# Generalized Non-Deterministic Finite Automaton


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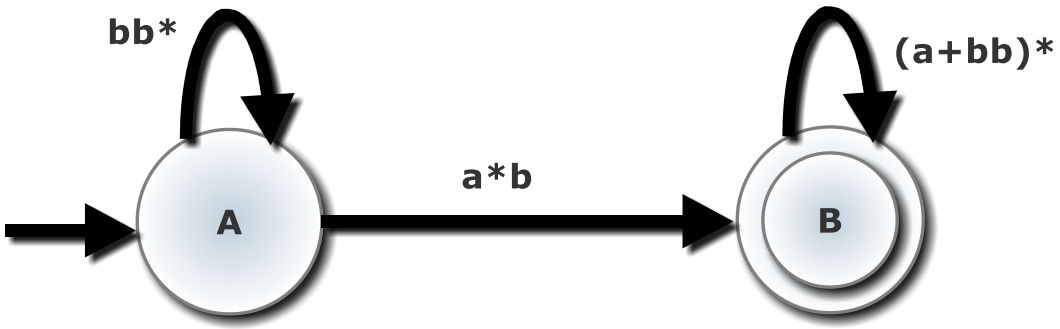
# Generalized NFA (GNFA)

- A GNFA is a NFA with the transitions being labelled by regular expressions.




For visualizing the property of GNF without the loss of any Generality, we can remove the self transitions from state A and B and the revised label of transition from A to B will become **(bb*).(a*b).(a+bb)***

# Generalized NFA (GNFA)

A GNFA is said to accept a string w if w can be written as $w = w_1 w_2 --- w_k$ and $\exists$ states $q_0, q_1, --- q_k$ in the GNFA s.t.

- $q_0$ is the initial state
- $q_k$ is the accept state
- $\forall i$ if $R_i$ is label on the transition $q_{i-1}$ to $q_i$, then $w_i \in L(R_i)$

Infact, all standard DFA transitions are generalized transitions with regular expressions of a single symbol.

# Properties of GNFA

GNFA has a unique accept state.

- If multiple accept states are already there, include new accept state and include epsilon transitions from the set of old accept states to this new accept state.
- Also, make old accept states as non-accept states.

There are no incoming transitions to the start state and no outgoing transitions from the accept state.

# Steps for Conversion for DFA to GNFA



**Step 1**
- Create new start state s and new accepting state t.

**Step 2**
- Add $\in$ transition from s to old start state.

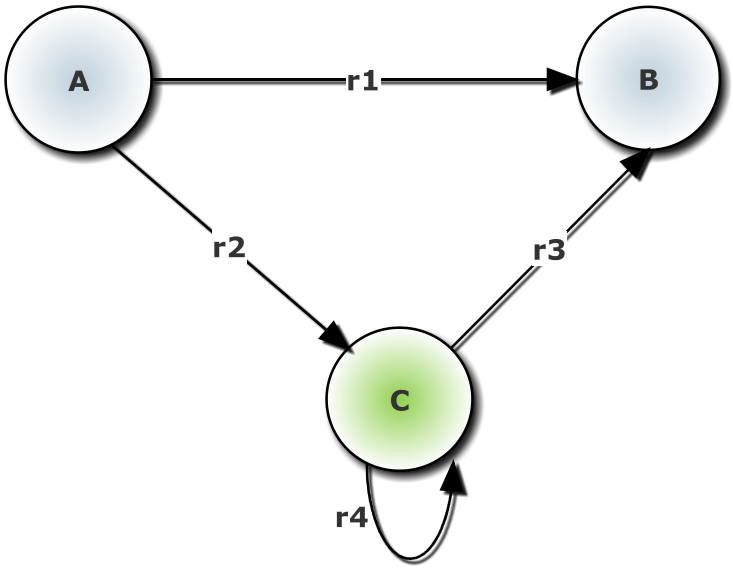
**Step 3**
- Add $\in$ transitions from old accept states to t.

