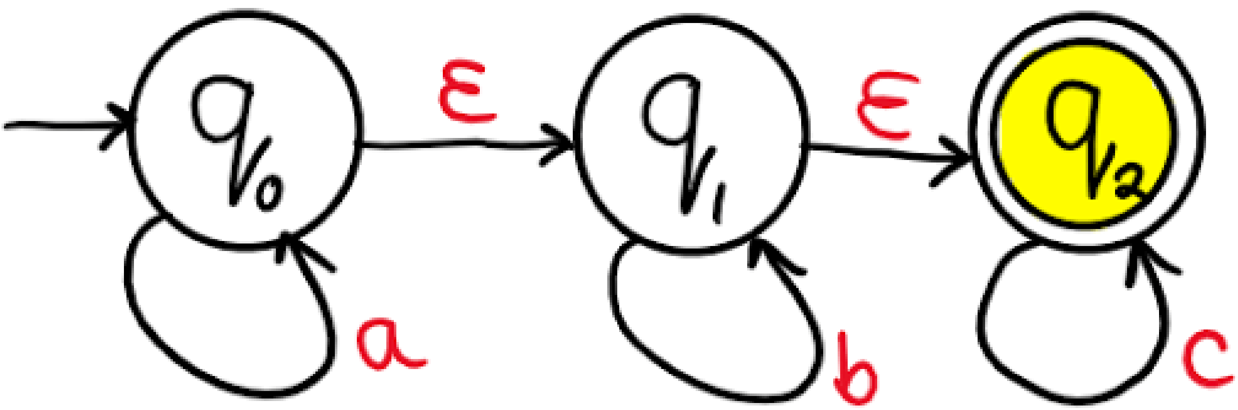
NFA with ∈ moves is exactly same as NFA without ∈ moves.

But differece exist in the transition function δ. δ must include information about ∈ transitions.

> *NFA with ∈-Moves has 6 tuples (Q, Σ, δ, q0, F).*
>
> *Where,*
>
> - *Q = finite set of states.*
> - *Σ = finite set input symbols.*
> - *δ = transition function that maps Q × (Σ ∪{∈}) to $2^Q$.*
> - *q0 = initial state.*
> - *F = set of final states.*

The non-deterministic finite automaton can be extended to include the transitions on null/empty input ∈.

## For example,

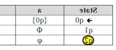



NFA with ∈

In this NFA with epsilon,

- It accept an input string ‘aabc’.
- Or string as number of a’s followed by number of b’s followed by number of c’s.
- The string ‘aabc’ is accepted by the NFA by following the path with labels a, a, ∈, b, ∈, c.

## Transition table for above NFA.



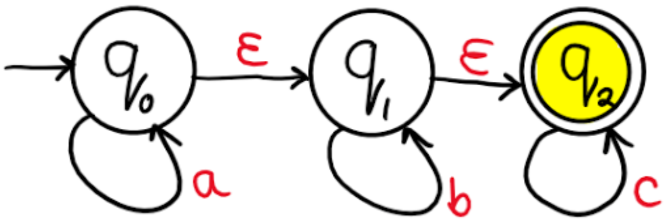
| State | a |
|---|---|
| → q0 | {q0} |
| q1 | Φ |
| q2 | φ |

### ∈-closure

∈-closure of a state q is a set of states following by all transitions of q that are labeled as ∈.

- ∈-closure (q0) = (q0, q1, q2)
- ∈-closure (q1) = (q1, q2)
- ∈-closure (q2) = (q2)

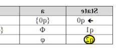
## NFA with ∈ to NFA without ∈




NFA with ∈

Transition diagram

Transition table NFA with ∈

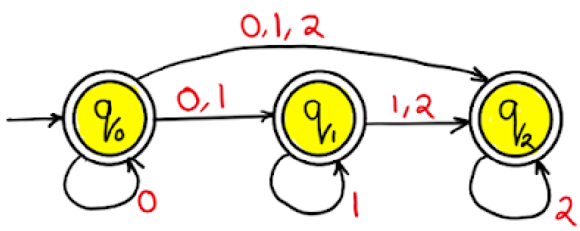


First find out ∈ closure:∈-closure

- (q0) = (q0, q1, q2)
- ∈-closure (q1) = (q1, q2)
- ∈-closure (q2) = (q2)

Transition table NFA without ∈

| State | a | b | c |
|---|---|---|---|
| →q0 | {q0, q1, q2} | {q1, q2} | {q2} |
| q1 | Φ | {q1, q2} | {q2} |
| q2 | ϕ | ϕ | {q2} |




NFA without ∈

Transition diagram

Reference:

- Introduction to the Theory of Computation” by Michael Sipser.

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