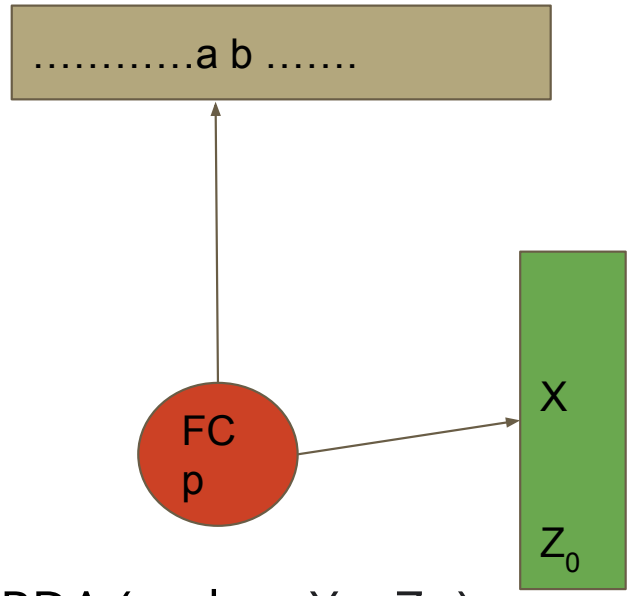


Instantaneous Description of PDA

Instantaneous Description of PDA
It gives snapshot of PDA in terms of

1. current state of PDA
2. remaining part of the input string to be read
3. contents of pushdown store

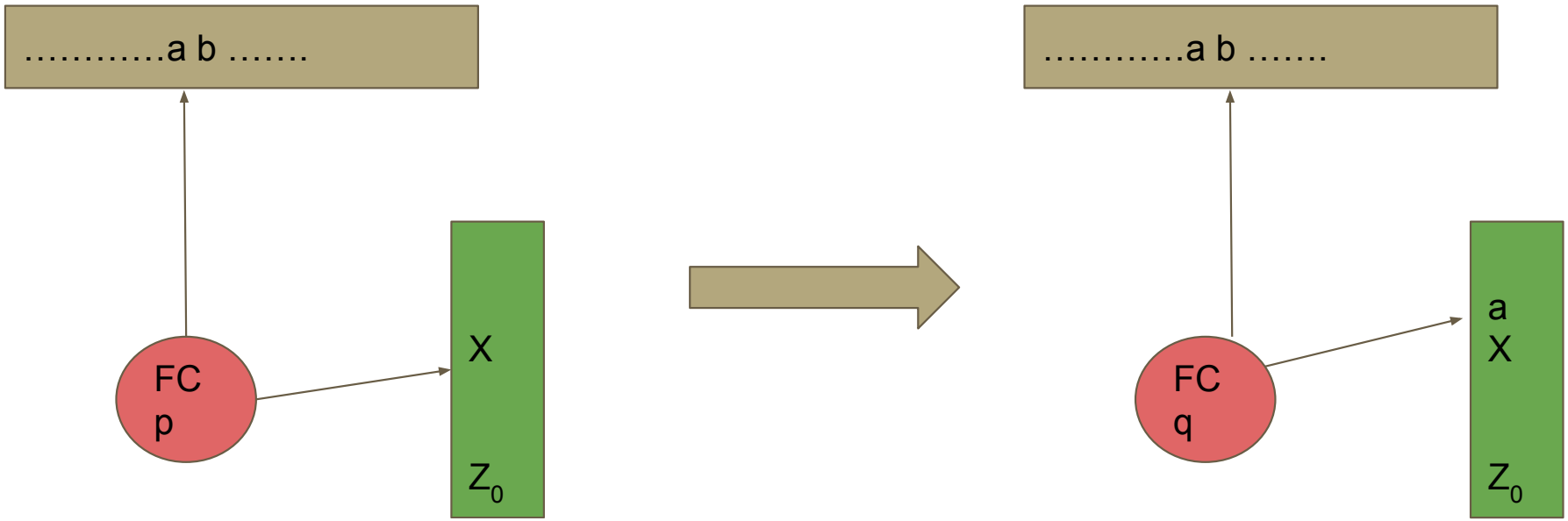
ID of PDA (q,w,γ)
q-current state
w-remaining input string to be read
γ - stack contents



Example - ID of PDA (p,ab....,X....Zo)

State Transition in terms of ID entailments

Suppose δ(p,a,X) contains (q,aX)



ID (p,ab....,X...Z0) entails ID (q,b.....,aX.....Z0)

Initial ID of PDA

Initial ID (q0,w,Z0) where w=a0a1a2....an (Input string)

PDA makes state transitions by taking into account current state, current input under tape head and top of pushdown store.
It makes state transition to next stack performing push,pop or noop operation onto stack/pushdown store.