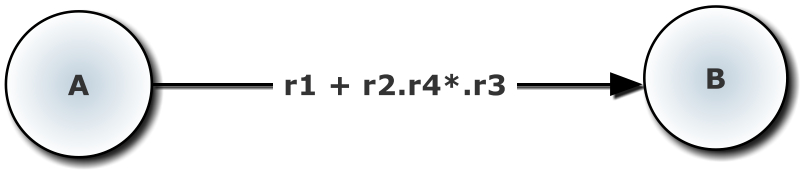
**Step 4**
- Delete states (except s and t) one at a time. replace the resulting transitions with suitable labels as described further.

**Step 5**
- Repeat the step 4 until all states (except s and t) gets deleted.

# More About Step 4

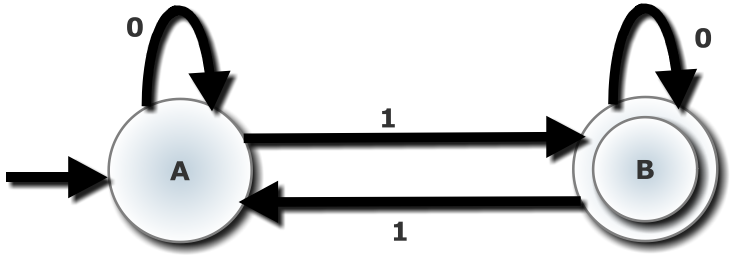
## On removing the state C



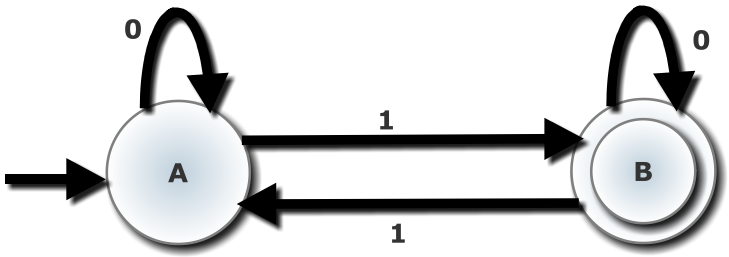



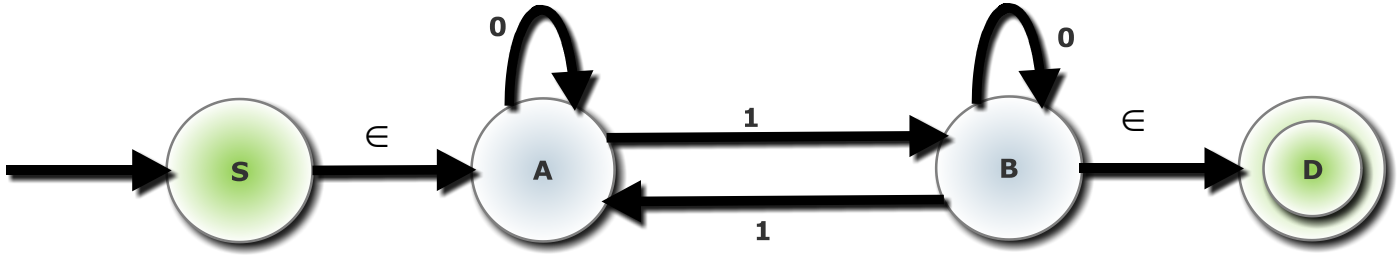
# Example

- Convert the following DFA into regular expression

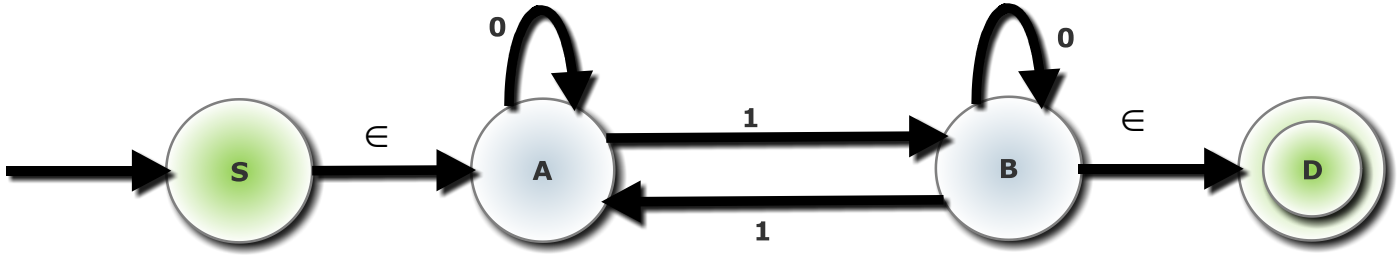


# Example (Continued…..)

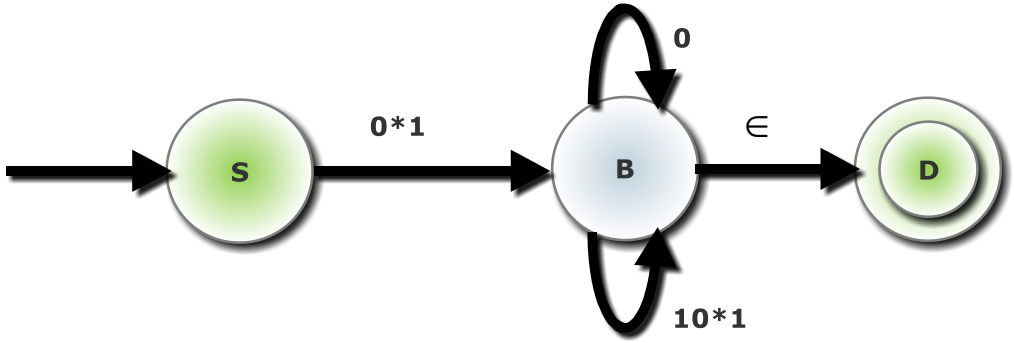


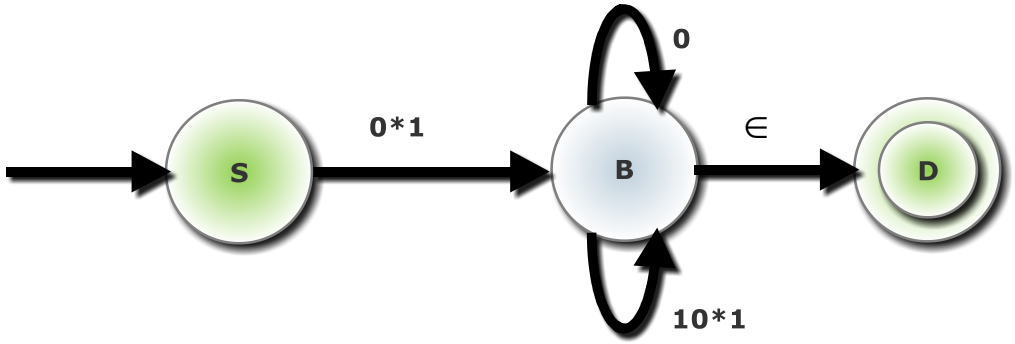
# Example (Continued…..)



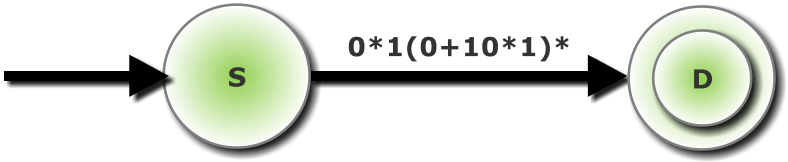

## Removing A



# Example (Continued…..)

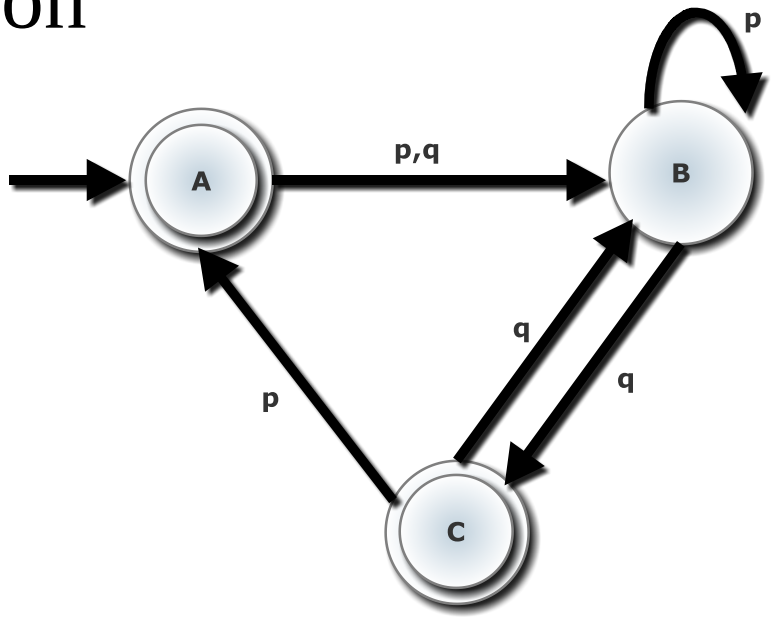



## Removing B

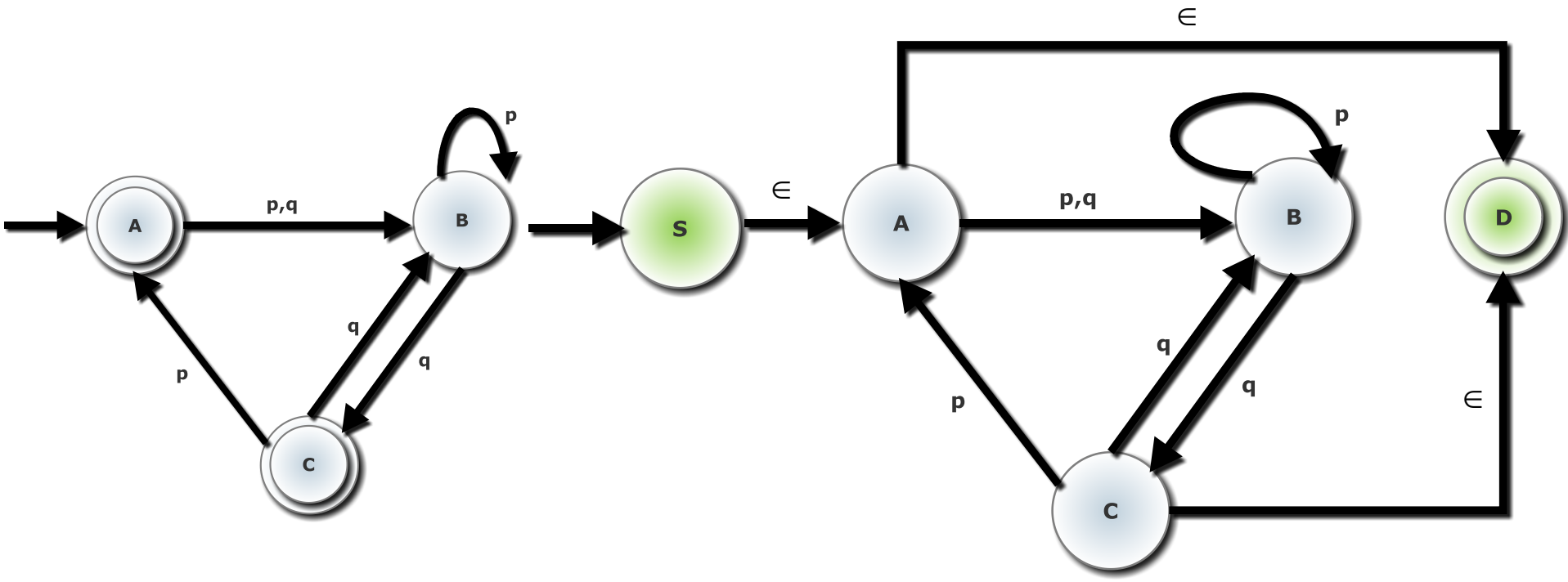


# More Examples

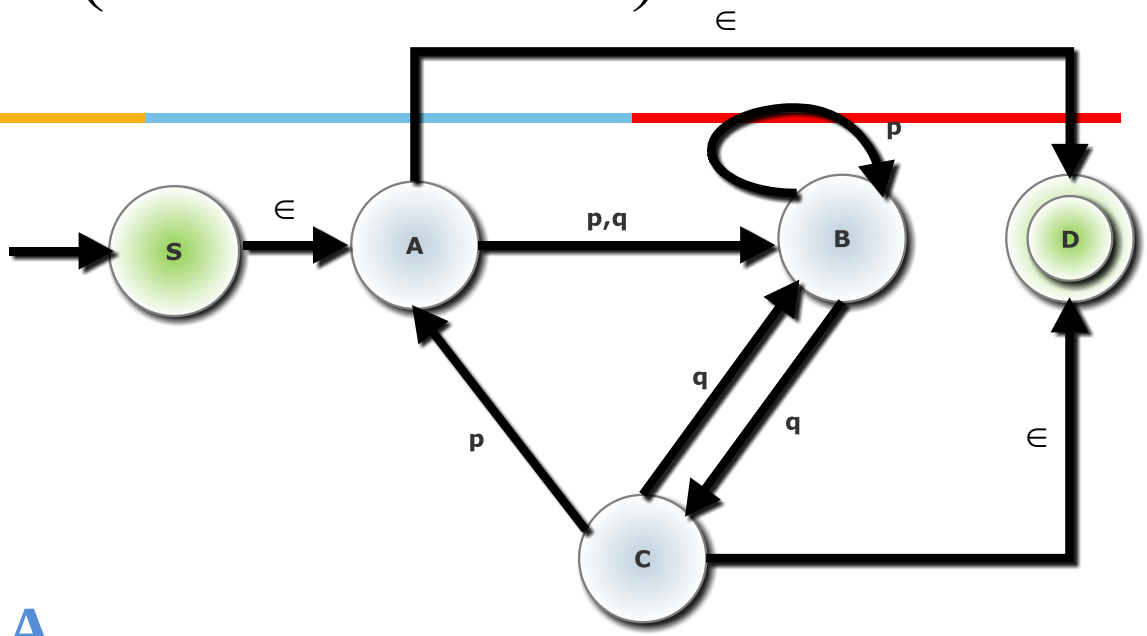
- Convert the following DFA into regular expression



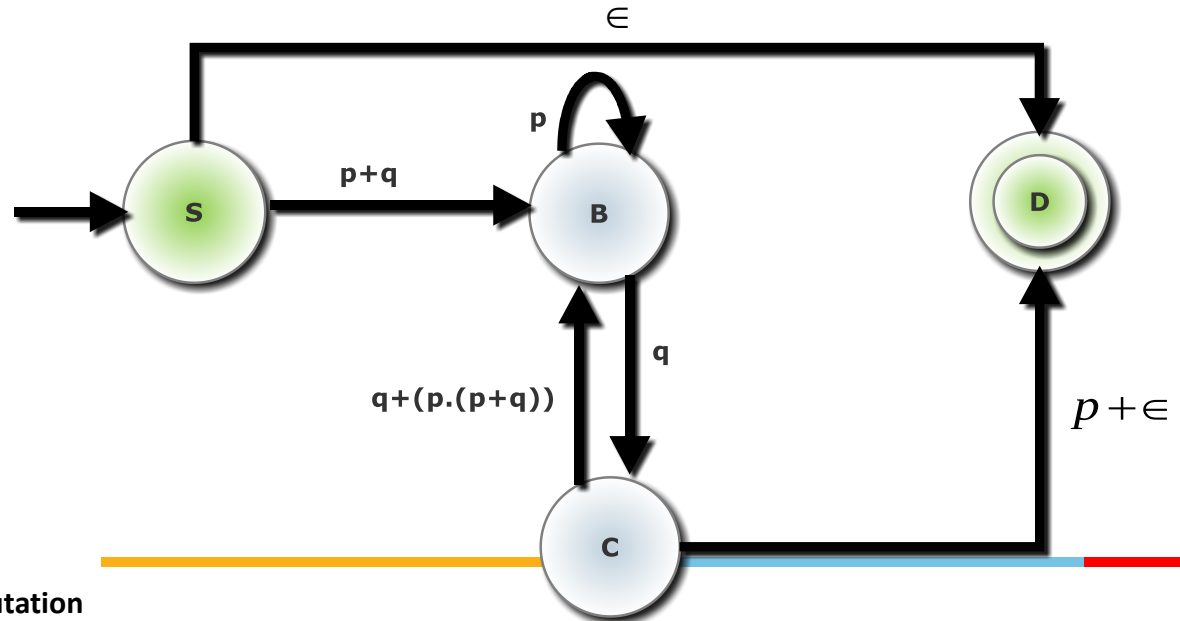
# Example (Continued……)



# Example (Continued……)



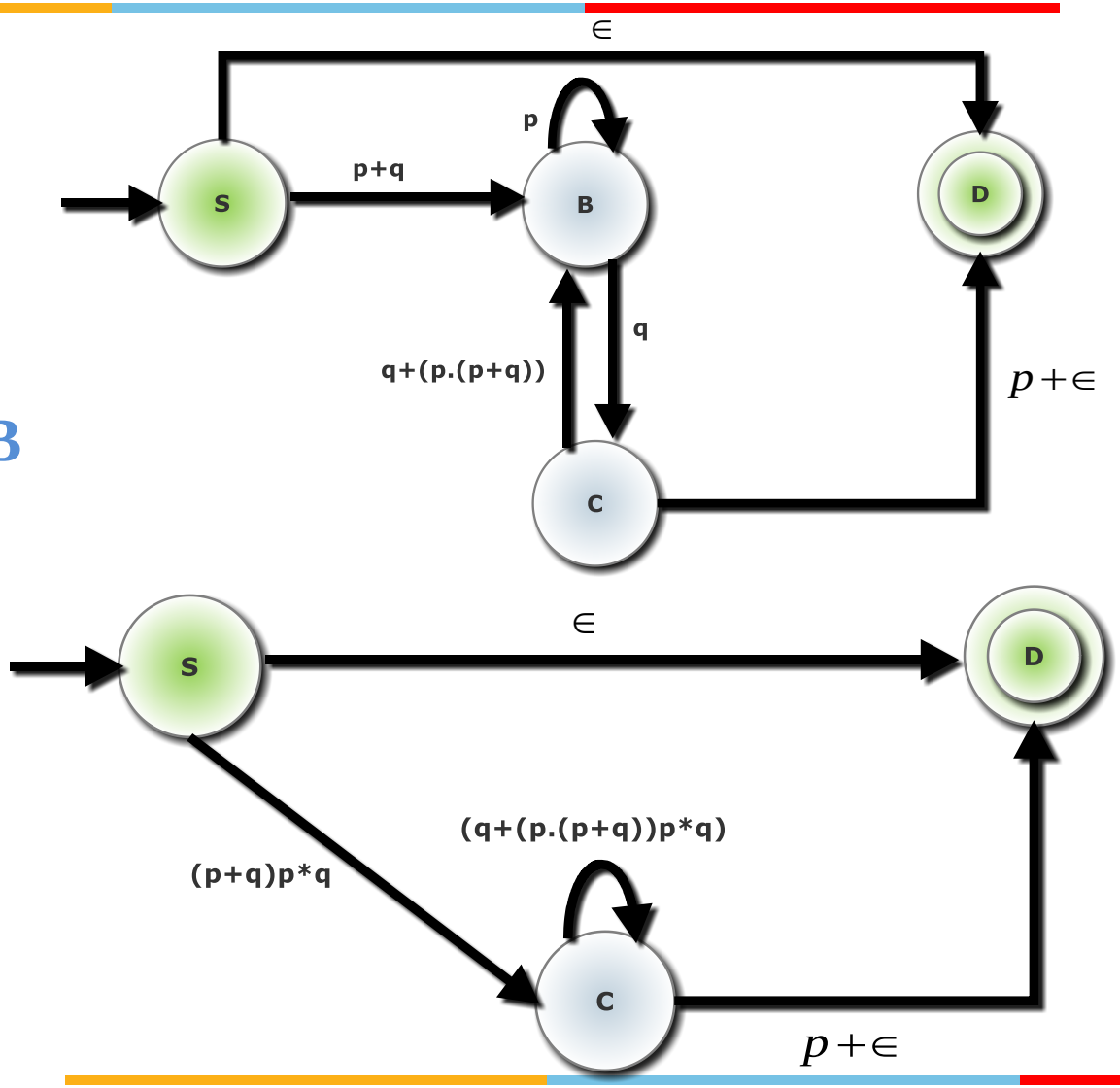

## Removing A



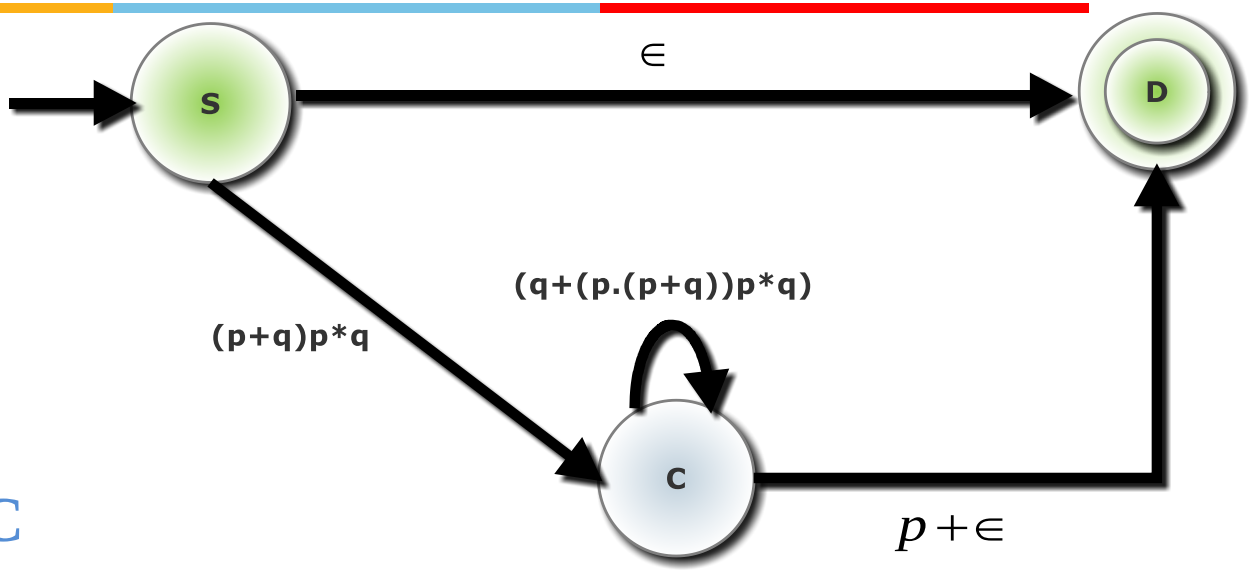
# Example (Continued……)



## Removing B



# Example (Continued……)




## Removing C